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21st century teaching, learning, and one-to-one computing

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21st century teaching, learning, and one-to-one computing

Abstract

The rapid dissemination of technology is changing teaching and learning in the twenty-first century. Use of technology integration and one-to-one computing can meet the diverse and evolving needs of twenty-first century students and enrich learning opportunities in the classroom. The purpose of this paper is to examine teaching and learning in the twenty-first century and how one-to-one computing can enrich learning environments.

The sources used were scholarly journal articles, a technical research report, a periodical and a chapter of a book. Effective technology integration and one-to-one computing can enrich teaching and learning for students' needs in the digital age. Current trends indicate one-to-one computing in classrooms motivates and engages students in higher-order cognitive tasks, connects academics to the world, strengthens teaching and contributes to change in schools.

21st CENTURY TEACHING, LEARNING, AND ONE-TO-ONE COMPUTING

A Graduate Review

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ABSTRACT

The rapid dissemination of technology is changing teaching and learning in the twenty-first century. Use of technology integration and one-to-one computing can meet the diverse and evolving needs of twenty-first century students and enrich learning opportunities in the classroom. The purpose of this paper is to examine teaching and learning in the twenty-first century and how one-to-one computing can enrich learning environments. The sources used were scholarly journal articles, a technical research report, a periodical and a chapter of a book. Effective technology integration and one-to-one computing can enrich teaching and learning for students' needs in the digital age. Current trends indicate one-to-one computing in classrooms motivates and engages students in higher-order cognitive tasks, connects academics to the world, strengthens teaching and contributes to change in schools.

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INTRODUCTION

First grade students will be retiring in the year 2066. Educators can only begin to imagine what the world may look like in the next 10 years let alone in the next 50, yet they are responsible for preparing their students for life in that world (Shaw, 2008). Students in the twenty-first century have different needs than students of the past. As Prensky (2001) states, “Our students have radically changed. Today’s students are no longer the people our educational system was designed to teach” (p.1).

Within the last century technology advances have changed the way people live, interact, and learn. The explosion of computing technology and interconnectedness has given students of all ages the ability to communicate globally and be involved with international social issues. This has created the educational need for students to be able to communicate and create change locally, nationally, and now globally.

Formal education and the 21st century students it serves are changing. Twenty- first century students expect an engaging global educational environment when they walk into the classroom, one that mirrors their world outside of school. The world of easy access to media and entertainment influences how students prefer to learn and interact within their classroom walls. They expect an engaging educational environment when they walk into the classroom with internet access. They want the opportunity to learn with technology as it is an integral part of their daily lives. According to Prensky (2005) educators must find ways to engage students if formal education is to have relevance in this century.

Educators need to provide a variety of opportunities for teaching and learning with technology to meet the diverse and evolving needs of 21st century students. One-to-one computing is one way to enrich teaching and learning in the 21st century. One-to-one

computing means that every student and teacher has individual immediate access to a networked computer anytime or anywhere and access to personal computing devices is readily available throughout the school day and often at home. This is usually achieved using laptop computers. An educational one-to-one computing environment can potentially transform teaching and learning.

Understanding strategies for one-to-one computing that can impact teaching and learning targeted at preparing students for a global society is important. Research indicates technology use by way of one-to-one computing can make important contributions to the learning environment in schools when used to support traditional classroom settings, to open the classroom to the outside world and to enhance student achievement (Judson, 2006). In addition to the emerging evidence of the positive impact of technology integration and one-to-one learning on student academic achievement, there is significant evidence of the impact that it has on the teaching and learning process (Apple, Inc. 2005, Muir, 2004). One-to-one computing can provide 21st century students engaging and meaningful learning experiences preparing them for the future. In education it is essential to understand that, “Our ability to learn what we need for tomorrow is more important than what we know today” (Siemens, 2004, p. 33).

The purpose of this paper is to examine 21st century teaching and learning and influences of one-to-one computing on teachers, students and classroom learning opportunities. It will examine the evolution of 21st century students’ learning needs, transformation of teaching instructional practices and the literature that explains how one-to-one computing has empowered teachers and students in a technology integrated educational

environment. It will also explore how professional development can enhance technology integration.

Additionally, effective integration of one-to-one computing can create change and enrich learning opportunities in a classroom where teachers and students are empowered in teaching and learning. The analysis of this topic is important because the rapid dissemination of technology into daily lives has changed how people communicate, live, and learn and consequently the process, tools, and needs for teaching and learning.

Review questions addressed in this review of literature include:

1. Do students learn differently today?
2. How can teachers transform their instructional practices for 21st century students?
3. Can one-to-one computing enrich 21st century teaching and learning?

METHODOLOGY

Results of this review will add to the growing body of knowledge and topics surrounding evolving student learning needs, transforming teaching and learning opportunities and one-to-one computing in the 21st century.

The reviewer identified sources through the Wilson Web database, Education Resources Information Center collection (ERIC) and the JSTOR archive through the University of Northern Iowa Panther Prowler via the Rod Library. Other resources were identified from Google Scholar Internet searches and from bibliography lists from relevant works. Keywords and descriptors used in searches include: technology supported pedagogy, one-to-one computing, 21st century students, technology integration, technology and connectivism.

