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Instructional Technology Usage and Implications for Student Academic Achievement and Further Success

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INSTRUCTIONAL TECHNOLOGY USAGE AND IMPLICATIONS FOR STUDENT

ACADEMIC ACHIEVEMENT AND FURTHER SUCCESS

Bradley D. Petry

Submitted in Partial Fulfillment of the Requirements for the

Degree of Doctor of Psychology

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PHILADELPHIA COLLEGE OF OSTEOPATHIC MEDICINE
DEPARTMENT OF PSYCHOLOGY

Dissertation Approval

This is to certify that the thesis presented to us by Bradley Petry on the

7th   day of June, 2012, in partial fulfillment of the requirements for the degree of Doctor

of Psychology, has been examined and is acceptable in both scholarship and literary

quality.

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Abstract

The digital divide was once a term used to indicate disparity between socio-economic classes and access to digital devices. The digital divide may now more accurately indicate differences in the types of usage between members of different socio-economic classes. Differences in usage among the middle school student population may play a role in the development of critical thinking and collaborative communication. The Maryland results of the 2010 Speak Up survey – a national student survey regarding the usage of technology - were used in comparison with student respondent school district differentiation and were also compared with student state standardized test scores. No statistically significant relationships were found between student responses to questions of technology access or usage, dependent on urban or suburban/rural district setting.

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Glossary of Terms

Blog (noun) – portmanteau of "web" and "log", a recurring publication that is written by an author, usually covering a specific topic or theme. These articles can be made available on a specific hosting website (Blogger or WordPress), or can be compiled on a website that hosts multiple blogs (The Huffington Post or Gawker). (verb) – the act of writing this article

Bookmarking Site (noun) – A website that compiles a user's web search history, or a user's denoted preferences to suggest similar sites or articles based on those preferences (Digg, Reddit, or StumbleUpon)

Cloud (noun) – a specific amount of space on a server to store data; the cloud can be accessed by multiple people wherever there is internet access. Clouds are used to create documents in a collaborative manner; changes to the product are made instantaneously so that everyone with access can see the evolution of the product.

Consumership (verb) – the act of using technological devices and internet capabilities to consume information without adding or producing. This term connotes superficial analysis of information, or using technological products at the minimum potential. This term also encompasses remedial skill development and drill work using software programs.

Digital Whiteboard - *see* Interactive Whiteboard

eReader (noun) – a device that is used to store book text and pictures digitally. These devices generally have an extraordinary capacity for storage, so that a student might only need an eReader to access all of the textbooks needed for an entire school career. These devices are generally smaller than tablet computers, but can basically be used only for reading content.

Information and communication technologies (ICT)(noun) – a derivative of the term *Informational Technology* (IT) to encompass technological products and unified communication between users of these products. This terms is often used in educational technology literature because multiple students are using the devices collaboratively

Interactive Whiteboard (IWB) (noun) – a device that is a large screen connected to a computer and sometimes, to a projector. These devices allow computer content to be

displayed for a large group. A stylus is used to write on the board or to move the cursor (much like a mouse). Specific programs and software are available to increase the interactivity with the content.

Mobile Phone (noun) also known as *cell phones*. Mobile Phones that have the capacity to display internet content are known as *smart phones*. With increased capability, more educational applications are being made available. Research into the ways in which to use mobile phones in the classroom is presently emerging.

MP3 Player (noun) – a small device (can be as small as a matchbook) that can store MP3 data files. These are the common files used for audio storage and playback (songs or lectures). Larger versions have screens that can also store and play video files.

Notebook Computer (noun) – a smaller version of the traditional laptop computer. With decreases in size come decreases in overall storage, screen size, and processing speed. The benefit is that they are also much cheaper than traditional laptops, and can still perform most tasks that might be needed by school-aged students. Because they are cheaper, they may be a more affordable option for schools that are considering one-to-one laptop programs.

One-to-one Laptop Program (OTOL) (noun) – a program in which a school provides laptop computers to a significant number of students. Programs differ in scope; some are based on educational programming; some are based on the age-group of the students. Research about the effectiveness of such programs on educational outcomes is emerging. With widespread access to school-based technology at home come concerns about security and ethical use.

Podcast (noun) – a portmanteau of "iPod," a popular MP3 player, and "broadcast." These are recurring audio transmissions, generally surrounding a central theme. Many talk radio shows provide content available as a podcast, and some podcasts are produced by amateur broadcasters. Because podcasts can be subscribed to via an internet-accessible MP3 device, they can be heard in many different settings and are portable.

Prosumership (verb) – the act of using technological devices and internet usage to analyze information critically, to collaborate with others in order to develop products, and to publish information to the World Wide Web. This type of technological usage takes advantage of Web 2.0 capabilities.

Social Network Site (noun) – a website that allows registered users to upload in order to "post" information for other users to view. Usually, different levels of access can be granted to other users. The number of people who can access any one person's uploads (or profile) is the network. Facebook, Twitter, and Google+ are currently popular social network sites.

Tablet Computer (noun) – a one-sided, touchscreen computer. These devices are basically the size of a common laptop monitor, and rely on finger tapping and swiping to navigate through use. These devices can usually be used as an eReader, an MP3 player, and can access the internet, but are generally more expensive than either of these devices. The downside is that word processing and other forms of production are limited because of the smaller capacity and lack of a keyboard.

Vlog (noun) – portmanteau of "video" and "blog," This is a method of creating recurring and theme-based content in video form. YouTube, a website that can be used to publish user-created videos, is a common site to find vlogs.

Web 2.0 (noun) – a general term that describes how current trends in internet use facilitate production of content, such as blogs and podcasts, rather than being a format only for consuming information.

Wiki (noun) – a website that allows for multiple users to add, adjust, edit, and remove content. Wikis can be contained on a local network (such as a school network), or they can be available on the World Wide Web.

Instructional Technology Usage and Implications for Student Academic Achievement

and Further Success

Chapter 1: Introduction

Originally, the term "digital divide" described differences in access to technology devices between the "haves" and the "have-nots." This phenomenon emerged in the early to mid-1990s, as internet access for middle and upper socio-economic status (SES) citizens grew rapidly, but access for low SES Americans remained nearly nonexistent. To address this problem in the public domain, greater numbers of internet-accessible computers have been available in schools and libraries (Gorski & Clark, 2003). Moore's Law, a relatively well-known technology theorem that predicts exponential increases in efficiency of microprocessors due to advances in design, has ensured that accessible technology is affordable due to an exceedingly fast rate of growth (Mack, 2011). This speed of upgrading technology leads to affordable devices, thereby granting greater access of personal devices to people of all means, as well as to educational institutions; this has led to the minimization of the "digital divide" relatively quickly.

Statement of the Problem

Most research now focuses on a secondary "digital divide," a term describing not only the differences in accessing the internet and new technological advances between the lower and higher SES groups, but also whether or not different SES groups are using this technology to its fullest potential. That is, higher SES groups tend to use technological advances to a greater degree and for collaborative communication, thereby producing content for others, but low SES groups tend to be more passive consumers of available technological products (Gorski & Clark 2003; Warschauer & Matuchniak

2010). This is not a problem that can be solved primarily with the simple provision of resources, as was the original divide because creational and highly interactive usage of the technological resources in question requires knowledge of the skills to utilize the applications, along with a feeling of comfort with this usage. Solving this problem requires education and encouragement, as well as consistency in access to technology devices and engagement strategies from school to home. This is a problem that is observable in public school classrooms across the country. Teachers may have access to technology, but do not have the training to use it to its fullest potential, nor to develop instructional practices that ensure that these potentials are met. This occurrence is particularly true in low SES school systems, where adequate funding may be available through Title I to provide devices, but instructional practice may limit usage (Gorski & Clark, 2003). Recent research suggests that children in urban school systems tend to use programs on computers and other devices for drill and remedial work in core areas of mathematics and language arts (Volman, van Eck, Heemskerk, Kuiper, 2004, Warschauer & Matuchniak, 2010). Children in school districts with greater means tend to use the same devices to run programs that involve cooperative collaboration, concept development, and research-based learning across multiple subject matters. The usage differences between two groups is also observable with personal technology use; lower SES children tend to look at pictures and play simple games, but children of middle and higher SES groups are more likely to use communication programs and publish personal work to the internet (Volman, et al. 2004, Warschauer & Matuchniak, 2010).

Purpose of the Study

The purpose of this study is to investigate trends in educational and instructional usage of technology as well as personal usage and to relate these trends to implications for academic success, and also for future success in an increasingly technologically-based world. Trends in educational technology will be examined on both sides of the current incarnation of the "digital divide," both in the school and in home settings. Furthermore, sociocultural implications, as well as implications for future success, based on current uses of technology will be examined.

Research Question

The first question to be addressed by this proposed research project is "Has the digital divide of access truly been reconciled for students across rural, suburban, and urban settings?" The second and third questions, which focus on disparate usage are, "Does more collaborative and production-oriented usage of instructional technology devices in classrooms correlate positively with student success as measured by Maryland state standardized test score (MSA) data?" and "Does usage of technology for academic skill drills, remediation of basic materials, and skimming over webpages correlate negatively with student success, based on MSA data?" Variability of access and differences in degree of usage of specific types of instructional technology will be measured by results of a survey completed annually and voluntarily by students, parents, and teachers within Baltimore City Public Schools (BCPS). It is proposed that MSA data be extracted from existing data compiled by the state department of education.

Chapter 2: Literature Review

Overview of history and current encapsulation of the digital divide

In the early to mid- 1990s, a great fear emerged because of a relatively new phenomenon increasing the achievement gap between students of means and those without resources. Internet-connected computer access was becoming increasingly available to students who could afford such technology, but the historically disadvantaged sections of the public were once again being neglected (United States Chamber of Commerce, 1999). The initial days of internet accessibility allowed for instant long-distance communication, the ability to consume information from websites, and early games and means of shopping. Users were generally consumers of such services, accessing what was available without significantly adding to the content of the internet. Educationally, students with access were provided opportunities for a wide-ranging ability to research topics of interest (and knowledge) with an ease that baffled those who had previously been subjected to long hours bent over library card catalogs. The potential for such instantaneous opportunities was realized among those with access to this new-found power, but those who did not have access were initially neglected by public education policy and practicality (Riley, 2000).

This neglect gave rise to the "digital divide" label. Educational researchers wisely feared that disadvantaged students without access to internet-connected computers would quickly be left behind in an increasingly high-speed educational society. In order to alleviate this problem, funding was made available to provide internet accessible computers to all students, often at the behest of federal regulations concerning education (Gorski & Clark 2003). By the early years of the 21st century, 99% of students had access to internet-enabled computers in school (Gorski & Clark 2003).

These years were also a time of exponential growth in technological devices and capabilities. Although nearly all students had access to the internet, disparities emerged from the speed of the internet connections to the usage of newer and more highly capable machines (Warschauer & Matuchniak 2010). In 1965, an electronics developer and researcher, G. Moore, observed that the number of components that could be fit onto a microchip doubled about every year. This growing capacity led to exponentially greater ability and efficiency in electronic devices. This trend, known as Moore's Law, has now been adopted and expanded to include accelerated capacity among all types of electronic devices, the basics of which are now the microprocessor, as opposed to the microchip that Moore observed (Mack, 2011). Moore's Law, was remarkably evident in the late 1990s through the 21st century, as internet technology added the dimension of wide-spread communication and information sharing to the capacity of electronic devices. Today, netbook computers, with the processing power of high-end desktop computers available in 2000, can be bought for less than $300. Devices such as mobile phones are ubiquitous, worldwide, with similar leaps in computing capabilities (Muyinda 2007). New technological devices, such as interactive whiteboards (IWBs), developed for corporate uses have also made their way into many classrooms (Kennewell & Beauchamp 2007). As can be expected, the digital divide that was once defined as the lack of access among the underprivileged has been addressed with cheaper devices. The divide now encapsulates disparities of access to newer device access and device usage of a higher potential (Volman, et al 2004, Angus, Snyder, Sutherland-Smith 2009).

Digital Divide in Public Education

In order to understand the characteristics of digital disparity, one must first be familiar with the terminology of the new technology. With growing affordability, laptops are becoming more prevalent in schools. Prevalence is rising to the point that schools are now adopting one-to-one laptop programs, in which every student is provided a laptop to use at school, and sometimes for his or her use at home. Another growing trend in instructional technology is the use of a digital whiteboard. These devices look like large dry-erase boards that are connected to computers and often, to a dedicated projector. Anything that can be accessed with a desktop computer can also be shown on the digital whiteboard. Teachers and students can use a stylus to write on the board and to move the cursor, much the same as with a mouse. With more specific programs, teachers and students can manipulate the board in other ways as well, such as turning all the text into another language, splitting the board into separate work areas, and developing animations in presentations.

