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Critical Thinking And Problem Solving: Can Technology Be A Tool? It's As Simple As I-V-C!

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Abstract. In the age of the digital residence, it has become imperative for both new teachers and experienced teachers to meaningfully incorporate the technological tools in daily teaching. Using technology daily as an essential instructional tool enhances the opportunities to meet the instructional needs of all students. This study presents the collaborative efforts of a higher education faculty member and a new teacher, engaged in using interactive video conferencing to enhance the cyclical teaching and learning process of a group of fourth grade students. Ultimately the project supported that technology should be used in all classrooms to enhance student performance on authentic applications and be integrated into core aspects of the daily curriculum, (Miranda & Russell, 2012). The study also points to the fact that collaboration between higher education and p -12 school faculty can make a positive difference for all participants.

Keywords: technology tools; university-school partnership, collaboration

Introduction

There is no doubt that education in the 21st century has been greatly impacted by technology. The Alliance for Excellent Education increased its focus on the role of digital learning and technology during the last few years (Alliance for Excellent Education, 2012). During this time the Alliance adopted this definition of Digital learning:

> Digital learning is any instructional practice that is effectively using technology to strengthen the student learning experience. Digital learning encompasses a wide spectrum of tools and practice, including using online and formative assessment, increasing focus

> and quality of teaching resources and time, online content and courses, applications of technology in the classroom and school building, adaptive software for students with special needs, learning platforms, participating in professional communities of practice, providing access to high level and challenging content and instruction, and many other advancements technology provides to teaching and learning (Alliance for Excellent Education, 2012, p. 1)

It is this definition of digital learning that must be embraced and implemented effectively as part of the teaching and learning process by teacher preparation programs, as well as P-12 school administrators and teachers, to enable us to graduate students prepared to be active citizens in our rapidly changing, global society. To make this goal a reality faculty members from higher education must become involved in school-based initiatives where technology is used to enhance the learning of P-12 students, and use their experiences to impact teacher education candidates as they prepare for classroom teaching. This study sought to determine the impact of a higher education professor collaborating with a classroom teacher in using interactive video conferencing (IVC) on the teaching and learning process of fourth grade students across content areas.

Technological Reformation

The late 20th century began the technological reformation in public schools with computer-assisted instruction, word processing, and other digital devices that many educators used to improve and enhance their instruction. Today students demand that technology is an integral part of their classroom learning experiences in ways beyond ordinary (Metlife, 2011). As digital natives (Presnky, 2010) they are not just information gatherers but they are information creators (Robin, 2008), accustomed to feedback, collaboration, and ease of implementation. Technology should be an essential component of actively engaging learners, and active engagement is critical to keeping students in school (Metlife, 2011).

Unfortunately however, it is often the case in many public school classrooms that technology is not used in the daily teaching and learning process (Zucker & Hug, 2007). Effective use of technology in the classroom is more than requiring students to have a netbook to read their textbook from a fancy word processor. For students today their schema is embedded in technological dimensions as they do not have first-hand knowledge of life prior to computers and the Internet, making the global society a natural part of their personal and academic life (Kent, 2012). Linking technologies that many students use daily at home to learning at school enhances the opportunities for students to see the relevance in what they are learning and the transferability to novel situations (Godzicki, Godzicki, Krofel, & Michaels, 2013).

Classroom Adventures

The Internet and other technologies must have a prominent place in today's classroom (McBride & King, 2010). A meta-analysis of the research on the impact of

digital technologies on learning consistently revealed positive outcomes for public school classrooms (Higgins, Xiao, & Katsipataki, 2012). Thoughtful implementation of technological resources should significantly enhance learning and create a positive learning environment (McBride & King, 2010). Although there are countless ways technology can and should be implemented in elementary classrooms, presented in this literature review are selected examples that the readers may find beneficial and provide a foundation for the premise of this research.

In elementary schools blogging can potentially boost cognitive ability and improve student writing while in an active learning environment. In elementary school blogging is still in the early stages of implementation, but there is evidence to suggest that when students have an audience, that is, their writing is subject to reader comments, then their interest in writing and quantity of writing increases (Jackson, 2012). A study with fifth-graders by McGrail and Davis (2011) revealed that as the students engaged with the teachers through blogging, the sense of audience helped improve their writing and confidence about writing.

Podcasts are another technological tool that can be used as a way to enhance vocabulary and other instruction across all content areas (Putman & Kingsley, 2009). A study by Putman and Kingsley (2009) revealed that using podcasts enhanced the vocabulary development of fifth grade students, and the students reported having a positive learning experience using podcasts. Moreover, teachers can have content experts or guest speakers speak to their class by way of a podcast (EdTechTeacher, 2013).