The reviewer used the following criteria for evaluating the information cited in this paper.

- Is the information from a scholarly publication?

The reviewer found sources through on-line reference databases with published journal articles and searched scholarly journal archives to find material written by scholars and researchers within the instructional technology field. Articles used were accessed from national, peer-reviewed and refereed sources.

- Does the information have a recent publication date?

Sources used had to have publication dates between the years of 2001 to 2008 with the exceptions of an 1995 article reporting on initial findings of the project, Apple Classrooms for Tomorrow (ACOT) and Seymour Papert's second edition of his book, *Mindstorms: Children Computer and Powerful Ideas* published in 1993.

- Is there a variety of authors?

The reviewer used scholarly journal articles, periodicals, a technical research report, electronic media including an on-line forum, a private organization report and a corporate report to ensure a variety of authors' work and multiple contributors.

- Has the research impacted teaching and learning with technology?

Sources were selected based on the significance in the field of teaching and learning with technology. Resources from the predominant researchers in the educational technology field indicate emergent educational implications for teaching and learning in the 21st century. For example, influential articles written by Marc Prensky have changed views of the importance of teaching and learning with technology. Also, articles about The Apple Classrooms of Tomorrow (ACOT) and Maine Learning with Laptop Studies were valuable sources because they provided historic foundations and findings of initial one-to-one initiatives and contribute to the knowledge base for current and future initiatives in educational technology and one-to-one computing.

ANALYSIS AND DISCUSSION

Twenty-First Century Students

Today's students represent the first generation to grow up with their lives immersed in today's digital technology. They are different from students of the past because of the sudden dissemination of digital technology into their lives (Prensky, 2001).

Students in the 21st century, digital natives (Prensky) or millennials (Oblinger, 2003), have never known life without the Internet. They have been surrounded by computers, video games, cellular phones, instant messaging and a magnitude of other digital devices the majority of their lives. Shaw (2008) suggests they are digital learners taking the world of mobile computing devices everywhere, plus having access to computers, TVs, and gaming systems at home. Twenty-first century students are accustomed to being connected at all times through instantaneous communication and quick access to information. They are comfortable with multi-tasking while listening to music, texting, and chatting; often from the same digital device. They do not view using these digital tools as technology but as an essential and assumed part of their lives (Prensky, 2001; Oblinger, 2003).

Furthermore, students expect to use technology as a learning tool. "Whether the computers are desktops, laptops or tablets...in a lab or on a wireless cart...students want 1-to-1 access and see computers as learning tools, as essential as a pencil or calculator" (Wambach, 2006, p.58). Prensky (2005) offers that in the past, students did not expect to be constantly engaged. Twenty-first century students' predecessors had lives less rich in entertaining technological devices. They did not have the vast communication and media technologies. They did not have the creative, interactive, and stimulating variety of technologies to learn from that twenty-first century students do today.

Unsurprisingly, twenty-first century students are discontent with the lack of technology being used in schools today. Concurrently, schools have the potential to create meaningful learning that is rich in engagement through the use of technology. McHale (2005) proposes that wireless technology and new gadgets such as devices such as iPods, portable video games, and cell phones vie for students' time are creating an increasingly mobile world. Prensky (2007) suggests twenty-first century students' daily use and mastery of these technologies have lead them to desire these technologies to be used as part of their education.

Do Students Learn Differently Today?

Seimens (2008) reports that during the last twenty years the rapid dissemination of technology into people's daily lives has considerably changed the way people communicate live, and learn. He indicates that the field of education, however, has been slow to accommodate this change. The world of instant multimedia information and interactive technological devices has also contributed not only to how students learn but to the way they desire to learn.

People change physically and physiologically as they experience life which creates evolving learning needs. Experiences using new technology tools encourage change in how people work, function and learn (Seimern, 2008). Prensky (2001) suggests that today's students think and process differently than students in the past as the result of the vast interaction of a ubiquitous computing environment. People who grew up with the computer at an early age think differently. Students today seem to have parallel cognitive structures and hypertext minds. The current culture and environment has affected thought processes and stimulation which has created changes in brain structure as it is constantly reorganized throughout life The digital generation has developed multitasking abilities and thinking

patterns beyond that of its predecessors due to training of the brain to multitask through the use of experiences with technology (McHale, 2005; Prensky, 2001).

Students in the twenty-first century appreciate technology-rich learning environments and Prensky (2001) reports they prefer to parallel process and multitask when learning. He also believes they function best when they are networked to people and resources. Fulton (2003) agrees that new views of cognition support learning as interaction with content and experiences with the world. Consequently, instructional designers seeking to facilitate learning of twenty-first century skills for today's students create non-linear stimulating learning environments where learning is manipulated, transferred and created with technology is significant. Additionally, an important part of the change for instructional designers is about knowing where to look for information rather than rote memorization of facts (Seimens, 2004).

Students today can benefit from being in a social and collaborative environment with the educational ideas involving individual knowledge and learning as a process of continual networking while learning from human and non-human modes to know more in the digital age (Siemens, 2004). McHale (2005) reported that digital devices will become increasingly capable of delivering educational content for educational purposes as the technology evolves.