Internet-based methods of teaching are also becoming standard as greater technological usage develops. Cloud technology enhances the ability to save information on a server, so that documents can be accessed and worked on by any collaborator, anywhere there is access to the internet. Similarly, wikis are web pages that allow multiple people to edit and refine content. These web pages can be contained on an internal network, or can be published to the World Wide Web. Another method of publishing information to the internet is by using social media pages (some popular examples are Facebook, Twitter, LinkedIn and Google+). This method of internet "publishing" restricts people from seeing the product being produced to those who are

also members of the site, or those to whom the publisher has granted access. A more widely-accessible method of internet publishing is through the use of blogging (a portmanteau of "web" and "log"). In this manner, an author can regularly post entries, generally surrounding a certain theme. Some blogs are stand-alone webpages, often facilitated by a web-based publishing service (such as Blogger and WordPress), and some are recurring articles hosted by specific sites (such as The Huffington Post, and Gawker). Vlogs are blogs that primarily consist of video content (recurring blogs can be found on YouTube or similar video sharing sites). Podcasts are audio blogs; this portmanteau was coined because audio broadcasts became very popular once the Apple iPod could be used to subscribe to recurring authors, and the content could be portable. Another internet application is the use of a bookmarking service (such as Reddit, Stumbleupon, and Digg). These sites monitor a user's interests, and then recommend content-specific websites based on those interests.

All of these internet-based services can now be utilized as an integral part of instruction. Using the internet as a platform for searching and then publishing content is a relatively cheap and efficient method of allowing students to collaborate on research, critically analyze source material, cooperatively develop products, and then monitor the reactions. Because of the vast uses afforded by new technology, it is important to ensure that all students have the same access to the opportunities and instruction in how to use them efficiently, accurately, and collaboratively. The skills that are developed and practiced by using these devices and internet-based opportunities are becoming increasingly important for future success.

Cheap and highly capable technology has helped alleviate the original digital divide, but has also benefitted those students afforded access in the first place. Usages of these new technologies have also changed over the past decade leading to new gaps, sometimes referred to as the "Digital Divide 2.0" (Vie 2008, Warschauer & Matuchniak 2010). Here there are emerging problems in three distinct areas.

Within the framework of the new digital divide – that which encompasses the disparities in usage of technology as opposed to access to usage- there are emerging problems in three distinct areas. The first area is the previously discussed problem of access to devices. Although significant improvements have been made, access to more emerging technological devices are still enabling a gap; these devices include digital whiteboards, e-readers (devices that allow multiple books to be accessible on a portable device), tablet personal computers (small, lightweight, and relatively affordable computers that primarily use touchscreens), and MP3 players (small, portable devices that can contain and play music and video files).

A second factor that differentiates privileged and nonprivileged students is the type of usage that these students utilize with electronic devices. In the past decade, usage of the internet has evolved into an incarnation known colloquially as the "Web 2.0." The difference is not seen in the information processing and storage capacity of the internet, but in the methods by which people use the internet. No longer do people simply consume what is available, but they are also able to create and share content for others. Integrating content to develop new products for others' use is known as "prosuming"; people who use current technology in this manner are "prosumers," (Vie 2008, Warschauer & Matuchniak, 2010). This trend can be observed with the phenomenon of

social networking sites (such as Facebook and Twitter) and media upload sites (such as

YouTube and Flickr). Although these applications of the internet may evoke

connotations of personal use rather than of educational use, derivatives of these

capacities, along with developing specialized content, i.e., blogging, podcasting, and

collaborating, have recently emerged in the public education realm. However,

widespread use of these techniques in education seems afforded only to those students

with greater resources and means, hence widening the second version of the digital divide

(Warschauer & Matuchniak 2010).

    The third area of need that contributes to the current incarnation of the digital divide

is an issue of teacher training and skill in using technology to its highest instructional

potential and of meeting the needs of the student populations. Warschauer and

Matuchniak (2010) indicate that students in lower SES settings tend to be subjected to

high teacher turnover, an inconsistency that can exacerbate deficits in basic skills. These

problems lead to these students having access to computers, but having instruction in

using them primarily for remediated practice of basic skills and drilling, such as

memorizing multiplication facts (Gorski & Clark, 2003; Warschauer & Matuchniak,

2010). Moreover, because more time and resources are utilized to maintain basic skill

development among students, teachers tend to lack the accessibility and training to use

more advanced techniques, leading to more collaborative and meaningful use of digital

devices, instruction and guidance that is often afforded the students with greater access to

resources. This disparity is contributing to the current form of the digital divide.

Current Trends in Educational Technology

Appendix B is a glossary of terms; many of these terms are mentioned below.

The digital revolution of the nineteen-eighties and nineties brought about access to desktop computers, followed by internet accessibility. Usage of the personal computer can still be considered the quintessential use of advanced technology. Early concerns about the digital divide regarded numbers of internet-accessible computers per student. Although this ratio continues to be important, personal computers are no longer the only source of technology used in instruction.

Laptop computing, particularly One-to-One Laptop (OTOL) programs are considered the height of personal computer accessibility for students because large-scale distribution of laptops lowers the ratio of students per computer, hence lowering overall access disparity issues. Another source of technology that is emerging, and is increasingly targeted in the literature is the interactive whiteboard (IWB). Accessibility of and efficacy with usage of these two hardware devices informally denotes digital readiness of classrooms. Mobile phones and gaming consoles are other forms of hardware that are increasing in capability and prevalence, specifically for home use, but uses for instruction are not currently addressed as extensively as laptops and IWBs in the available research.

The other side of technological readiness is within the capacities of internet-ready devices. All four types of devices mentioned can access the internet, but it is the type of usage therein that separates digital consuming from prosuming. Again, differences between standard web-surfing and publication of information to the internet are also established in educational settings. Software available for devices also spans the extent

of generic skill practice to internet-upload-able presentation production. Consequently, not only is there a spectrum of hardware devices available for educational uses, but also the potentials for such devices are modified by the types of programs and applications used.

Types of educational technology

Current one-to-one laptop program research

One-to-one laptop programs provide internet accessible laptops to students for use in school. Some OTOL programs allow students to take the laptops home, but others relegate the usage of the technology to the school setting. OTOLs also differ in prevalence of accessibility. For instance, Maine's OTOL program provided laptops to all seventh and eighth grade students in the state (Berry & Wintle, 2009). Henrico County, Virginia provided laptops to all high school students. The school district in Littleton, Colorado implemented writing and language-arts based OTOL program, providing the computers to all English and Language Arts classes in the fifth through tenth grades (Warschauer, Arada, & Zheng, 2010), increasing prevalence of the technological devices, but limiting the scope.

OTOL programs that are reviewed in research literature tend to acknowledge the success and the transformative implications for learning with implementation of such programs. Gulek and Dimirtas (2005) found that within one school district in California, students enrolled in a laptop immersion program earned significantly better grades and achieved significantly better test scores. Alberta Education (2009) examined parameters of success for an OTOL program that more closely matches the reviewed implications of technological-based learning. This study found that after the implementation of the

OTOL program, students appeared to demonstrate greater engagement, and self-rated

themselves as more highly engaged. Engagement on a cognitive, social-emotional, and

behavioral level was defined as a criterion for success of the OTOL program (Alberta

Education, 2009) In Littleton, Colorado, the OTOL program for language arts students

resulted in higher-quality writing, particularly in regard to research-based writing, multi-

modal writing, and review and revision (Warschauer, Arada, Zheng, 2010). Increases in

these aspects of writing can also be construed as increases in engagement with

assignments. This hypothesis is supported when reviewing student opinions of the

project, indicating that individual students report enjoying the process of writing more

with laptops than without access to the laptops. Melissa, a high school student

interviewed about the project made a statement that demonstrated a very accurate

knowledge of the current benefits and further implications for the program:

> There are very few jobs left that do not require knowledge of computers in
> some way. In colleges, students will be required to type up their papers,
> fill out online applications, and use the Internet to complete research
> papers. If schools are to prepare students for success in today's world,
> they must spend money on computers. Otherwise, students will be unable
> to compete for places in colleges and for jobs in the work force. *As quoted
> in Warschauer, Arada, and Zheng (2010).*

Berry and Wintle (2009) found similar results when analyzing one science

teacher's success in implementing the Maine OTOL program. In this review, two science

classrooms completed a unit project about the changing of seasons due to the tilt of the

earth's axis. One classroom used laptops to create digital animations of this phenomena;

the other classroom used more traditional means of displaying the concepts, such as

drawing a diagram poster. The students who collaborated with laptops were found to

understand the concepts better and retained knowledge of the concepts more accurately

over time. Again, some of the most revealing findings occurred in the student interviews. Examples provided indicate that students found the digital assignment more engaging and compared this assignment favorably against traditional display development.

OTOL research gaps mirror digital gaps

These research reviews indicate that wireless OTOL programs are highly beneficial in increasing student engagement with instruction. Engagement is an attribute that is often lacking in instruction of digitally-disadvantaged students (Gorski, 2009). Of some interest is the fact that all three of these program reviews took place in schools or school districts with a fifty percent or greater white student populations, and relatively low prevalence of students meeting criteria for free and reduced meals (FARMs), the demographic variable indicating SES. Henrico County Public School in Virginia has implemented an OTOL program, and includes the urban center of Richmond. However, demographic information also indicates a largely white student population (Jones, 2007).

Some research has shown, however, that students with the least outside access to technological devices are those most likely to benefit from an infusion of hardware, such as an OTOL program. Ferrer, Belvis, and Pamies (2010) noted that benefits from high prevalence of instructional and communication technologies (ICT) in learning include overcoming some of the educational gap that is attributed to SES. However, this review of literature is set in Spain, where children who reside in urban areas are more likely to have access to and be able to utilize computers fluently, whereas students in rural areas are more likely to be disadvantaged economically and technologically, a reversal of trends commonly accepted in the United States.

Research pertaining to urban student and low-SES student achievement as a result

of high-ratio technology infusion is nonexistent. This dearth of findings can be attributed

to a lack of advances in greater distribution of technological devices for digitally

disadvantaged students. Disparity in access continues to lead to a continued divide, as

well as a continued divide in educational engagement, teacher instructional practice,

student capacities, and a possible absence in the type of skill-attainment that is necessary

to ensure future career opportunities.

Interactive whiteboard basics

Interactive Whiteboards (IWBs) are a relatively new device utilized in

instructional settings. This device is a large presentation surface which is connected to a

computer interface. Teachers can use the screen to show the entire class the contents of

his or her personal computer screen. The IWBs can be controlled by a connected

computer, or can be controlled by a stylus on the board, much like a mouse in the form of

a dry-erase marker for clicking and dragging content. Furthermore, a teacher can add

comments or graphics by drawing on the screen with the stylus. Teachers can display

content from the internet, word processing and data manipulation software, and

slideshows, much like a personal computer interface. However, IWBs also have access

to a host of device-specific software and functions that allow for expanded use in display

For example, a teacher can use software that makes the IWB appear as a Jeopardy-style

trivia game for the entire class, or, a large interactive calendar can be displayed that

students can manipulate. The whole experience of IWB usage can be greater than the

sum of the technological device components.

Like most devices, IWBs were used initially in the corporate world as a means of displaying and interacting with data in meetings. More and more uses for educational implications are being developed. In an office setting, a company may require only one or two boards to place in dedicated meeting rooms. However, schools face a much bigger challenge. To provide dedicated whiteboards to each teacher in a school is an expensive proposition because this new technology has not yet dramatically decreased in price as have internet-accessible computers. If only a few whiteboards are available for an entire school, access continues to be at a minimum. Portable models are still large and cumbersome, and most IWB models are designed to be stationary. Schaffhauser (2009) mentions a progressive teacher-training college providing a portable IWB to student teachers to take to practicum settings. This technological access made student-teachers very popular among district schools. However, student-teachers found it ineffectual if they were assigned to a fourth-floor classroom site. If a school provides one stationary IWB per grade or subject-team, the class will need to move to the dedicated IWB room in order to use the device. Sutherland et al. (2004) found that teachers who had to transition classes to dedicated IWB rooms shared more negative feedback about the implementation of the devices in instruction. Cuthell (2003) reports teacher feedback that stressed the benefits of having a dedicated IWB in a classroom for teachers who previously had to "sign up for time slots."