Interactive whiteboards (IWB) can be used to engage and motivate students as they incorporate a range of digital resources in the exploration of content (Manny-Ikan, Tikochinski, Zorman, & Dagan, 2011). Murcia and Sheffield (2010) conducted a case study where they found that using IWBs increased student participation in science conversations, engaged teachers in more open questioning techniques, and allowed for more think time from the students.

The use of the multi-dimensional tool of video conferencing offers a way to engage auditory and visual learners. Interactive video conferencing (IVC) has become an accessible way for teachers and students to connect globally (Forrester, 2009). Using simple Internet based tools such as Skype, or other video conferencing systems, they can talk, share ideas, and create incredible learning experiences with people around the world. In 2010, there were approximately 30,000 video conferencing systems in U.S. Schools for the purpose of connecting with students around the world (Svitak, 2010). Video conferencing tools allow educators and students to connect with experts in "real-time," take virtual field trips, collaborate with students on projects outside of their school and city, engage in distance learning courses, and participate in professional development. The Internet knows no physical boundaries, therefore the opportunities for collaborating and learning across time and space are limited only by our personal restrictions.

The impact of video conferencing on student academic performance has been inconclusive thus far (Greenberg & Zanetis, 2012). Most of the research has lacked rigorous controls and been with small sample populations that were not generalizable to large student populations (Cisco, 2011). However digital video was shown to improve math achievement in sixth and eighth grade students (Boster, 2004); early childhood educational programs demonstrated significant academic achievement in many academic areas (Bryant, Alexander, & Braun, 1983); and access to video promotes problem-solving abilities, especially through collaboration (Journell & Dressman, 2011).

Teachers must incorporate technology into instruction in order to reach the 21st century students who are submerged in technological tools as a natural part of their daily lives. Not only do the students embrace digital media, they also rapidly adapt to the ever-changing technology. Students today more than ever before, are comfortable exploring technology and have come to expect the immediate feedback of digital media. Teachers must capitalize on this by making a cultural shift in education, making technology student centered (Dessoff, 2010) by integrating technological tools like blogging, digital stories, podcasts, video conferencing, and interactive white boards into the daily life of all classrooms. Technological tools provide the mechanism for collaborative, active, hands-on, engaging learning to be an integral part of the daily classroom experience. Implemented in this manner, technology can enhance critical thinking while scaffolding the success of students expected upon becoming college and work force ready. This article presents the collective efforts of a classroom teacher and a university professor in effectively implementing technology as an instructional tool to enhance the teaching and learning of a group of fourth grade students.

Learning Live!

Participants

In the spring of 2013, a technologically savvy fourth grade teacher in a large urban school district in southern Alabama and a literacy professor at a local university worked together to help make learning come alive for a diverse group of 21 fourth grade students, 9 males and 12 females. There were a variety of learning abilities present, with four students identified as below grade level in reading and four identified as below grade level in math. The class had 9 students that were on free or reduced lunch, and 10 black, 10 white, and one Asian student.

The partnership was a natural outgrowth of the teacher being a recent graduate from the institution, and the school where the teacher taught was also an established partner in the teacher preparation program. Both participants were committed to developing the time necessary to planning and preparation for the project to be successful. Much like the findings of Miranda and Russell (2012), the teacher involved in this project believed that technology was beneficial for a broad range of instructional purposes.

This group of fourth grade students experienced using technology as a tool for learning on a daily basis, across all subject areas. For example, prior to this project her students commonly read books on eReaders, regularly blogged with college students about reading and math concepts, engaged in project based learning through the creation of Lego WeDo, and connected with local, national, and international classrooms. Likewise, the classroom teacher and the professor involved in this project embraced the research of Charles Fisher and David Berliner (1985), Robert Marzano (2001) and his colleagues, as well as John Hattie (2009) that support the notion that carefully planned and implemented instructional practices result in increased student achievement as the amount of rigor and relevance is increased. Thus the classroom teacher's philosophy of active engagement in meaningful learning activities mirrored that of the higher education faculty member, making this project exhilarating for both the educators and students.