Technology use in classrooms can promote creation of networks and interconnection for student learning and, "With the correct blend of teaching methodology and technology as a learning tool, students can be stimulated to learn in new and exciting ways" (Alexiou-Ray, 2007, p.1). Fulton (2003) when discussing the need to redesign schools for 21st century learners offered that media in multiple forms can address differentiation in learning styles. She also believes that interactivity's motivating aspects can support student interest and

effort and that the impact of technology will play a major role in the redesign of schools and the transformation of teaching.

Transforming Teaching Instructional Practices

According to Prensky (2001), teachers assume learners are all the same therefore the same instructional methods that have always worked for their previous students will work for their current students. However, today's digital technologies have affected thinking and the way people process information that has also had an effect on learning.

Teachers draw from their individual current pedagogical stances when making instructional decisions in the classroom whether it is math, reading or integrating technology into teaching and learning. Prior knowledge, pedagogical stance and personal philosophy are crucial factors in determining how a teacher will utilize technology into teaching and learning. These factors are the basis in which the knowledge base drawn upon when learning how to teach with technology and ultimately determines what happens in the classroom. Teachers possess tremendous authority to implement adoptions and adhere to classroom reforms with fidelity (Judson, 2006).

In order to establish new learning environments there are differences that need to be made in teachings paradigm to teach today's kids. The National Educational Technology Standards for Students Project (NETS-S) suggests that traditional learning environments move from (a) teacher-centered to student-centered instruction, (b) single sense to multisensory stimulation, (c) single path progression to multipath progression, (d) single media to multimedia, and (e) information delivery to information exchange. Additionally, they suggest replacing (a) factual knowledge-based, isolated, and passive learning with critical thinking, and collaborative inquiry-based work, (b) reactive response to proactive

planned action, and (c) artificial isolated contexts to authentic real-world contexts to provide students with the necessary skills for learning today (NETS Project & Brooks-Young, 2007). In order for teachers to change teaching methods and instructional strategies they must acknowledge their beliefs to begin questioning their practice or considering change. It is also important that teachers are life-long learners and continue to expand their knowledge base for teaching with technology by transforming their pedagogy to include technology use (Hughes, 2005).

Although digital technology may not change what is taught it has potential to change how it is taught (Healy, 1998). Strategies, materials, and technology utilization that fit the learning styles of today's learners must be incorporated in teaching and learning as part of transformation of teaching. The opportunities that technology provides can make a difference in the teaching and learning paradigm. Transforming teaching and classrooms to meet 21st century student needs does not have to be all or nothing. Technology can lead to major changes in teaching practices. Eventually, as teachers become comfortable and increasingly confident utilizing technology in their classroom, they can focus more on content and student learning and less on technology training (Warschauer; 2006, Cramer, 2007; Nussbaum-Beach, 2008).

It is essential that certain conditions are in place for teacher transformation (e.g., See Appendix B for *Essential Conditions to Make It Happen.*). According to The International Society for Technology in Education (ISTE) *National Technology Standards for Teachers* (NETS-T) (2008), teachers are responsible for (a) facilitating and inspiring student learning and creativity, (b) designing and developing digital age learning experiences and assessments, (c) modeling digital age work and learning, (d) promoting and displaying digital

age citizenship, and (e) responsibility and engaging in professional development and leadership demonstrating effective use of digital tools and resources. These responsibilities create the need for new learning and professional development for educators.

Importance of Professional Development

Professional development is an important tool for transforming teaching that effectively integrates technology to improve student learning in the classroom. The state of Iowa Department of Education (2005a) reports that there is overwhelming evidence that well-designed staff development, integrated with school improvement practices can increase student learning. As a result, they created *The Iowa Professional Development Model* (2005a) as a road map to planning, providing, and evaluating professional development for educators in Iowa with the intention of increasing student achievement. (See Appendix A for *Iowa's Cycle of Professional Development Model*.) A key element to the plan is student need and student learning drives the basis for professional development with increased students achievement identified as its outcome. This is articulated in the foundations of the plan:

- Foundation 1 — School improvement and staff development decisions are driven by student learning needs.
- Foundation 2 – When increased student learning is the goal of professional development, the efforts of collectivities of people have the best chance for success.
- Foundation 3 – The collection and analysis of data guide the entire professional development process.
- Foundation 4 – Specific student learning goals provide the direction for selecting professional development content.

- Foundation 5 – Content selected for professional development is supported by research.
- Foundation 6 -- The professional development process is cyclical.

With its focus on the students and student needs this model provides a framework for effective professional development that can transform teaching in the 21st century. Rodriguez (2000) identifies traditional lecture, isolated workshops and non-engaging instructional methods, each of which are highly ineffective with students in a classroom, as an ineffective means for teaching teachers how to meaningfully integrate technology as well.

Rodrigues and Knuth (2000) offer that professional development for technology use should contain essential components. These components include (a) relevance to student learning, (b) technology use, (c) curriculum-specific applications, (d) collegial learning, (e) an evaluative process, and (f) sufficient time. Additionally, teachers need continual support provided in a comprehensive professional development model to maximize learning with technology (Fox, 2007).