Interactive whiteboard usage in education

IWBs can be considered a hybrid presentation tool, adding high-tech computer processing tools to the whole-class display structure of the traditional dry-erase whiteboard or chalkboard. Some teachers may use the whiteboard as a projector for

digital slideshow presentations. This function decreases the need for a separate projector. When integrated with the computer interface, teachers can stand at the board displaying the presentation, and make graphic comments with the stylus, a feature not available when projecting a slideshow from a computer without the aid of the whiteboard. Teachers can also use the whiteboard as a "digital flipchart" in order to go back and review pages of material covered previously. Kennewell, Tanner, Jones, and Beauchamp (2007) found that many potentially positive aspects of using an IWB are negated by teachers using them solely for projection of computer-mediated presentations, highlighting the benefits of the "interactive" characteristic of these whiteboards. By developing instructional content presentations before class (rather than writing on a presentation tool during class), teachers are able to take advantage of efficiency and speed characteristics of IWB instruction, which may provide more opportunities for engaged instruction with students (Kennewell & Beauchamp, 2007).

IWBs are also considered tools for collaboration and engagement among students, because they can be "called to the board to use the stylus for independent work display and to exhibit group work" (Smith, Higgins, Wall, Miller, 2005). Smith, et al. (2005) found that children who are too young to manipulate a computer mouse effectively or students with disabilities tended to be more effective in working on the large screen with the hand-held stylus. In this manner, students are being producers of work that can be viewed by many, a skill emulative of prosumer publication to the internet found more often in digitally advantaged students.

Because IWBs emulate the work that one can complete on a personal computer, displaying instructional information on the IWB is also considered a positive modeling

tool for students when completing work on a computer independently. Again, the interactive nature, and high value attributed to production of work for an audience specifically reinforces digital prosumer behaviors.

IWBs are also indicated as a positive means for differentiating instruction to student populations with multiple learning needs. As mentioned previously, some students with disabilities may find using the stylus an advantage over using a mouse. However, differentiation of instruction is also dependent on the nature of information dissemination. Cuthell (2003) notes the potential of IWBs for exhibiting material in a visual, aural, and kinesthetic method that can accommodate the strengths of individual students among a class. An even more intensive method of instructional differentiation is highlighted by a teacher who divided her whiteboard screen into three equal parts, each part displaying content at a differentiated instructional level (Smith et al., 2005).

Once again, the benefits of increased technological usage in the classroom, along with an increase in digital devices can be implicated in greater learning advantages for students with the means to have such devices. However, the research that espouses the benefits of IWB usage in classrooms tends to describe the dissemination of content and projects that is not reminiscent of the drill and remediated practice of basic skills noted by Gorski (2009) to be the focus of instruction in low SES populations. When using this technology for drill and repetition of facts, the instructor is really using an IWB as a projector, negating the "interactive" aspect that facilitates more engaged and engrossed learning by students and emulating the thought processes necessary for future education and career success. When these considerations are interpreted along with the relatively

expensive cost of these devices, it appears that the digitally disadvantaged students are

again poised to be neglected.

Internet usage and publication

Internet "prosumer" behavior involves the use of material on the internet for

personal instructional use, and then using that knowledge to develop information that can

be shared on the internet. A minimal, popular example of this type of usage can be

exhibited with social networking sites, where people publish personal thoughts and

information for a network of "friends" to review at will. More complex usages are found

with the publication of original video content on YouTube, or the development of

recurring Podcasts (primarily audio productions of information, such as an audio blog).

In the latter cases, producers are constructing useable content for public consumption,

and often, content requires development more complex than the "microblogs" that are

ubiquitous on social networking sites. The development of this complex content can

indeed be expected to require both "expert thinking, as the producer needs to be

knowledgeable of the "rules", or parameters involved with the specific project, and also

be able to transcend such basic knowledge in order to develop the original vision.

Likewise, communicating the information in a manner that will be digestible to a target

audience requires "complex communication." Warschauer and Matuchniak (2010) note

that this type of prosumer behavior is more likely observed in digitally advantaged

children.

On the other hand, strictly consumer usage of internet content is more likely

observed in digitally disadvantaged children (Warschauer & Matuchniak, 2010). These

children are more likely to "surf" webpages of personally interesting content. These

children are also more likely to skip over text, and prefer browsing sites that offer greater access to pictures and videos, resulting in even less interaction with content, and even less emulation of skills necessary for educational and career success. The "surfing" of internet sites only reinforces skills that are becoming less valuable in the disappearing job market. In this case, children know rules and parameters, such as locating sites that they find worthwhile, but do not access "expert thinking" by transcending the content to evaluate the information critically (Levy and Murnane, 2009). Likewise, the children are choosing to ignore text, and focus on more easily accessible video and pictures, inherently choosing the communication of least resistance, and further fail to transcend basic communication. "Complex communication," the ability to collaborate with others and express ideas that convey more meaning than that which is readily available is a skill noted to be necessary in today's job market (Levy and Murnane, 2009).

Not only are blogging and Podcast publication examples of the types of skills necessary to compete in the digital job market, but digital production skills are also being utilized in the classroom as an advantageous method of instruction. Colombo and Colombo (2007) and Putnam & Kingsley (2009) extol the virtues of using Podcasts as tools for increasing student collaboration on project development and for providing differentiated instructional opportunities for a variety of learning styles. However, using this technology requires teachers who are familiar with internet production, and requires teachers who have time for instruction that is not dedicated to remediation of basic skills.

Another positive aspect of utilizing internet production techniques for instruction is positive peer pressure. Students tend to put forth more effort into assignments when they know that critiques of their work can come from anyone with access to the internet;

literally, "the whole world is watching." Warschauer, Arada, and Zheng (2010) found

that students using the Littleton, Colorado OTOL program for language arts repeatedly

noted that work accessible to classmates generated feelings of greater industry, and

greater engagement with assignment completion and accessing of knowledge. Berry and

Wintle (2009) also anecdotally noted that children working collaboratively to produce

class-accessible displays claimed to put forth more effort and to engage in "hard fun."

Interclassroom prosumership

Publishable educational outcomes do not always have to be relegated to the

internet. Both Kennewell et al. (2007) and Smith et al. (2005) noted that children

engaged in classroom use of an IWB felt positive peer pressure to perform better on tasks

that would be seen by classmates. Children tended to enjoy the competition that came

with working on the large display board in front of peers, particularly on a program that

made a "buzz" if the wrong answer was selected. However both in the OTOL

engagement studies and in the IWB studies, these areas of higher-level learning due to

increased and intensive use of instructional technology are generally afforded to the

digitally advantaged, where they increase prosumer skills of the advantaged and widen

the digital divide.

Differences in usage of technology between socio-economic cultures

Trends and factors contributing to differences

Because of the development of these new technological advances in education,

and because of the greater availability of such products, it is easy to forget the factors

contributing to the current incarnation of the educational digital divide. The research that

was reviewed describing the trends in OTOL programs, IWBs, and engagement in

internet prosumership generally focuses on the positives of such technological infusions, with only minor attention given to populations lacking the resources or the knowledge to use them effectively. First, it is important to define accurately who is on the "wrong side" of the current gap. Gorski and Clark (2001a, 2001b, 2002a, 2002b, 2003) and Clark and Gorski (2002a, 2002b) have identified populations affected by digital gaps among races, language, socioeconomic class, gender, and those with disabilities. For the purposes of this study, terminology that encompasses these wide-ranging definitions will most often be used, although it is often assumed that people with fewer means and resources (low SES population) are those that suffer more profoundly from access and usage limitations.

Student access

Identifying the main problem areas in the digital divide between public school students is a logical first step toward identifying solutions to these problems. The first variant of the current digital divide focuses on continued lack of access to hardware and other state-of-the-art applications. President Clinton endorsed educational legislation in 1994 to try to ease the original digital divide (Warschauer & Matuchniak, 2010). Since then, technological stipulations have also been part of the No Child Left Behind Act of President George Bush, and part of the Race to the Top legislation of our current president. Federal legislation does not necessarily guarantee funding that is specific for technological access, but mention of the needs for a technology-driven educational system helps to raise awareness of needs. Resource attainment has indeed increased but access is defined as being in the same room with a computer that has internet access, without clarifying usage (Gorski, 2009). This definition could include an entire

classroom with only one or two computers; internet access could consist of dial-up connectivity. Warschauer and Matuchniak (2010) mention that the likelihood of students being engaged in prosumer internet practice is very low in technological settings where there is a high student to computer ratio, or where internet connections are slow. Downloading and uploading content to the internet with a slow internet connection or with outdated machinery is an exercise in frustration. Computer usage in these situations is more likely to include drill and remediation software, or using internet capabilities in a strictly consumer manner.

A new trend in internet-connected computer accessibility for students is to provide each student with a laptop that can access wireless internet provided at the public schools. Research regarding the efficacy of OTOL programs tends to focus on small school districts with demographics that suggest a large prevalence of middle to high SES student populations, based on geographic area (Alberta Education, 2009; Berry & Wintle, 2009; Gulek & Demirtas, 2009). Henrico County Public Schools in Virginia, a larger district with a larger urban student population including the Richmond metropolitan area, recently implemented a one-to-one laptop program, and was considered a trendsetter among larger, urban districts for implementation of this program. However, the program was fraught with problems and criticism (Jones, 2007), failing to meet goals of bridging this specific area of the digital divide because all computers had to be returned to IT headquarters for re-imaging due to district-wide internet security problems (O'Hanlon, 2009).

Research on the prevalence rates of other forms of technology has been limited in scope when outlining ratios of teachers with access to devices, such as IWBs (Cuthell,

2003). Prevalence rates of teachers with access to IWBs is particularly difficult to analyze, because some teachers have dedicated access, but others share amongst teams or whole schools (Smith, Higgins, Wall, & Miller, 2005). Research concerning mobile phone use as an educational device indicates widespread ownership of such devices by both students and teachers (Wishart, Ramsden, & McFarlane, 2007, Muyinda, 2007), but large scale studies regarding usage as dedicated instructional devices do not exist. With smaller, more suburban and rural school districts implementing OTOLs, and mobile devices not yet being used for widespread instructional potentials, it appears that the original divide still exists, despite decreases in the student-to-internet access computer ratios nationwide.

Teacher training and knowledge

There are no clear solutions to address the current Digital Divide problem of usage between different SES-level students. Resolutions to this particular problem are inherently related to another problem that has arisen, i.e., those instructors do not have, or are unable to utilize properly, the expertise in encouraging greater student engagement with instructional technology. That is, if instructors were trained to encourage students to be more engaged with technology, and inspired students to use technology as designers, producers, and communicators, these students would be closer to bridging technological gaps.

The interaction between these two problems may seem relatively straightforward, but solutions are convoluted. The United Kingdom has addressed the problem of teacher expertise and implementation at the pedagogical level (Sutherland, Armstrong, Barnes, Brawn, Breeze, Gall, Matthewmann, Olivero, Taylor, Triggs, Wishart, & John, 2004,

Sutherland, Robertson, John, 2004, Sutherland & The InterActive Project Team 2004).

Programs there have forced educators to utilize instructional technology (ICT) in every

lesson, with presentation of new topics as well as with drill and remediation, rather than

utilize ICT as a supplemental aspect to a regular lesson as prescribed by a curriculum,

which is the strategy more widely used in the United States, and particularly with low-

SES instructional methods (Warschauer & Matuchniak, 2010, Gorski, 2009). University

training programs have recognized the fact that many teachers are gaining greater access

to technological devices and capabilities, yet are not trained to integrate these potentials

seamlessly into practical, everyday lessons (Schaffhauser, 2009). "Digital Natives" a

term used to describe people who have grown up with internet access and exponentially

advancing technology are the current pre-service teachers. However, even with "nativist"

ease of usage, these teachers may not be naturally inclined to use this knowledge to

integrate ICT with day-to-day instruction. Developing intensive methodologies at the

teacher training level may help pre-service and novice teachers integrate the engagement

of device usage, but these programmatic responses to the new digital divide do not

address the needs of the thousands of teachers currently in the field, and, therefore, do not

effectively address the needs of this aspect of the digital divide.

Why educational technology equality is important

Educational engagement

        With this emphasis on meeting these challenges and devising solutions for the

challenges, it is understandable that the reasons why the point of bridging the digital gap

can be lost. Why should public education be so highly concerned that all students have

the same access to technology, be instructed to utilize this technology to its potential, and

be engaged in interactive and complex learning using this technology? There are two

answers to this question. The first is summarized in the work of Paul Gorski (with

Christine Clark, 2001a, 2001b, 2002a, 2002b, 2003, 2009) and by Warschauser and

Matuchniak (2010). These researchers cite growing bodies of evidence that children,

particularly low-SES students, are increasingly disengaged with more traditional formats

of teacher-directed, lecture-based instruction. These researchers indicate that this

frustration and disengagement are sources of high dropout rates and unsuccessful

acquisition of basic and complex knowledge for students in the low-SES groups.

Proponents of integrating technological resources into daily lessons champion findings

that indicate that group projects with specific technological requirements facilitate

engaged learning and cooperative collaboration among students (Berry, Wintle, and

University of Maine, 2009; McLoughlin & Lee, 2008). However, these same researchers

cite examples of collaborative, prosumer usage of technology for learning among

children with access and with instructors who have been trained to use the technology

appropriately; this lack of access and lack of teachers with appropriate technological

training are sources of difficulty in wide-spread resolution to the current divide.

Skill building for future success

The second response to the "Why should closing the digital gap be important?"

question does not concern the here and now of day-to-day challenges in education as

much as it concerns the future of our public-educated students. Future careers demand

complex information processing. Levy and Murnane (2006) note that rule-based

information processing is a task that is easily adaptable to machines. Many jobs that

focus on problem-solving with basic rules can easily be replaced by computers. Many

jobs that currently necessitate a human engaging in low-level, rules-based information processing are being outsourced to other countries (Levy & Murnane, 2006). Careers that are increasingly available in the United States require what these researchers' term, "expert thinking," and "complex communication." Development of these skills is not solely attributable to prosumer technological usage; using these skills in conjunction with technological production can position students to be ready for the higher-tech job market.

"Expert thinking" involves understanding the basic rules (which a computer can do) of a given situation, but also being able to analyze information that transcends the rules, such as mechanical and electrical design, researching, or even professional cooking. These are jobs in which basic parameters guide work, but metacognitive apperception of the rules can make work more efficient, and creative solutions can be developed should a problem arise.

"Complex communication" is the skill to provide information (which a computer can do), but utilizing methodology that ensures effective transfer of the knowledge being communicated, such as teaching and consulting. These acts require greater skill than simply providing informtaion. To succeed in these careers, one must impart adequate knowledge of a subject, but also be able to gauge understanding, as well as differentiate instructional techniques should the student or consultee have difficulty with comprehension.

Levy and Murnane (2006) not only provide data that supports the growing needs to be qualified and successful in these careers, but also critique the current trends in education that focus on repeated assessment of basic information, without assessment of more complex, transcendental skill-sets that are the hallmark of the changing career-

scape. High-stakes standardized testing requires teachers to focus on the outcomes of such assessments and instruct students to achieve. These practices generally involve the type of remediation and drill instruction that is evident in basic instructional technology practice and is utilized in schools with less-than-adequate ICT resources. On the contrary, using instructional technology in an engaging, collaborative manner, such as assigning group projects to develop computer-animated solar system models or use podcasts to present interpretations of literary classics, invokes both "expert thinking," and "complex communication." These practices ensure that students are engaged and are building the skills necessary for future success.

Discrepancies in student achievement between SES groups

How student achievement is measured

The factors that Levy and Murnane (2006) explain may be informally identified and taught in schools with robust ICT programs. Students working cooperatively on projects that are published to the internet are using both "expert thinking" and "complex communication" skills as part of the assignment. Though seemingly integral to future success, one's success in school is not measured by growth in these two attributes. Student achievement is measured by scores on tests and by progress toward graduation. "Expert thinking" and "complex communication" may be subsumed in the curricula of many public educational programs; district test scores may be "proficient" and graduation rates may be high. However, it is a mistake to assume that "proficient" scores imply the same skills among students in different districts or states.

Standardized testing

School district success, particularly in education of primary children, is often represented by district standardized test scores. Standardized tests have been used to measure student success since the initial ratification of the Elementary and Secondary Schools Act (ESEA) by President Johnson in 1965. However, a more recent version of this educational legislation, "No Child Left Behind" (NCLB) enacted by President G. W. Bush used standardized testing data as a means to judge the effectiveness of educational practice of schools and school districts (PL107-110, 2002).

The practice of standardized testing under NCLB indicates that all students from third through eighth grades will take the same grade-based test in a given state. The state has the choice of the standardized testing instrument. Standardized testing in this manner, for the purpose of judging the effectiveness of all schools and school districts equally, has been the source of vast criticism. The newest proposed incarnation of ESEA legislation includes a component of funding called "Race to the Top" (RTTT); which is a system of points that can be earned by states to receive greater federal support and funding (United States Department of Education, 2009). One way to earn points is to adopt the Common Core State Standards Initiative, which is a set of educational benchmarks that will be used nationwide. Standardized testing will eventually be based on these Common Core State Standards, should RTTT remain enacted. Although the name of the legislation is different, and the test construction should change in relationship to new, unified reference points, standardized testing scores will continue to be gathered and used to judge school district educational performance.

No Child Left Behind has had a particularly polarizing effect on the public, especially in terms of the "high-stakes" emphasis put upon standardized test results. Kohn (2000), considering the practice to be "destructive to learning", gives a point-by-point critique of the use of standardized tests as a benchmark for school or teacher performance .However, critical reviews such as Kohn's did not deter law-making bodies from rejecting this usage. Even with a new system of school accountability proposed, high-stakes testing continues to be a significant factor in defining educational effectiveness.

Kohn (2000) takes great pains to emphasize the inequality in the use of standardized testing for all students, regardless of minority or SES status. In these arguments, he describes a cycle of failure in which teachers must repetitively cover basic factual information to "teach to the test," for students with less concrete knowledge (generally low SES and minorities, often in large urban districts). These students are less engaged with instruction, and continue to produce substandard scores on high-stakes tests. Therefore, the teachers are branded as failures, or are likely to suffer from frustration that impedes professional growth and leads to high turnover in low SES schools. This is a nearly perfect parallel to the argument provided by Gorski (2009) and Warschauser and Matuchniak (2010); low SES students are not engaged, however, here it comes from the standpoint of standardized testing, rather than from an instructional technology perspective.

Graduation rate and career readiness

Just as standardized testing score are a maligned method of measuring the success of low SES students, graduation rates are also a source of skewed data. Students who are

not engaged, and who are perpetually victimized by low resources and high teacher turnover are more likely to drop out. In Chapman, Laird, Ifill, and KewalRamani's (2011) report on trends in high school dropout and completion, minorities students with less access to resources are unsurprisingly the most likely to drop out of high school before graduation. The United States uses dropout statistics as a measure of overall public education success, again, relying on data that marginalizes the poor and minorities. Without completing high school, there is no chance for college, and a very small chance for "career-readiness."

A report on California high school educational programming from Education Trust-West (2011) discusses the term "career readiness" as courses designed to train students for more labor-intensive careers; a type of class programming that was once termed "vocational education." The report critiques the educational rigor of such classes, and suggests that students who are not destined for college should have access to educational opportunities that can provide preparation for today's technical workplace. This report does not directly cite Levy and Murnane (2006), but parallels the need for today's student to be able to use "complex communication" and expert thinking" skills, regardless of the career pathway the student chooses. However, the students most likely to take courses related to vocational training are the poor African-American and Hispanic students. These courses are preparing students for the types of "careers" that Levy and Murnane (2006) suggest are the easiest to export, and involve less of the higher order cognitive skills necessary for success in the current American workplace. Again, disenfranchised students are not prepared for viable careers due to discrepancies in access; in this case, the access is between educational course tracks common in American

high schools. It is assumed that the college-preparatory course sequences are those that

use instructional technology in a manner that encourages "complex communication" and

"expert thinking," whereas the "career-preparatory" courses are those that use

instructional technology for remedial skill building or for basic vocational training.

Current practices for defining student success are standardized test scores and

graduation rates. These two methods directly discriminate against disenfranchised

students. However, to succeed in standardized testing and to graduate from high school,

the public education student has increasing pressure to be an engaged student. Career

readiness, if practically applied, assumes the capacity for a student to use communication

skills that indicate inherent expert knowledge and to transcend rote, repetitive parameters.

Again, this type of complex training (which often involves engagement and higher-order

use of instructional technology) is not afforded to poor minority students. Student

success data measures discriminate against low SES and minority students, and the

process of making students successful in terms of this data also discriminates against

these students.

Future directions in measuring student achievement

Although the Common Core Standards will continue to use standardized testing

data to monitor student achievement, there is initial evidence to suggest that more efforts

to include instructional technology literacy for all students will be included. "Anchor

Standards" in the area of Language will demand training in keyboarding, and eschews

responsibility for requiring training in cursive writing, because less time for remediation

of this skill is available in an educational landscape that should promote more complex

comprehension and communication skill (Supon, 2009). Furthermore, two consortia that

won RTTT grant funding to create the next generation of assessments, the Partnership for

Assessment of Readiness for College and Careers (PARCC) (2011) and the SMARTER

Balanced Assessment Consortium (SBAC) (2010) have committed to use technological

platforms as a means to administer new common standard achievement tests. This

commitment will require all schools to have the technological resources available to

administer the tests, and will require all students taking the tests to be at least semi-

literate with keyboarding and word processing in order to respond to open-ended items.

Common Core Anchor Standards for grades six through twelve in Language also

include verbiage that suggests at least introductory exposure to the usage of "Complex

Communication," and "Expert Thinking:"

> **Speaking and Listening: Flexible communication and collaboration**
> Including but not limited to skills necessary for formal presentations, the
> Speaking and Listening standards require students to develop a range of
> broadly useful oral communication and interpersonal skills. Students must
> learn to work together, express and listen carefully to ideas, integrate
> information from oral, visual, quantitative, and media sources, evaluate
> what they hear, use media and visual displays strategically to help achieve
> communicative purposes, and adapt speech to context and task. *As quoted
> in Common Core State Standards Initiative, page 8 (2010).*

Interestingly, technological display of information is noted, as is the usage of technology

in a collaborative manner that necessitates the need for students to communicate with

each other effectively regarding technical information, and included is the need to

integrate data to make suppositions transcending the face value of the information. This

communicative aspect of the new standards is illustrated throughout all of the subject

areas and indicates an understanding by the designers of the skill needs for current work-

force- and college-ready graduates.

A commitment to teaching both low cognition technological-based tasks (keyboarding), to more robust, higher-order technological-based tasks, such as collaboration and using technological modality for data presentation represents a shift in public education practice to align with current college and career-ready needs. With this new commitment, lower-SES schools will need to begin to move away from passive educational technology use in schools as described by Gorski and Clark (2003) and Warschauer and Matuchniak (2010) and toward more integrative and collaborative usage. Without evolving to the level of mimicking trends set by their middle and high SES public school counterparts, these lower-performing school systems will not be able to compete in terms of achievement, as measured by the new Common Core standards. However, discrepancies in resources and in teaching styles have historically reinforced both educational and digital gaps, and without major renovations, will likely continue to facilitate such gaps.

Summary

The Digital Divide has evolved; almost all students in public education have access to some form of internet connection and basic word processing and data analysis tools. However, the manner in which students use these tools differs between low SES students and middle and high SES students. Low SES students tend to be passive consumers of internet content; that is, they look at pictures or play skill-remediation games online (Warschauer and Matuchniak, 2010). Middle and high-SES districts tend to use technological devices for the purposes of becoming producers and developers of technological and internet content.

New types of instructional technology are actually contributing to this current incarnation of the digital divide. Teachers who lack the training and skill necessary to utilize new technological instruments and resources tend to be employed and then, hastily, to leave low SES school systems, but teachers with the applicable knowledge to use such devices are trained and then retained by middle- and high-SES school systems (Warschauer and Matuchniak, 2010). New developments in technology include fast-paced internet connections that allow for greater production of internet material by students with the knowledge and skill to use it for that purpose. Broadband internet is becoming ubiquitous in schools; however, teachers that must focus on basic skill remediation to meet standardized testing benchmarks cannot afford to spend valuable time on higher-order internet use. The same is true for other advances in instructional technological instrumentation. Interactive whiteboards, one-to-one laptop programs, document sharing and wiki development, and even mobile device usage are becoming more affordable and more available to all schools and students. These devices and services have the potential educational power to promote amazing educational results through collaborative production. However, the types of usage between have- and have-not students continue to contribute to an achievement gap, not only to a digital gap.

The modern American career landscape demands that students have expertise in the skills that are encouraged with more engaged usage of current technological resources. Students who can develop web-published presentations that can be interactive for other users are encapsulating the "complex communication" and "expert thinking" skills that are suggested by Levy and Murnane (2006) as the new fundamental skills necessary to compete in the modern competition for viable careers.