In Iowa, training and learning opportunities; collaboration and implementation; and data collection are ongoing components of a comprehensive professional development plan. Additionally, professional development goals should be directly linked to understanding implications of technology use and improving student learning. Sessions should center on lesson planning, modeling of new teaching strategies and allowing for teacher opportunities for practice applying new skills and ideas. Teachers should understand specific curriculum applications and the need for technology as a learning tool (Iowa Department of Education 2005a).

Modeling, coaching, professional collaboration, and practice integrating technology into lessons with colleagues during the school day is essential. Observation of peers while teaching with technology is also essential. It provides feedback necessary for growth for attaining pedagogical and technological competencies useful for effectively integrating technology into teaching and learning. Having access to a personal computer contributes to considerable professional development as well because individual professional development can occur when educators have one-to-one access to a personal computing device. Technology uses at school and at home help teachers develop confidence in their technological skills because they increase a teacher's comfort level with the technology. When teachers are comfortable using the equipment to for their own productivity, they can connect similar uses to supporting student learning (Rodriques & Knuth, 2000; Fox, 2007).

Teachers can also learn from their students' technology expertise. Nellen (2001) states that, "Too often, teachers believe that they have to be the expert, until they realize how helpful students in their classes become at facilitating the use of technology in the classroom" (p. 122). Additionally, Prensky (2007) suggests that technology advances are moving so fast that it is vital that teachers allow themselves to learn from their students. Teachers do not need to master all the new technologies, instead they should find ways to incorporate information and knowledge that their students gain outside of the classroom through digital means into the classroom. Teachers, however, must understand how and when technologies can be valuable to learning even if teachers do not understand how to specifically utilize the technology (Prensky, 2005). Students can be the best collaborators for teachers when looking for ways to meaningfully integrate technology into the classroom (Prensky, 2005). "A very important feature of work with computers is that the teacher and the learner can be engaged

in real intellectual collaboration” (Papert, 1993, p. 115). Likewise, the more teachers rely on their students; the less they need to know about the technology thus allowing for more time for learning about how to integrate the content with the technology (Nellen, 2001).

In addition, Warschauer (2006) states that an effective professional development plan should spend as much time on shared technology learning goals, curriculum and pedagogy as it should on teacher technological skills and understanding of computing network configurations. Furthermore, The Iowa Department of Education (2005) reports that evidence of increased student learning indicate successful school improvement and professional development programs are well worth the effort.

Importance of Effectively Integrating Technology

A decade ago, Healy (1998) suggested constructively integrating technology was lacking substantive research and guidelines. The historical results of effective technology integration attempts failed with the technology that was available. Additionally, she reported computer learning for children ten years ago was less brain building than simple activities such as playing board games. However, today’s digital technologies provide a new world of learning opportunities for 21st century students.

When integrating technology Healy (1998) advises that just because students can perform tasks that are sophisticated with technology, it does not mean they are learning anything important. Thus, important factors educators must consider when using technology because they affect of the quality of student learning are developmental appropriateness, links to curriculum, and the educational value of technological applications. Furthermore, the use of edutainment, software with bells and whistles and few links to learning objectives, does not have educational value and is difficult to integrate into a rich curriculum.

More currently, schools have more access to use multiple technologies to enhance learning than ever before. However, Cuban (2001) suggests that classroom use of technology is still uneven, infrequent, and at entry level usage. Nellen (2001) advised that simply putting computers in every classroom is not enough to ensure the equipment will support classroom instruction. In order for technology to enhance student learning, “Teachers need to change their methods of teaching to hold students’ interest and guide them in the right direction using the technology” (Owen, Farsall, Knezek & Christensen, 2006, p. 14). Effective technology integration requires learning experiences aligned with student learning goals and technology used for engaged learning projects and student centered learning (Rodriguez, 2000).

Continual technology integration into teaching and learning is important to meet the needs of today’s students. In addition, ISTE supports teacher-facilitated and student-centered technology integration by outlining standards and expectations for teaching and learning in education (Judson, 2006). Classrooms in the 21st century need to be collaborative spaces where student-centered knowledge development and risk taking are accepted as the norm and where ecology of learning develops and thrives (Nussbaum-Beach, 2008).

“As knowledge continues to grow and evolve, access to what is needed is more important than what the learner currently possesses” (Siemens, 2004, p. 34). Educators can innovatively use digital technology to teach subject matter skills and concepts in an integrated manner. When students have access to technology they have what is needed to connect them with resources and learning opportunities inside and outside the classroom.

Presently, many applications of students' current daily use of digital tools outside the classroom demonstrate higher-order thinking skill application in their digital lives. Prensky (2005) states,

“They're [students] busy adopting new systems for communicating (instant messaging), sharing (blogs), buying and selling (eBay), creating (Flash), meeting (3D worlds), collecting (downloads), coordinating (wikis), evaluating (reputation systems) searching (Google), reporting (camera phones), socializing (chat rooms), and even learning (Web surfing)” (p.2).