However, schools are not currently held to the standards that are subsumed in these skill-deficits. Standardized test score data and graduation rates fail to encapsulate the need for these more advanced problem-solving skills. Through the use of this data, the low-SES student is again short-changed. To compete in the battle of high test scores, remedial skill-building must be emphasized, a practice that is leading to the current divide in usage of digital resources. Graduate rates have historically shown greater failure to succeed amongst poor minorities; these rates have been inflated with students who are earning diplomas but who do not have "complex communication" and "expert thinking" skills. If these students graduate with any skill at all, they are likely the types of skills currently being outsourced to developing countries or being managed by computers. Despite these great advances in technological access and capabilities, the low-SES minority student is still being set up to fail.

Currently there is a reliance on standardized testing data as the means to measure student achievement success, and this measurement is not likely to change. However, proposed modifications to the standards by which success is measured have at least attempted to address the overarching problems. Unfortunately, the pattern that has emerged in the past twenty years, that with technological advances comes more sophisticated ways for the disadvantaged student to be unsuccessful in American culture, leaves ample room for pessimism.

Hypotheses

The current study will focus on various aspects of urban versus rural/suburban sixth through eighth grade students' uses of technology at home and at school. Data will be obtained from the "Speak Up" survey administered on a voluntary basis to all Maryland students in 2010. Children from the Baltimore City Public School District will be considered "urban" for the purposes of this study and students who attend schools in other districts in Maryland will be considered in the "suburban/rural." Urban versus rural/suburban students will be compared on their access to technology, the types of activities they are engaging in while using the technology, as well as how the type of utilization might be related to their performances on standardized testing.

Hypothesis #1: Access to technology

Research conducted by Gorski and Clark (2003) and Warschauer and Matuchniak (2010) suggests that the original "Digital Divide" has been addressed relatively successfully because disenfranchised children now have relatively equal access to advanced technological resources. It is predicted, therefore, that urban students will report that they have nearly equal access to technological devices in classrooms as do the suburban/rural students. That is, that frequency of responding positively to "access" questions will be equal between these two groups. For this hypothesis, "access" is defined as an affirmative response to questions on the 2010 Speak Up survey that involve having contact with specific technological devices. For example, "access" questions on the survey will be, "Does your school provide a laptop for your personal use?" or "Does your classroom have computers with fast Internet access (such as DSL, Broadband, or Cable)."

H_0: There will be no differences between urban versus rural/suburban students'

access to technology.

H_A: There will be differences between urban versus rural/suburban students'

access to technology.

Hypothesis #2: Prosumership

Gorski and Clark (2003) and Warschauer and Matuchniak (2010) indicate that the

most recent incarnation of a divide between the "have" and "have not" children is a

matter of the way in which they use readily available technological devices. Students of

means tend to use the technological products in more collaborative and productive ways.

These analyses will consider "prosumership" of technology as (a) using resources

collaboratively with peers to develop a coordinated effort or group product, (b) using

resources as a means to develop a product that will be uploaded on the internet for other

people to use, or (c) thinking critically about products available on the internet and

drawing original conclusions based on critical thinking. This definition of

"prosumership" is an amalgamation of the types of usages outlined by Gorski and Clark

(2003) and Warschauer and Matuchniak (2010), as well as usage of skills necessary to

succeed in the contemporary American career market as outlined by Levy and Murnane

(2006). Example survey questions that will identify prosumership include "Do you use

internet messaging technology (IM, chat, email, or texting) to communicate with

classmates to complete collaborative projects?" and "Do you participate in online

communities focused on specific subjects,?" and "Do you regularly post to a blog or

wiki?"

H_0: There will be no differences between urban versus rural/suburban students'

utilization of technology as "prosumers".

H_A: Students from rural/suburban areas will utilize technology as "prosumers" to

a greater degree than students from urban areas.

Hypothesis #3: Consumership

"Consumership" of technological resources includes consuming available content

without originating new products and without thinking critically about meanings; i.e.,

accepting information provided at face value. Gorski and Clark (2003) and Warschauer

and Matuchniak (2010) suggest that this type of use of technology is most often used by

students on the disenfranchised side of the contemporary digital divide. Skill remediation

drill work, playing online games, and referring to textbooks online are considered types

of consumership. For this study, "consumership" will be operationalized by positive

responses to survey questions such as "Do you use computers in school to practice math

skills?" or "Do you use computers to play educational games?"

H_0: There will be no differences between urban versus rural/suburban students'

utilization of technology as "consumers".

H_A: Students from urban areas will utilize technology as "consumers" to a greater

degree than students from rural/suburban areas.

Hypothesis #4: Relationship to achievement

Prosumership, as operationalized in this study, encapsulates the qualities of

"complex communication" and "expert thinking" as defined by Levy and Murnane

(2006). Levy and Murnane indicate that these two capabilities are necessary for success

in the modern career landscape (2006). That is, by being able to communicate and

collaborate with others in a manner that utilizes the expertise of the group members (complex communication), and by being able to think about things in a manner that transcends basic rules or procedures (expert thinking), one is able to secure a modern American career that is not easily replaced by computers or out-sourced to another country (Levy and Murnane, 2006). Consumership does not necessarily utilize these two skills, and therefore, is less likely to prepare current students for careers. It is hoped that public education is preparing students for careers. Although public school student success is often measured by the results of state standardized assessments, it is the career preparedness of students that ultimately determines educational success

The final hypothesis suggests that students who report engagement in prosumer activities will likely attend schools with better MSA achievement scores. Students who report greater engagement in consumer activities will likely attend schools with lower MSA achievement.

H_0: There will be no differences in MSA scores between students more likely to engage in "prosumership" versus students more likely to engage in "consumership"

H_A: Students who are more likely to engage in "prosumership" will attend schools with higher MSA scores, on average, than students more likely to engage in "consumership."

Chapter 3: Methods

This study analyzed archival data. Data sources were the results of the 2010 administration of the Speak Up Survey, and the 2010 results of the Maryland State Assessment (MSA). Speak Up Survey data were gathered and compiled by Project Tomorrow. MSA data were gathered and compiled by the Maryland State Department of Education (MSDE). Data were coded and analyzed by the investigator.

Instruments

Speak Up survey

Speak Up is an annual survey that is completed on a voluntary basis by students, teachers, and administrators of participating schools nationwide. The survey is administered by Project Tomorrow, a national educational nonprofit group based in Irvine, California. Project Tomorrow's main goals, as indicated on their website, are to conduct the Speak Up research project, replicate model technological projects in school and communities, provide online tools for students and stakeholders, and contribute to the national dialog regarding technological issues (Project Tomorrow, 2012). School-based or district-level staff members volunteer to participate in this survey. Participation is encouraged because the results of individual school data can be compared with national and local samples, and can be used by school staff to make decisions regarding technological needs and accessibility of products. Data are also used by Project Tomorrow to further their goals of understanding current trends to develop projects (Project Tomorrow, 2012). Results are meant to reflect student opinions regarding "how they are using and would like to use technology for learning in and out of school";"the benefits of using technology for learning"; "attitudes and interest in math and science, as well as career aspirations," and "how they self-assess their 21st century skill

competencies (Project Tomorrow, 2012)." Teacher, parent, and administrator surveys are also available.

This survey is completed by students in schools, ostensibly at the behest of a teacher. Project Tomorrow provides school and district data to policy makers, so that they make more informed choices regarding student, parent, and teacher use of technology at school and away from home. Therefore, the rationale for completing the survey is to comply with school policy. Project Tomorrow provides no benefit to the students surveyed. Students, teachers, and parents who complete surveys for the benefit of the school district, or because they are requested to do so by a teacher or district leader may represent a biased population of respondents. This type of sampling, called "nonprobability sampling," may impact representativeness to the entire American population, but makes the process of collecting data more convenient for the surveyors (Graziano & Raulin, 2010).

The design of this survey collection method can help to achieve a desired completion rate for Project Tomorrow, because nonprobability sampling without regard to stratification can put fewer restraints on the surveying procedure. Rapid turnaround for data collection and relative inexpensiveness of the design are two such benefits (Creswell, 2009). However, skewed results due to sample population characteristics can significantly impact the validity of the results, which may not be representative of an entire population. Students who complete the survey have access to computers, because the survey can be completed only online. Therefore, the population being represented by the results is not all public school children, but rather, all public school children who already have access to computers. Furthermore, by accepting all voluntary submissions,

the participants are not expected to be a representative sample of gender differentials, ethnic or racial make-up, socio-economic status, or ability groups.

Schools or districts that choose to participate in the SpeakUp survey register early in the school year. The survey is available for completion in the fall, and the results are available in the following spring. Project Tomorrow has administered the survey since 2003 (it was then known as NetDay (Project Tomorrow, 2012). Since then there have been over 2.2 million surveys completed; 416,758 were completed this year (Project Tomorrow, 2012). Project Tomorrow supplies no benefit for participants except for access to the data. Districts that participate in multiple years can compare sequential results. Researchers are granted permission to access data in order to promote the use of the survey results for greater information.

There are different versions of the survey for students in different grade groups. Surveys completed by students in the 6th through 8th grades include 28 close-ended questions, each with many response options. Some questions provide "either-or" responses such as, "At home, do you have a computer?" Response options include three "Yes" options (without internet, with slow internet, and with fast internet), and two "No" options (use only school computers; use only library or afterschool program computers). Surveys completed by students in the 6th through 8th grades include 28 questions of the same response style. See Appendix A for the 2012 version of the sixth through eighth grade Speak Up survey. Teacher survey questions are arranged in much the same style; 33 questions are generally reflective of current practice or are rhetorical.

After survey information was supplied by Project Tomorrow, the data were used to analyze hypotheses. For the purposes of this study, survey questions were coded as

being either "Access," "Consumership," or "Prosumership." Questions that pertain to access to technological resources are coded as "A" questions. Generally, the survey is designed in a manner that frontloads these items so that their position on the survey is an extension of demographic information. Questions regarding access to technology will be primarily used to explore hypotheses regarding equality of access between groups of students. In Appendix A, questions 4 and 5 are examples of items that indicate access.

Questions that were coded "C" are indicative of consumership. This type of usage code was applied to questions that identify students' uses of technology as intended by a developer (educational programs used for drill and remediation), using technology for more entertaining pursuits, and using technology in a "face value" type manner, that is, consuming content without inferring greater meaning, generalizing meaning to other topics, and without communicating and collaborating with peers regarding content. In Appendix A, some responses to question 6 are coded as indicative of consumership.

Questions that were coded "P" are generally indicative of prosumership. This type of usage code was applied to questions identifying students' use of technology to derive more abstract meaning from content, facilitating collaborative efforts among peers, and particularly with developing content for publication for other people to see and use. In Appendix A, some responses to question 6 are coded as indicative of prosumership.

In the multistage identification of those questions which should comprise each of the three subscales (Access, Consumership, and Prosumership), two individuals (the investigator and an assistant) independently identified those questions which they thought belonged in each of the subscales. Following this, the coders met in order to come to a consensus about those questions belonging in each of the subscales. Items not agreeably

identified by the two categorizers were discussed until a consensus was reached. In the

final step of the development of the subscales, an alpha analysis was performed in order

to confirm that items belonged appropriately in the subscales of "access,"

"prosumership," or "consumership."

Maryland State Assessment

The Maryland State Department of Education (MSDE) is responsible for

conducting the annual Maryland State Assessment. MSDE (2012) describes the

assessment as

> The Maryland School Assessment (MSA) is a test of reading and math
> achievement that meets the testing requirements of the federal No Child
> Left Behind Act. The test is given each year in early March in reading and
> math at grades 3 through 8.

Results of MSA scores available from MSDE for specific schools show

categorization of scores into Basic, Proficient, and Advanced levels for both reading and

mathematics test portions. These categorizations were used for statistical comparisons

among students attending different school districts.

Participants

Data from the 2010 administration of Speak Up were used for the current

analysis. Survey results from the Baltimore City Public School System were used for

data regarding the comparison group encompassing students and teachers of urban public

schools. Data available from surrounding districts in Maryland encompass the

comparison groups of rural/suburban students. In the Baltimore City Public Schools

sample, 1996 surveys of 6th through 8th grade students were completed.

Completed surveys can be traced to specific schools of origin within the district.

Maryland State Assessment (MSA) data for each participating school will then be used as

the comparison data for exploring hypotheses regarding educational achievement based on district resources. Maryland State Assessment data are compiled from results of all students taking the assessment at each school (generally nearly 100 percent participation).

Procedure

Data were provided by Project Tomorrow, the nonprofit company which develops and distributes the Speak Up Survey. Data are available to researchers upon request. Data provided by Project Tomorrow will be sent directly to Philadelphia College of Osteopathic Medicine (PCOM) School Psychology faculty in anticipation of approval from the institutional review board (IRB).

Project Tomorrow conducts the annual Speak Up survey by developing an online questionnaire that is completed by participating schools and school districts. Students, teachers and administrators of participating districts and schools can complete the surveys. After survey data has been categorized and analyzed by Project Tomorrow, participating schools and districts can use the results to analyze technological access and use within organizations and can use the data to help guide future decision making or to apply for grants. Project Tomorrow is a national, non-profit research organization that aggregates these data to present on national trends and to help promote greater in-depth research on usage of instructional technology. Speak Up survey data are generally completed by participants in the fall and early winter, and data are aggregated and returned to districts in early spring of the following year. National data are also available for comparisons between national trends and the trends found in the participants' specific districts.

Chapter 4: Analysis

Hypothesis #1: Access to technology

H_0: There will be no differences between urban versus rural/suburban students'
access to technology.

H_A: There will be differences between urban versus rural/suburban students'
access to technology.

This hypothesis was evaluated by conducting an Analysis of Variance (ANOVA)
comparison study. Students classified as "urban" and students classified as
"rural/suburban" will be identified as dependent variables. The alternate hypothesis
indicates that significant differences ($p < .05$) will be found between groups in terms of
average group access to technology.

Hypothesis #2: Prosumership

H_0: There will be no differences between urban versus rural/suburban students'
utilization of technology as "prosumers".

H_A: Students from rural/suburban areas will utilize technology as "prosumers" to
a greater degree than students from urban areas.

This hypothesis was evaluated by conducting an Analysis of Variance (ANOVA)
comparison study. Students classified as "urban" and students classified as
"rural/suburban" will be identified as dependent variables. The alternate hypothesis
indicates that significant differences ($p < .05$) will be found between groups in terms of
average "prosumer" usage of technology.

Hypothesis #3: Consumership

H_0: There will be no differences between urban versus rural/suburban students'

utilization of technology as "consumers".

H_A: Students from urban areas will utilize technology as "consumers" to a greater

degree than students from rural/suburban areas.

This hypothesis was evaluated by conducting an Analysis of Variance (ANOVA)

comparison study. Students classified as "urban" and students classified as

"rural/suburban" were identified as dependent variables. The alternate hypothesis

indicates that significant differences ($p < .05$) will be found between groups in terms of

average "consumer" usage of technology.

Hypothesis #4: Relationship with achievement

H_0: There will be no differences between MSA scores between students more

likely to engage in "prosumership" versus students more likely to engage in

"consumership"

H_A: Students who are more likely to engage in "prosumership" will attend schools

with higher MSA scores, on average, than students more likely to engage in

"consumership."

This hypothesis was evaluated by conducting a Pearson correlation comparison

study. Students classified as "prosumers" and students classified as "consumers" will be

identified as variables. These variables will be compared with MSA achievement data.

MSA data that were used for these comparisons represent the total percent of students

that achieved "proficient" or "advanced" scores on the assessment. The alternate

hypothesis indicates that a significant correlation ($r > .80$) will be found between groups in terms of average MSA scores.

Results

Three thousand, nine hundred and seventy-nine Maryland public school sixth through eighth grade students compose the sample. The sample was distributed relatively evenly among grades, but was very unevenly distributed in terms of district categorization. Student responses to the survey were categorized into two groups. The urban group includes all responses from students who attend a Baltimore City Public School. Student respondents attended 45 schools within that district. Students responding to the survey that attended a Baltimore County Public School, a Frederick County Public School, a Prince George's County School, or a St. Mary's County Public School were included in the suburban/rural group. Eighty-one schools are represented in the suburban/rural group. Separation was determined by the number of students per area of the district. A vast majority of respondents attended the urban school district. See Table 1 for descriptive statistics of these groups.

Hypothesis #1: Access to technology

Three separate variables indicating access to technology were used in the analysis of this hypothesis. The first variable, "Access of Device" is a summation of positive responses to a "check all that apply" item of the Speak Up survey. This item asks which devices are available to the student for the student's own use. The second variable, "Speed of Home Computer" is a scaled response to a question regarding availability of a computer away from home, with access to the internet at home, and the speed of the internet available of a home computer. The third variable, "Obstacles at School to Access" is also a summation total of positive responses to a "check all that apply" item of

the Speak Up survey. This item asks what obstacles to using technology at school are perceived by the student respondent. Refer to Table 2 for ANOVA data for all three access variables.

An analysis of variance (ANOVA) was computed with Access of Device response summations being compared between urban and suburban/rural respondents. No significant difference was found at the $p < .05$ level between average responses of urban and suburban/rural groups $F(1, 12) = .964$, $p = .482$. A non-significant finding does not indicate that average access to technological devices between members of these groups is relatively equal, but that there does not seem to be a significant finding between average responses.

An ANOVA was conducted with responses to the Speed of Home Computer item being compared between urban and suburban/rural respondents. No significant difference was found at the $p < .05$ level between the average responses of the two groups $F(1, 4) = 1.328$, $p = .257$. A vast majority of respondents ($n = 2688$, $N = 3720$) indicated home access to high speed internet service. Five hundred and ten respondents indicated that their home computer has dial-up internet service, and the remaining 522 respondents do not have internet access in the home at all.

An ANOVA was performed with responses to the Obstacles at School to Access sums being compared between urban and suburban/rural respondents. No significant difference was found at the $p < .05$ level between the average responses of the two groups $F(1, 15) = .777$, $p = .705$. These results do not indicate that respondents from the groups indicated equal freedom from obstacles to using technological devices at school, but rather that no major differences between response patterns was found.

Hypothesis #2: Prosumership

"Prosumership Total" is a variable that is a summation of all positive responses to all items that indicate prosumer usage of technological devices at home or at school. See Table 3 for means and standard deviations of this variable.

An analysis of variance (ANOVA) was computed with Prosumership Total summations being compared between urban and suburban/rural respondents. No significant difference was found at the $p < .05$ level between responses of urban and suburban/rural groups $F(1, 36) = .804$, $p = .792$. A non-significant finding does not indicate that prosumer usage of technological devices between members of these groups is relatively equal, but that there does not seem to be a significant finding between average responses. Refer to table 3 for ANOVA data regarding Prosumership Total summation analysis.

Hypothesis #3: Consumership

"Consumership Total" is a variable that is a summation of all positive responses to all items that indicate consumer usage of technological devices at home or at school. An analysis of variance (ANOVA) was computed with Consumership Total summations being compared between urban and suburban/rural respondents. No significant difference was found at the $p < .05$ level between responses of urban and suburban/rural groups $F(1, 73) = .908$, $p = .697$. A non-significant finding does not indicate that consumer usage of technological devices between members of these groups is relatively equal, but that there does not seem to be a significant finding between average responses. Refer to Table 4 for Consumership Total summation analysis.

Hypothesis #4: Relationships with achievement

Multiple Pearson correlations were conducted to assess the relationship between student summative responses to prosumer questions on the Speak Up survey and MSA test results. MSA test result data are an average percentage of students in a grade at a school who achieved "proficient" and "advanced" scores on both the reading the math portions of the MSA. There are average scores for 6th, 7th, and 8th grade students at a given school. Data analyzed include schools that had MSA information available to the public and had student responders on the Speak Up survey (N = 43). Refer to Table 5 for correlation data.

No correlation was found between average 6th grade MSA percentages and responses to prosumership items (r = .038, n = 43, p = .810), average 7th grade MSA percentages and responses to prosumership items (r = -.080, n = 43, p = .611), and average 8th grade MSA percentages and responses to prosumership items (r = .186, n = 43, p = .231).

Likewise, Pearson correlations were conducted to assess the relationship between student summative responses to consumer questions of the Speak Up survey and MSA test results. No correlation was found between average 6th grade MSA percentages and responses to consumership items (r = .080, n = 43, p = .610), average 7th grade MSA percentages and resopnses to consumership items (r = -.104, n = 43, p = .505), and average 8th grade MSA percentages and responses to consumership items (r = .116, n = 43, p = .714).

Pearson correlations were also conducted between MSA percentage groupings and the student responses to types of access to technology, as well as to student responses

to survey items regarding obstacles preventing use of technology in the classroom. No correlation was found between average 6th grade MSA percentages and access (r = -.177, n = 43, p = .257), average 7th grade MSA percentages and access (r = -.162, n = 43, p = .299), and average 8th grade MSA percentages and access (r = -.007, n = 43, p = .966). No correlation was found between average 6th grade MSA percentages and obstacles (r = -.046, n = 43, p = .768), average 7th grade MSA percentages and obstacles (r = -.068, n = 43, p = .664), and average 8th grade MSA percentages and obstacles (r = .049, n = 43, p = .580).

Chapter 5: Discussion

When survey respondents were categorized into two groups, a vast majority of respondents belonged to the urban group (n = 3503), the remainder being categorized as surburban/rural students (n = 256). The sample of results includes all responses available from Maryland students, but the distribution is highly skewed to urban students. This skewed sample may impact the reliability of the data to be generalized to Maryland's total population of students.

In terms of access to devices, most respondents indicated access to five (n = 641) or six (n = 637) devices. The distribution of responses appears qualitatively normal (m = 5.22, SD=2.41). This finding supports the null hypothesis of Hypothesis #1, namely, that access to technological devices is relatively equal between urban and suburban/rural students. When positive responses to each individual item were compared with national comparisons, the percentages of students indicating access to specific devices was nearly equal. This comparison may contextualize the skewed sample that is available for Maryland students.

When evaluating the analysis of the type of access students have to the internet outside of school, 78 percent of respondents indicated that they had a computer at home with access to high speed internet, and 13 percent indicated that they had a computer at home with a dial up connection. Responses indicate that only 16 percent of students have internet access outside of home; four percent of the total responders indicated that their only internet access was at school. Although a large majority of students have adequate access to high-speed internet at home, those students with slower access or without home access at all would be considered much less likely to engage in technological prosumer behavior (Warschauer & Matuchniak, 2010). No significant difference was found

between urban and suburban/rural respondents, which further strengthen the consideration that access is generally equal between the groups.

When evaluating barriers to using technological resources in school, again, no significant difference was found between respondent groups. Although this finding further supports equal access to technological devices, an implication that suburban/rural students would have fewer barriers (supplementary to Hypothesis #3) was unfounded in this analysis.

When evaluating the analysis of Hypothesis #2, no significant difference between group respondents was found; this supports the null hypothesis. One hundred and forty-nine respondents did not respond to any "consumer" item positively. This finding supports that null hypothesis that no difference would be found between groups. However, this finding does not support the theme of the research, which suggests that suburban/rural students would engage in more prosumer activities.

Hypothesis #3 which compared responses to a sum of "prosumer" items between groups was also found to have no significant difference between groups. Again, this finding supports the null hypothesis that no difference would be found between groups. In addition, this finding does not support the theme of the research, which suggests that urban students would engage in more consumer activities.

There are several implications that can be derived from these findings. The available data did not accurately represent usage; items were coded either in a manner that did not accurately represent the ideals of prosumer and consumer usage, or student responders did not make up a representative sample of technology users, or the research themes are incorrect.

Hypothesis #4 which compared average 6th, 7th, and 8th grade MSA results to prosumer usage and consumer usage totals also found no significantly strong correlations. This finding supports that null hypothesis. These findings suggest that there is no relationship between standardized achievement test scores and methods of using technology.

Furthermore, correlational comparisons were made between average 6th, 7th, and 8th grade MSA results and access and obstacles to access variables. Again, no significantly strong correlations were found. These findings suggest that there is no relationship between standardized achievement test scores and access to, or obstacles preventing technology and technological devices.

This last finding is contrary to conventional wisdom and to the research indicating that greater access to technology can increase academic achievement. The earliest incarnations of the digital divide concerned access. As the results of the analysis of Hypothesis #1 indicate, there are no significant differences in self-reported access between groups, as divided by residence community, in this data set. However, this equal access has done nothing to equalize achievement on state standardized testing.

Limitations

There are inherent limitations in using survey data for hypothesis testing and analysis. People who complete surveys tend to have a reason to do so, and reasoning by participants alone can skew results. This survey data are made up of a sample of convenience. Therefore, no effort was made to ensure that the population of survey takers was culturally representative of the American student population as a whole. In this specific case, the data show that the vast majority of Maryland participants were students from Baltimore City Public Schools. Students from suburban and rural school districts of Maryland were underrepresented in this survey. Interestingly, the results of the survey-takers as a whole closely matched national results. If student participant populations in other states were over-represented by urban students, the national results may be considered skewed as well.