In addition, he suggests using instant messaging, Wikipedia, podcasting, camera phones and MP3 players have instructional implications for integration within subject matter content. However, often times these tools are banned from being used as educational tools. Rather than forbid the use of these learning tools, Prensky argues that it is an educator's job to teach students to act appropriately and the responsible use of these tools. Alexiou-Ray (2007) concurs that, “Technology integration in schools today should help teachers and students focus on real-world applications of technical literacy and critical thinking skills” (p.2). In addition, integrating technology allows teachers can have the best of both worlds. They can build skills while using technology to push students into higher levels of learning. Teachers can deliver interactive lessons over a cell phone, website or iPod as the use of technology integration can open up new worlds of learning (Prensky, 2005; Nussbaum-Beach, 2008).

Creating an engaging classroom environment through technology integration supports learning and is also a suggestion for educators from *The National Technology Standards for Students and The National Technology Standards for Teachers* (ISTE, 2007b). The current *National Technology Standards for Students* (ISTE, 2007a) serve as the foundation for the

No Child Left Behind Act requirement that all students demonstrate technological literacy by grade 8 (“Meeting No Child Left Behind Technology Literacy Requirements”, 2006). These standards for technology literate students include: (a) creativity and innovation, (b) communication and collaboration, (c) research and information fluency, (d) critical thinking problem solving and decision making, (e) digital citizenship and (f) technology operations and concepts. Effectively integrating technology in to meaningful learning experiences allows for students to engage in activities promoting technology literacy.

It is evident there are barriers and challenges to including technology for educational purposes. Environments rich with technology such as classrooms with one-to-one computing programs, where student have immediate, individual access to a computer, can eliminate the challenges of accessibility and allow for a reduced amount of complex issues for integrating technology into instruction (Warschauer, 2006, Cramer, 2007). Additionally, “Newer technology integration models, including in-class access to laptops...are responding to students’ changing educational needs. It is through this...that learning through technology integration can reach its fullest potential” (Alexiou-Ray, 2007, p. 3).

Can One-to-One Computing Enrich 21st Century Teaching and Learning?

“Just as pencils, papers and books were the predominant tools for learning and knowledge production during much of the last century, computers and the Internet are the tools for learning and knowledge production in the 21st century” (Warschauer, 2006, p. 37). Suitably, in 1985 educators Apple (1995) initiated a project to answer questions such as, “What happens to students and teachers when they have access to computers whenever they need it? How does a critical mass of technology affect the way teachers teach and students learn?” The company initiated the Apple Classrooms of Tomorrow (ACOT) project to

answer these questions.

In response to multiple questions surrounding how immediate, personal access to technology could affect teaching and learning, the ACOT experiment began in 1985 with one classroom in Oregon and a classroom in Minnesota. Each student and teacher was given two computers, one for home and one for school. This was before laptops were commonplace so they were given desktops.

By the end of the first year, students' attendance, behavior and attitudes towards learning improved. The research findings indicated improvements in writing, continued standardized test scores, and collaboration among students. After ten years, multiple sites, and work on a teacher professional development model during the positive pilot of the program, initial findings have made valuable contributions to the body of knowledge of how people use technology for teaching and learning today (Apple, 2005).

More currently, Maine became the first state to implement a one-to-one statewide laptop initiative in 2002 giving student access to laptop computers at school and for home. The governor of Maine, Governor Angus King, worked with Maine resident and education technology guru Seymour Papert as he proposed to use a fifty million dollar surplus to buy laptops for middle school students and teachers. During the summer of 2002, 1,800 seventh grade teachers attended training to learn about their new laptops and at the beginning of the school year they began distributing laptops to 17,000 seventh graders. The following fall, those same students grade then took their laptops to the eight grade and a new round of seventh graders received laptops. As of now, Maine has more than 39,000 wireless laptops deployed to their seventh and eighth grade students and teachers in every one of their 239 middle schools (Muir, 2006).

The use of laptops has had a major impact on the teaching and learning in Maine's middle school classrooms. Since ACOT and Maine's first statewide one-to-one initiative, students in all types of schools have gained much better access to instructional computers in classrooms and today, "Schools are moving towards one-to-one computing at radically different speeds" (Prensky, 2007, p.1) On average, Mitani (2007) reported 3.8 students share a single instructional computer and high-minority schools had a ratio of four students to a computer. In addition, there are also differences in each state's efforts for contributing to instructional computers even further through laptop initiatives.

Teaching with One-to-One Computing

Placing a computer into the hands of every student empowers students to learn and challenges teachers to rethink the way they teach (Owen et al., 2006). One-to-one computing environments have prospective advantages for enriching education in the classroom environments. Unfortunately, financial challenges are a reality to an initiative such as one-to-one for it involves mass quantities of technology equipment. However, "Schools and districts that can meet the financial challenge while focusing on broad education goals will find one-to-one computing an exciting and worthwhile adventure" (Warschauer, 2006, p. 38).

One-to-one computing environments in which teachers as well as students have immediate and individual access to a computing device empowers teachers and enhances professionalism. It also elevates teachers' commitment to classroom goals by being equipped with the tools of 21st century professionals. Teachers in one-to-one computing classrooms realize the new ways for students and begin to understand why traditional ways we expect youngsters to learn are unsuccessful (Wambach, 2006). One-to-one classroom environments require a different kind of teaching and change in classroom practice (Kenney, 2006). A

computer in each student's hands provides a personal, individual learning experience that can enhance education by creating a connection to the world.