Survey data that are focused on the use of technology, yet require technology to complete the survey, are biased in the most basic form. Classes of students who have completed this survey must also have teacher or administrative direction to be aware that the survey exists, as well as an interest in the results specific to a school or class, and in comparison to national data. This interest and direction greatly skews the representativeness of the results. Students may have less access to computers, and so they may not be aware of the existence of the survey. Likewise, districts that may not prioritize the value of access to technology (and so do not make it available) may also not value the type of results that are made available by completing this survey, leading to less participation. These limitations likely skew the results in favor of greater access and greater types of usage in the results.

In terms of the first hypothesis, access items indicated relatively equal access among participants when analyzing items that indicate current access to specific items. Items that focus on access might be considered the most likely to produced positively skewed results, because the participants have inherent access to computers in order to complete the survey. Therefore, the more representative access items might be the items that are concerned with access of the internet at home. Here, Maryland students again responded in a manner that closely resembled the national results. With this item, students are not automatically at a positive "advantage" by having access to the computers at school.

The item that lists obstacles to using technology at school is difficult to interpret. The item asks what obstacles (other than not enough time) prevent access to using technology at school. The item does not indicate what type of usage; which gives this item the connotation of a "wish list." Students who may like to use technological resources at school to communicate with friends about non-educational topics, play games, or look up popular cultural topics may respond to this item in a manner very similar or very dissimilar from a student who views this item within the context of using technology at school for strictly educational means. The item lists "cannot use my own cell phone, Smartphone, or MP3 player" as a possible barrier. School districts may be investigating the use of smaller, more cost efficient computing technology for students. However, students who use these devices for entertainment and generally non-educational communication can see a restriction on these devices as a barrier to entertainment and socialization, rather than as a barrier to greater educational usage. The item "not enough computers or they don't often work," might be a better indicator of a

representative obstacle to achieving greater educational means in the classroom. Items were weighted equally in the summation when analyzing these specific items; this can be considered a limitation for this study, and be indicative of a direction for further research.

In terms of the second and third hypotheses, there are similar limitations in how the data designation was determined. Variables that were used as indicative of consumer or prosumer behavior were summations of responses to multiple items, and responses were all weighted the same. Items such as "post to blogs or wikis to communicate with other students to complete schoolwork," might be considered a much more purely prosumer activity than "communicate with friends on a social networking site (such as facebook or myspace) to talk about schoolwork." Students who communicate via social networking sites may have educational intentions in mind, or may be using such as sites in a more social/entertainment manner. It is impossible to know the rationale behind the responses, and it is difficult to weight specific items in terms of the degree to which students might use technology in an educational manner. Likewise, some items, such as "use bookmarking sites" could technically evoke responses from either a consumer or prosumer standpoint. It is considered likely that students who use such sites are interested in being more efficient and better organized in the consumption of information, and therefore, are more likely to be interested in the topic to the degree that they are using sophisticated research techniques. However, it might also be likely that some students use bookmarking tools in order to look at pictures or videos for entertainment. Although the items were vetted by a research assistant, and items such as this one were discussed, it is again impossible to be aware of the rationale behind a positive response to a vague item.

These difficulties with justification of the categorization of items demonstrate an overall limitation in using archival data. By using this data, a large population of survey responses could be analyzed, which greatly impacts the validity of the responses overall. However, the items cannot be retroactively worded and made to fit this investigation more appropriately. Logical interpretations, although considered generally accurate, leave room for threats to the validity of the data analysis when archival data are utilized for new analysis.

An overall limitation in conducting research on educational technology is the speed of the technology and the potential for usage. Research that has been gathered at the forefront of this project is sometimes antiquated or overtly dissimilar to findings that are more current. Trade publications offer articles on the newest uses for cloud technology in the classroom, three-dimensional video editing software, and "bring your own technology (BYOT)" programs for schools. These devices and educational technology movements are so new that peer-reviewed research investigating efficacy has not yet been conducted. Indeed, the most up-to-date version of the Speak Up survey includes very few items that investigate these programs. Research that investigates technology will always be behind current trends, because the nature of technology is to progress rapidly.

The fourth hypothesis used a variable that is defined as a school's average percentage of sixth, seventh, and eighth grade students who achieved "proficient" or "advanced" scores on the state standardized assessment. State assessment data may not be the most valid measure of a student's capacity for "expert thinking" or "complex

communication." This data are easily accessible, making the achievement data a variable of convenience, just as the respondents to the survey are also participants of convenience.

Of the 4023 total respondents, 1371 attend schools that did not have valid MSA data available for sixth, seventh, and eighth grade students. These schools tended to be in Baltimore City. Some respondents attending Baltimore City Public Schools listed their attending school as an elementary school or a high school, which does not have middle school achievement data. Using the available data to develop categories was not based on any established criteria for measuring successful students, but were based on a distribution of the averaged percentages.

Overall, the biggest limitation seemed to be that a fundamental assumption was found to be unsupported in this research. The literature review and the purpose of this research were to investigate types of usage and overall access to usage in regard to student achievement. The unmentioned assumption was that type of usage or access to technology would have some effect or impact on student achievement. This assumption was unsupported in these findings.

Implications and future direction

The overall implications of these findings is that there is no significant relationship between access to technology, amount of technological devices, usage of technological devices, or misuse of technological devices and achievement as it is measured by state standardized test results. It does not matter if the research indicates that disparities in access are to blame for inequalities in educational accomplishment or if disproportion in type of usage should be implicated in these inequalities, the underlying assumption was that technology has some bearing on educational accomplishment. This

assumption was not supported in these analyses. However, multiple limitations to research were identified, which can lead to future directions for research in this area.

These analyses used the results of the 2010 Speak Up survey. The 2011 data is now available. Likewise, 2011 MSA results are available. A future direction for research would be to investigate similar analyses with this more current data, and look for similar results. Both 2010 and 2011 surveys have teacher and parent components. The data from these surveys were not examined as part of this investigation. The validity of the student data might be better supported if the behaviors reported in the student survey could be highly correlated to reports of behavior by teachers and parents. An area of limitation in the current study was that a disproportionate number of urban students were included in the total Maryland sample population. Analyzing this student data in corroboration with parent and teacher data may help identify the extent of distortion that is a result of the skewed population.

A major limitation in the current analysis was that all items that implied prosumer or consumer behavior was weighted the same in summation variables. An area for future direction in research may be to analyze these items individually in order to investigate the possible relationship between very specific behavior and academic achievement. For example, "Posting to a blog," is an item that is considered highly indicative of prosumer behavior. Using web-based large-scale communication techniques is reminiscent of "complex communication," and posting to a specific blog indicates a narrow interest in a specific field, which can be assumed to resemble "expert thinking" about a particular topic. Aside from the reviewed research that indicates that this type of behavior is considered to occur more often in students with future success qualities, common wisdom

suggests that students who regularly post to a blog are transcending the type of critical

thinking that is the focus of education. However, the design limitations of the current

study did not allow for particular items to be investigated. This is certainly an area of

investigation that should be considered for future research.

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Table 1

Basic Demographic Characteristics of Sample

	n	%
Gender		
Males	2001	49.7
Females	1978	49.2
Grade		
Sixth	1464	36.4
Seventh	1301	32.3
Eighth	1230	30.6
District		
Urban (45 Schools)	3503	87.1
Suburban / Rural (81 Schools)	256	6.4

Table 2

ANOVA for Hypothesis #1

	df	F	p
Access* UrbanSuburbanRural	12	.964	.482
Speed of Home Computer* UrbanSuburbanRural	4	1.328	.257
Obstacles at School to Access* UrbanSuburbanRural	15	.777	.705

Table 3

ANOVA for Hypothesis #2

	df	F	p
Prosumership Total* UrbanSuburbanRural	36	.804	.792

Table 4

ANOVA for Hypothesis #3

	df	F	p
Consumership Total* UrbanSuburbanRural	73	.908	.697

Table 5

Correlations for Hypothesis #4

	Prosumer Sum	Consumer Sum	Access	Obstacles at School
6th Grade Average MSA Percentage of Proficient and Advanced Students	.038	.080	-.177	-.046
7th Grade Average MSA Percentage of Proficient and Advanced Students	-.080	-.104	-.162	-.068
8th Grade Average MSA Percentage of Proficient and Advanced Students	.186	.116	-.007	.049

Appendix A

Student Survey
Grades 6-8 and 9-12

1.) What grade are you in?
○   Grade 6
○   Grade 7
○   Grade 8

○   Grade 9
○   Grade 10
○   Grade 11
○   Alternative program or other

2.) Gender
○   Girl/Female
○   Boy/Male

3.) Thinking about the other students in your class, do you consider yourself…
○   An advanced tech user – more expert than most of the students at my school
○   An average tech user – the same as most of the students at my school
○   A beginner – below the skills of most of the students at my school

4.) What types of electronic devices do you have access to for your own use? (Check all that apply)
○   Cell phone (without Internet access)
○   Smartphone (with Internet access such as: Blackberry, Droid, iPhone)
○   Computer that is provided to me by my school
○   Home computer or laptop
○   Tablet computer (such as iPad)
○   Digital reader (such as: Kindle, Nook)
○   Music or video device (such as: MP3 player,iPod or iPod Touch)
○   Handheld game (such as: GameBoy, Nintendo DS)
○   Video Gaming System (such as: Xbox, Playstation, Wii)
○   Other

5.) When you are outside of school, what access do you have to the Internet?
○ My home computer has slow or dialup Internet access
○ My home computer has fast Internet access (such as: DSL, Broadband, or cable)
○ I access the Internet through a wifi or 3G/4G mobile device
○ I access the Internet at home through a mobile computer or tablet that was provided to me by my school
○ My access to the Internet is through computers at the public library, after school program or community recreation center
○ My only access to the Internet is at school

6.) How do you use technology for schoolwork? (Check all that apply)
○ Access online databases or real time data such as from maps
○ Communicate with other students via email, IM, text messaging
○ Communicate with other students via video conference, webcam or skype
○ Communicate with teachers via email, IM or text messaging
○ Complete writing assignments
○ Conduct Internet research
○ Conduct virtual experiments or simulations
○ Create slide shows, videos or web pages for an assignment
○ Get help from an online tutor
○ Listen to a podcast for a class
○ Play educational games
○ Post to blogs or wikis
○ Record or video a teacher lecture or lab
○ Take tests online
○ Turn in papers for plagiarism check (such as: TurnItIn)
○ Upload assignments and homework to school portal
○ Use mobile applications to keep organized
○ Use my social networking site (such as Facebook) to collaborate with classmates on a project
○ Use online textbooks or other online curriculum
○ Use Twitter to communicate or to follow others
○ Other

7.) In the future, some schools may be required to implement online tests in place of paper-based standardized tests. How comfortable are you with the idea of having your academic achievement measured through an online test?
○ Very comfortable
○ Somewhat comfortable
○ No opinion
○ Somewhat uncomfortable

○   Very uncomfortable

8.) Besides not having enough time in your school day, what are the major obstacles to using technology in your school? (check all that apply)
○   Cannot access Facebook or other social networking sites
○   Cannot communicate with classmates using email, text or IM
○   Cannot use my own cell phone, smartphone, tablet computer or MP3 player
○   Cannot use my own laptop in school
○   My assignments don't require using technology
○   Not enough computers or they don't often work
○   Teachers don't know how to use the technology
○   Teachers limit our technology use
○   The Internet is too slow
○   There are too many rules against using technology at my school
○   Websites that I need are blocked (through school filters or firewalls)
○   Not a big deal. I rarely use the technology at my school
○   Other

9.) How could your school make it easier for you to use technology for schoolwork? (Check all that apply)
○   Allow greater access to websites I need
○   Let me access the school network from home or school
○   Let me recharge my devices at school
○   Let me use my own cell phone, tablet computer, smartphone or MP3 player
○   Let me use my own laptop or netbook during the school day
○   Provide 24/7 access to my teachers
○   Provide access to an online tutor
○   Provide access to social networking sites (such as Facebook)
○   Provide class work, assignments and resources online
○   Provide me a laptop or other mobile device that I can use at school
○   Provide me with unlimited Internet or Wi-Fi access throughout the school
○   Provide tools for me to communicate with my classmates
○   Provide tools for me to communicate with my teacher(s)
○   Provide tools for me to organize my schoolwork
○   Provide tools to help me collaborate with my classmates on schoolwork
○   Nothing - I like the way things are
○   Other

10.) How much do you agree with this statement: My school is doing a good job of using technology to enhance my learning. (select one)
○   Strongly agree
○   Agree

○   Disagree
○   Strongly disagree
○   No opinion
○   I don't know

11.) Many schools are exploring how to leverage mobile devices such as smartphones and tablet computers (iPads) to improve student achievement. How would you like to use a mobile device to help you with your schoolwork? (check all that apply)

○   Access online textbooks
○   Access social networking sites (such as Facebook)
○   Access the school network from home or school
○   Check grades
○   Communicate with classmates and teachers
○   Create or share documents, videos or podcasts
○   Learn about school activities
○   Look up information on the Internet
○   Organize my schoolwork assignments
○   Play educational games
○   Receive reminders and alerts about upcoming tests or assignment due dates
○   Record or video lectures or labs so that I can review them later
○   Take notes for class
○   Upload or download information from my teachers' website and/or the school's portal
○   Use mobile apps to make me more productive
○   Use the calendar
○   Work on projects with my classmates
○   Write papers or do homework assignments
○   Other

12.) What has been your experience with taking an online class where the instruction and content was delivered primarily over the Internet?

○   I am in an online school where all of my classes are delivered over the Internet
○   I have taken at least one self-study online class for school credit in addition to taking traditional classes in school
○   I have taken at least one teacher-led online class for school credit in addition to taking traditional classes in school
○   I have taken at least one online class on my own to pursue my own interests
○   I have not taken an online class but would be interested in doing so
○   I am not interested in taking an online class

13.) What would be the most significant benefits to you of taking an online class? (check all that apply)
- Class could better fit my schedule
- I could earn college credit
- I would be in control of my learning
- I would be more comfortable asking my teacher questions
- I would be more motivated to learn
- I would feel more connected to school
- I would get extra help in a subject that is hard for me
- I would graduate early
- I would have a greater sense of independence
- I would receive more attention from my teacher(s)
- It would be easier for me to succeed
- It would be easier to review class materials as many times as I want
- It would be easier to share ideas with my classmates
- My technology skills would improve
- Take a class not offered at my school
- To work at my own pace
- I am not interested in taking an online class
- I do not know
- Other

14.) In what subject would you be most interested in taking an online class?
- English/Language Arts
- Science
- Math
- Statistics
- History/Social Studies
- Computer Science
- Art History
- Health
- Foreign Language
- Career training
- I am not interested in taking an online class
- Other

15.) Some schools now require students to take at least one online class as part of their education. Do you agree or disagree with this policy?
- Strongly agree
- Agree
- Disagree
- Strongly disagree

○ No opinion

16.) Thinking about one of your math or science classes this year, which of these best describes that class?

○ Traditional class with teacher lectures and textbook assignments
○ Traditional class with teacher lectures, textbook assignments and group projects and/or labs
○ Traditional class where teacher uses technology tools such as interactive white boards, powerpoint presentations and projectors to support instruction
○ Traditional class where teacher and students regularly use digital content, virtual labs, simulations and animations within instruction
○ Traditional class where students direct their own learning through the use of laptops, mobile devices and social media tools
○ Blended class where some class periods are spent in a traditional format and others involve self-paced online instruction
○ Online class in a special lab at school with Internet-based lessons and onsite teacher
○ Online class taken in a special lab at school with Internet-based lessons and remote online teacher
○ Online class taken at home with Internet-based lessons and an online teacher
○ Online class taken at home with self-study Internet-based lessons
○ I am not taking a math or science class this year
○ Other

17.) Now, imagine your ultimate math classroom. Which of these would be most effective in helping you be more successful in that class?

○ Being able to text or email my teacher with my questions
○ Collaborating with my classmates on problem solving tasks
○ Having access to an online math tutor
○ Learning from a teacher who I feel a connection with
○ Learning from a teacher who is excited about math
○ Learning math by solving real-world problems
○ Playing online or computer based math games
○ Practicing problems from my textbook
○ Taking an online math class
○ Understanding the context of math through a virtual reality environment
○ Using a class blog or wiki to share ideas with my classmates
○ Using a mobile device to video math lessons to review later
○ Using an online textbook that I can access through a mobile device
○ Using animations or simulations to help me visualize difficult math concepts
○ Using real time data to understand the context for math
○ None of the above
○ Other

18.) Internationally there is tremendous interest in having more students pursue careers in science, technology, math or engineering. Right now, are you interested in a job or career in any of these fields?
○ No, those subjects are too hard for me
○ No, my strengths are in other areas

○ No, my parents say that other jobs are better
○ No, those subjects are not interesting to me
○ Maybe, I would like to know more about those jobs or careers
○ Yes, I am somewhat interested in a job or career in those fields
○ Yes, I am very interested in a job or career in those fields

19.) Our national leaders would also like to have more students pursue careers in teaching. Right now, are you interested in a job or career in teaching or a related education field?
○ No, my strengths are in other areas
○ No, my parents say that other jobs are better
○ No, teaching does not interest me
○ Maybe, I would like to know more about the different kinds of jobs or careers in teaching
○ Yes, I am somewhat interested in a job or career in teaching
○ Yes, I am very interested in a job or career in teaching

20.) Which of the following would help increase your interest in a career you might be thinking about? (check all that apply)
○ Have a program at school about future careers
○ Have a summer or part-time job or internship in my field of interest
○ Learn about careers through "Day in the Life" podcasts or videos
○ Learn about the job through volunteer opportunities
○ Learn from teachers who have worked in the professional field I'm interested in
○ Let career professionals teach lessons at school
○ Participate in career exploration programs after school
○ Participate in career exploration programs during the summer
○ Participate in competitions that allow me to assess my skills against other students
○ Participate in virtual tours of companies
○ Provide access to websites with information about careers
○ Take a career technical education class at school to learn about careers
○ Take a field trip to visit companies and meet successful role models
○ Take a self-assessment test to identify my career interests or strengths
○ Use a mobile application to explore careers
○ Use the same tools in my classroom that professionals use at work
○ Work with mentors who can help me with my college and career planning

○ Other

21.) Which of these social based media tools or applications do you use outside of school? (check all that apply)

○ Communicate with others through discussion boards, social networking sites, chat or online communities
○ Communicate with others through email, IM or text message

○ Contribute to a wiki
○ Create videos to post and share with others
○ Participate in 3D virtual reality worlds (such as: Second Life, Whyville)
○ Participate in online games
○ Update my social networking profile (such as facebook)
○ Upload or download videos, podcasts or photos to/from the Internet
○ Use web tools for writing collaboratively with others (such as: GOOGLE docs, writeboard or letterpop)
○ Use web tools to create a list of resources I want to share or remember (such as: delicious, digg, diigo,reddit)
○ Use web tools to notify me about things I'm interested in (such as news or magazine articles, or changes to websites)
○ Write or contribute to a blog (my own or someone else's)
○ None of the above
○ Other

22.) How do you define success with your schoolwork?

○ Achieving your personal learning goals
○ Being looked up to by your classmates
○ Class rank
○ Development of critical thinking and problem solving skills
○ Getting a good job after graduation
○ Getting into a good college
○ Getting special privileges
○ Good grades
○ Knowing more than others about a subject that interests you
○ Learning more than you thought you would
○ Your parents or family are proud of you
○ School honors or recognitions
○ Self - satisfaction of working hard and trying your best
○ Other

23.) How much do you agree with this statement: I prefer to do the majority of my reading for my schoolwork online rather than reading from a printed page of text.
○ Strongly agree
○ Agree
○ Disagree
○ Strongly disagree
○ No opinion
○ Not sure

24.) Thinking about reading to support homework and class assignments, which of these statements are true for you?
○ I read longer when I am reading a printed book or article
○ I prefer to read short articles online
○ It is better for me to print long or complex articles to read
○ I would rather study for a test using printed materials
○ I remember more when I read from a printed text
○ I feel like I am making a contribution to protecting the environment when I read online
○ Reading online is a better fit for my learning style
○ Reading a printed text is a better fit for my learning style
○ Too much online reading creates eyestrain for me
○ I get easily distracted when reading an online article
○ I like that I can easily search terms or words when I am reading an online article
○ I prefer to use a printed text because it is easier to make notes on the page
○ I think you need to learn different skills to effectively comprehend information from an online article

25.) In the past year, which of these things have you done on your own (not teacher directed) to improve your education? (check all that apply)
○ Created my own video or podcast to help me share my knowledge with others
○ Found a tutor online
○ Found information online that helped me better understand a topic we were studying in class
○ Found experts online who could answer my questions
○ Listened to a podcast about a topic I was interested in
○ Posted to a blog or wiki
○ Sought help from other students through my social networking site
○ Took a self-paced tutorial on a subject
○ Took an online class
○ Took an online test or assessment
○ Tutored other students who needed help

- ○ Used mobile applications to help with my self-organization
- ○ Used online writing tools to improve my own writing
- ○ Used Twitter to send a tweet about something I was studying
- ○ Watched a video to learn something or to help me with my homework
- ○ None of the above
- ○ Other

26.) Which of these statements do you agree with? (check all that apply)
- ○ Homework helps me practice what I have learned
- ○ I am having problems with my schoolwork
- ○ I am interested in what I'm learning in school

- ○ I am motivated to do well in school because I like school
- ○ I am motivated to do well in school because I want to please my teachers or parents
- ○ I am succeeding academically
- ○ I am worried about my future
- ○ I believe my school cares about me as a person
- ○ I don't like school
- ○ I feel I am prepared to succeed in school
- ○ I feel safe at school
- ○ I know how to be safe and protect myself when I am online
- ○ I know what subjects I need to do more studying in to be successful
- ○ I wish my classes were more interesting
- ○ My parents are very involved in my education
- ○ My test scores don't match what I know
- ○ Teachers or my parents expect me to do well in school
- ○ There is at least one adult at school that I can talk to about school or personal problems

27.) Which of these have been problems for kids at your school? (Choose any that apply)
- ○ Approached by strangers online
- ○ Being harassed online with hurtful texts or photos
- ○ Seeing websites with inappropriate content
- ○ Sharing suggestive texts or photos
- ○ Sharing too much personal information online
- ○ Spending too much time online
- ○ Strangers asking to meet in person
- ○ Students' mobile devices have been stolen
- ○ Students using mobile devices to cheat
- ○ Students using others' ideas as their own (plagiarism)
- ○ None of the above

○ Other

28.) Imagine you are designing the ultimate school. Which of these tools would have the greatest positive impact on your learning? (check all that apply)
○ Ability to access the Internet anywhere at school
○ Ability to use my own mobile devices
○ Adaptive learning software which adjusts levels of difficulty and content to address your needs
○ Chat rooms to discuss topics with students while in class
○ Collaboration tools (such as: blogs, social networking sites, wikis, bookmarking)
○ Computer for every student to use at school (such as: laptop, netbook)
○ Digital content (such as: databases, electronic books, animations, videos etc)
○ Digital media creation tools (video, audio)
○ Digital reader (such as: Kindle, Nook)
○ Electronic portfolios for students
○ Games or virtual simulations
○ Handheld student response systems
○ High speed color printers
○ Instant messaging or text messaging tools
○ Interactive whiteboards (such as: Smartboard, Polyvision)
○ Learning management systems (such as: Blackboard, Moodle, Angel)
○ Mobile devices such as smartphones and MP3 players
○ Online classes
○ Online tests and assessments
○ Online textbooks
○ Online tutors
○ School website or portal
○ Tablet computer (such as iPad)
○ Tools to help me organize my work (such as: organize my assignments, take notes, organize my ideas)
○ Video conferences and webinars
○ Virtual or online whiteboard
○ Virtual reality games or environments
○ Other

Open Ended:

29.) Pretend that you are "Principal for the Day" at your school. Your #1 goal as Principal is to make sure every student feels that they are an important member of your school community and that they are well prepared for going to college or getting a good job. How would you use technology tools including social media to

accomplish this goal? What new technology would your school need? How would students and teachers use these new tools?
Remember - you are in charge now and your classmates are counting on you!

30.) The skills students are learning through experiences with the arts, in all of its different forms, are in high demand by employers – creative thinking, self-discipline, collaboration and innovation. How can technology/social media tools and applications help you develop your creativity skills? What kinds of artistic content, products or work are you already creating or producing (in school and out of school) that would not be possible without technology tools? How would you like to use more technology to explore different kinds of artistic experiences (music, dance, visual art, writing, film etc.)? What types of technology should be available in your school to help you develop those important creativity skills?
Be creative – share your ideas with us!