Innovative teaching strategies and methods are manifested in one-to-one computing environments (Nellen, 2001) and the old teaching paradigm of *stand and deliver* are becoming obviously ineffective because students no longer rely solely on the teacher to supply information for learning (Owen, Farsall, Knezek, & Christensen, 2006). In a one-to-one computing environment the traditional role of teacher as the only knowledge bearer and whole class instruction is being replaced by guided and facilitated learning with constructivist principles. Using one-to-one computing as an instructional method allows students to explore, discover and construct their own knowledge through collaboration and peer-to-peer learning. (Owen et al., 2006). Teachers in one-to-one classrooms in Maine identified a shift in their roles as moving away from the role of "keeper of the knowledge" to one of "learner" within a "community of learners" (Fairman, 2004). These teachers shifted away from lecture to small-group collaboration, toward more engaged learning in the classroom (Muir, 2006) and the changing learning environment propositions teachers to learn more about the technology and creates a desire to stay abreast their skills along with the students. Teachers report learning a great deal along side their students in a one-to-one computing environment (Owen et al., 2006).

One-to-one access to computers also allows for individualized instructional time freeing the teacher from the mundane and linear aspect of the classroom. This provides an environment suitable for all learning abilities and styles and allocates time for instructional differentiation for meeting multiple students' needs simultaneously (Nellen, 2001). Teachers in Maine's one-to-one classrooms described an increased use of the inquiry approach to

learning providing a context for greater differentiation in the curriculum. Students could be engaged in the same learning task or individual students would be able to have the freedom to choose another activity or topic allowing work at different levels of depth. Teachers also reported being empowered by having greater freedom to pose questions and research topics of interest to the students (Fairman, 2004).

Computer-assisted environments can provide motivation and an extension of thoughts to the learning process. They can provide a place to explore ideas, research questions, test hypotheses, compose thoughts, come to conclusions and create a context that encourages intellectual curiosity (Metri Group, 2006). They also allow for authentic experiences where multimedia, creative writing, engagement and participation are increased. A report entitled *10 Years of Apple Classrooms of Tomorrow Research* states that one-to-one computing classrooms have become a model for interdisciplinary studies, team teaching and addressing individual learning styles (Apple, Inc., 1995).

According to the *Maine Learning with Laptops Study* (2004) technology offers opportunities for student-centered learning, motivation, and connections to the real world. They also indicate that data-driven assessments implemented systemically and tied to content standards enhance student achievement. Teachers can be empowered with multiple indicators for measuring success and individual student learning needs useful in guiding instructional decisions.

Likewise, in a one-to-one learning environment the teacher is provided with unique opportunities to measure problem solving, critical thinking, visual and information literacy, communication skills, teamwork and the quality of the students' multimedia products. The most commonly reported result of instruction with laptops has been increased student self-

esteem, motivation and participation in classroom activities (Fairman, 2004). Teaching in a one-to-one computing environment can provide a motivational context for twenty-first century learning. Bill Gates (Stengel & Grossman, 2007) stated that learning is about creating a context for motivation not about the technology. He offered that although technology plays a role in learning and many technologies such as the videotape and television were all slated to change education, it was not until the arrival of the Internet that education seemed to be impacted by technology.

Prensky (2007) presented the following:

Some have opined that earlier technologies that were touted with great fanfare for their potential to changing education, such as television, didn't change much at all. I submit that all these technologies-especially television- did change education radically. Just not in our schools (p.2).

With the use of technology as a teaching and learning tool, teachers have the ability to do more for our students and bring change for our schools with the help of technology (Nellen, 2001). Apple, Inc., (1995) a contributor to the first statewide one-to-one computing initiative in classrooms, found "...technology itself is a catalyst for change encouraging fundamentally different forms of interactions among students and between students and teachers, engaging students systematically in higher-order cognitive tasks and promoting teachers to questions old assumptions about instruction and learning" (p.15).

Teaching in one-to-one computing environments allows teachers to have immediate access to professional tools for enhancing their teaching. Teachers utilizing technology in one-to-one environments can effectively coordinate technology in their classrooms to enhance student learning.

Learning with One-to-One Computing

Classrooms are filled with students who want more from their education than traditional instructional practices and systems can deliver. Students clearly desire use of technology in their educational environment (Cramer, 2007, Alexiou-Ray, 2007). Students' out-of-school hours are spent in a multimedia, hyper-communicating, multimodal world and it is unfair for them to give that up as they walk through their classroom doors. Spending time learning with multimedia in schools creates higher levels of student engagement and as previously noted by Prensky (2005) engaged students spend more time on task and enjoy learning more (Warschauer, 2006).

Alexiou-Ray (2007) suggests that, "Students engage in skills of evaluating, analyzing and connecting when they are exposed to "technology-rich classrooms" (p.6). Moreover, technology skills and concepts that are pertinent to the real world are explored through the use of technology and students in a one-to-one computing environment learn to produce and interpret content and valuable skills needed for today's world. Additional learning encouraged by technology integration is inquiry-based learning that addresses the needs of today's student to seek answers and acquire problem solving skills (Warschauer, 2006).

Student learning has potential to be intensified in a one-to-one environment as learning with technology provides students with multiple opportunities to get at the same material, enables them to dig further and deeper into the content and types of projects they create. The products, not the technology, enable students to create authentic products and enjoy learning (Alexiou-Ray, 2007). Additionally, all students can benefit from one-to-one computing access and learning in a one-to-one computing environment. Warschauer (2006) states that, undoubtedly laptops are an important technology resource for students who do not

have computers, digital devices or Internet access at home.

One-to-one computing can enrich teaching and learning opportunities for 21st skills. More importantly, Solomon suggests that, “Students who do not have access to technology in the learning environment will not be prepared to meet the needs of a society driven by information retrieval, acquisition and sharing” (as cited in Alexiou-Ray, 2007, p.10).

CONCLUSIONS AND RECOMMENDATIONS

First grade students who will be learning in classrooms for the next ten years will not retire until 2066. They need educational experiences that will prepare them for living and learning in the twenty-first century. Furthermore, transforming teaching instructional practices and enriching learning opportunities with one-to-one computing can support meeting the need of today's students. This literature review indicates there is potential for enriching teaching and learning in the twenty-first century in one-to-one computing environments.

The following are the findings to the research questions addressed in this review of literature:

1. Do Students Learn Differently Today?

Twenty-first century students learn differently and prefer to learn in different ways than their predecessors. People's brains change physically and physiologically as a result of experience. Prensky (2007) suggests that experience with new technologies have lead students to think and process differently. In addition, he purposes that current culture and environment has affected thought processes and stimulation creating changes brain structure.

Technology impacts how people experience life and consequently, it affects the way one learns (Seimens, 2004). Today's students' experiences with technology have led them to become acclimated to using learning strategies including networking, multitasking, and preference to being engaged by multiple stimuli. They seek motivation and engagement at much higher levels today than in the past and are accustomed to being connected to rapid access to immediate information by the use of the Internet (Prensky, 2007). In addition, they seek connectedness to the world outside the classroom because they have the ability to

collaborate and be global learners through learning with technology (Shaw, 2008).

2. How Can Teachers Transform Their Instructional Practices for 21st Century Students?

There is a need for teaching transformation and change in instructional practices to meet the need of twenty-first century students. Previous instructional strategies that were used with previous students will not work with today's students because technology has affected the way people think and prefer to learn (Prensky, 2007).

In order for teachers to consider changing their practices, teachers must bring their instructional practices and beliefs into question (Hughes, 2005). When learning about technology integration, teachers draw upon their current practice and pedagogical stance. Identifying one's own philosophy about technology and its use in the classroom is crucial because it serves as a knowledge base for including technology into teaching and transforming one's own pedagogy (Judson, 2006).

Technology must be incorporated into teaching and learning for transformation (Healy, 1998). In addition to understanding one's need for change, the National Educational Technology Standards for Teachers (NETS-T) contribute to transforming teaching practices. According to ISTE (2007) teachers are responsible for (a) inspiring and facilitating learning and creativity, (b) creating assessments and experiences for digital age learning, and (c) modeling and promoting digital age citizenship, work and responsibility. Furthermore, teachers also have the responsibility to engage in professional development for the utilization of digital tools and resources.

Considerable change can be made through the using professional development models. The Iowa Department of Education (2005) created a professional development model incorporating continual training and learning opportunities, collaboration, implementation

and data analysis driven by student learning needs. Teaching transformation for Iowa educators and evidence of increased student learning were contributed to by use of this cyclical professional development model).

Teachers can learn and benefit from their students' technology expertise as well. Prensky (2007) suggests teachers allow themselves to learn for their students. He advises teachers to not get caught up in trying to learn all of the new technologies but to understand how and when technologies can be valuable to learning. He also urges teachers to utilize students when integrating technology into curriculum content. Moreover, effective technology integration requires learning experiences aligned with student learning goals and technology in order to create engaged learning with technology (Rodriguez, 2000).

3. Can One-To-One Computing Enrich 21st Century Teaching and Learning?

Educational processes no longer rely on the traditional teaching paradigm of *stand and deliver*. The instructional process can be impacted by one-to-one computing causing classrooms change from teacher centered to student centered, whole class instruction to small group and independence, and from passive to engaged student learning (Muir, Knezek, & Christensen, 2004).

Having one-to-one computing environments with immediate access to information and computer access is a motivating instructional tool that personalizes the learning experience for the student. One-to-one computing provides a motivating learning context for multiple learning styles and abilities. Immediate access to networked computers allows students to be engaged in authentic learning experiences with the power of today's technologies. Standards-based learning activities become cooperative higher order thinking tasks for students within differentiated experiences. According to Apple (1995) ACOT

findings, engagement is one of the most relevant factors attributed to student achievement. Data linking student achievement to one-to-one computing is just beginning to generate however; the most frequently reported outcome is an increase in student engagement.

Recommendations

Learning opportunities abound with one-to-one computing in the classroom but not without analyzing past successful and unsuccessful implementations by applying what is known about how we learn best. Deployment of laptops must be first given to the teachers so they can learn with them through strong professional development, support and leadership. The following are the reviewer's recommendations for effectively responding to the learning needs of the 21st century student facilitated by the use of one-to one computing:

1. Future research needs to be conducted on long-term one-to-one computing initiatives in relation to student learning and achievement gains. Studies of twenty-first century students brain-based learning needs should be conducted indicating how one-to-one computing environments can foster learning environments and support the needs of our evolving technological society.
2. Research is needed on how current pedagogy and teaching philosophy affects willingness and/or potential barriers for facilitation of technology employing a technology infused curriculum in a classroom. Research and development of a compilation of research based effective lessons and units for utilization as a framework for beginning technology integration could have potential benefits as well.
3. Research on how one-to-one computing environments can support varied instructional strategies reaching multiple intelligences and differentiated

learning should be explored as it can be used as a teacher's tool. Growing numbers of students in classrooms and less individual time for each student in the classroom has created a need for maximizing instructional time.

4. One-to-one computing and new technology tools have a variety of implications for the educational process. The reviewer recommends relevant lessons about evaluating sources and validity of posted online material are important for students today because of the ease of access and breadth of public posted material on the Internet. Rather than ban cell phones and short-hand texting language, educators should teach appropriate uses and the importance and differences between modes of communication today.
5. Data from successfully implemented one-to-one computing projects be collected and examined to characterize a model implementation and support plan. The plan would include continuous professional development and support, computer deployment timelines for teachers and students, computer purchasing and funding options, ideal infrastructure, networking and support systems.
6. The reviewer urges for educators to be open to pedagogical change and embrace the challenge of preparing students for an unfolding world of technology transformation.

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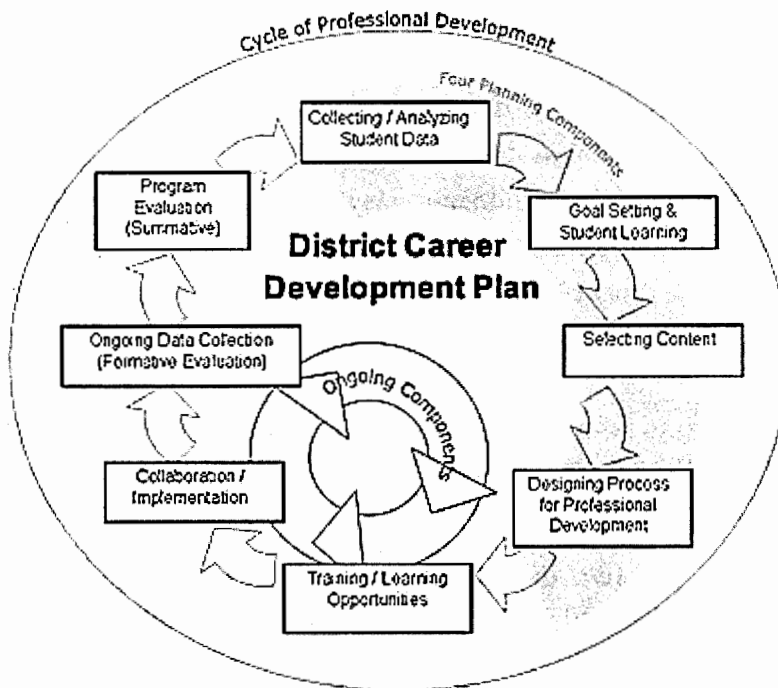
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Appendix A

Iowa Professional Development Model

Student Learning - The Center of School Improvement and Staff Development

Operating Principles: Focus on Curriculum, Instruction and Assessment,
Participative Decision Making (School & District), Leadership, Simultaneity



(Retrieved from <http://www.iowa.gov/educate/pdmtm/state.html>)

Appendix B

Establishing New Learning Environments

Establishing New Learning Environments

Traditional educational practices no longer provide students with all the necessary skills for economic survival in today's workplace.

Traditional Learning Environments	New Learning Environments
Teacher-centered instruction	Student-centered instruction
Single sense stimulation	Multisensory stimulation
Single path progression	Multipath progression
Single media	Multimedia
Isolated work	Collaborative work
Information delivery	Information exchange
Passive learning	Active/exploratory/inquiry-based learning
Factual, knowledge-based	Critical thinking and informed decision-making
Isolated, artificial context	Authentic, real-world context
Reactive response	Proactive planned action

The most effective learning environments meld traditional approaches and new approaches to facilitate learning of relevant content while addressing individual needs. The resulting environments should prepare students to:

1. Communicate using a variety of media and formats
2. Access and exchange information in a variety of ways
3. Compile, organize, analyze, and synthesize information
4. Draw conclusions and make generalizations based on information gathered
5. Use information and select appropriate tools to solve problems
6. Know content and be able to locate additional information as needed
7. Become self-directed learners
8. Collaborate and cooperate in team efforts
9. Interact with others in appropriate ways

(Retrieved from <http://www.uni.edu/darrow/frames/iste/learnenv.html>)