Project Beginning

The project began as the classroom teacher engaged in conversations with the professor regarding technological methods to meet instructional objectives in the content area of social studies. While the focus was to be on history as the content, enhancing critical thinking, problem solving, and collaboration were the central learning goals, with a focus on project based learning. In Alabama, Alabama History is first studied in fourth grade, with standards addressing the past to the present in the historical context of the state. With this premise the classroom teacher invited the literacy professor to engage with her students using social studies standards as a gateway to learning, while also incorporating literacy and math standards, embracing various technological tools as the instructional modality.

The project was multi-faceted but the overarching lesson design was to engage in interactive video conferencing (I-V-C) sessions using Skype between the professor and the fourth grade students as the professor traveled to three different states, reading the class books about these states. Ultimately the project culmination was the students using their knowledge to analyze state features, comparing and contrasting state characteristics through the creation of a quadruple Venn Diagram, and presenting their learning to their peers and the professor.

Going Live!

The teacher's reflections revealed that there was just something electric about the live conversations between the students and the professor that were occurring in real time, but thousands of miles apart. In March the professor was on location in Columbus, Ohio, and in April she was in Denver, Colorado and San Francisco, California; all were a great distance from Mobile, Alabama, and much further than most of the students in the class would ever travel. In each of the sessions the professor preselected a nonfiction text that provided an overview of the state where she was visiting The students and teacher completed the beginning elements of a K-

W-L (Know-Want to Learn-Learn) chart together, and they predicted what they would learn about the new state through the session.

The professor would share with the class a little about the city and things that she had personally experienced in the city during her visit, such as the climate and scenery. Then the lesson would continue with the professor sharing preselected elements of the text, not only stopping to discuss various facts and interact with the students, but also reviewing text features in the nonfiction selection that she used to help determine important information.

After reading the book, the professor would incorporate numeracy through the cost of the round-trip plane ticket to travel to the state from Mobile, Alabama, the cost of the hotel stay, and meals. The students would compare this information from each trip, and researched the cost of local hotels and dining out in order to compare the information their home state as well. The professor would conclude the lesson encouraging the students to think about their new learning, and with the approximate date of the next session. The IVC sessions each lasted approximately 30 minutes.

At the conclusion of the lesson the students thought about their new learning in relation to what they had learned about Alabama, comparing and contrasting the information. The classroom teacher spent a few minutes after the session debriefing with the students, completing the "L" (what we "learned") on the K-W-L chart, and helping them make connections to their prior learning with the new learning. The teacher saw the critical thinking and problem solving skills become enriched for her students through each session. She claimed that the process was essentially as simple as IVC!

In the late spring the professor made her first "in-person" visit to the fourth grade class. Another exciting moment for both the students and professor, as the visits from various states now became more real by meeting the traveler in real life. The students presented their final projects, a quadruple Venn diagram, giving facts about each state and highlighting the differences and the instances where they found that all four states were alike. The presentations revealed that students learning and excitement in sharing with the professor.

Data

The professor and classroom teacher engaged in on-going conversations throughout the project, and wrote reflections after each session. Notes were used to record the conversations for future analysis and reflection regarding the process, successes, and challenges of the experience from both the perspective of the professor and classroom teacher. The teacher lead reflective conversations with the students, taking notes to their responses to collect data on their perceptions of the using technology as an instructional tool in this endeavor. In addition, the teacher took

anecdotal records of the students as they worked in small groups on each element of the project.

The classroom teacher included both formative and summative assessments in language arts, reading, social studies, and math as they aligned with curricular objectives for the grade level. The assessments were project-based, allowing the teacher to further enhance the students' opportunities for collaboration and problem solving with their peers. For example, in English Language Arts the students worked in groups and were evaluated on the use of a K-W-L chart to organize their thinking after each IVC session, and then using the organizers to create a synthesis of their learning in a quadruple Venn. They were responsible for research, writing, using electronic and traditional sources of informational text, and presentation of their findings. In mathematics the students were evaluated in determining which computational skills they needed to use to solve problems related to mathematical comparisons, and then solving the problems. They also created graphs to represent the various costs of elements of the trip and used the graphs to create and answer questions. In social studies the students were evaluated as they compared and contrasted different geographical regions, determined how geographical features of the land impacted industry, and made the historical connections between basic state facts, such as the name of the state, state flower, and state song with the origin. In addition technology standards were met as students were engaged in interactive video, followed by using technology to research and collaborate with their peers.

Results

The teacher reported that the IVC lessons were extremely motivating, resulting in the students wanting to stretch themselves academically, to really think critically about what they were learning in history, math, and language arts in effort to create a project with their group that was unlike the others. Over the course of the project, the students successfully met many objectives across the content areas. The teacher reported that the project had a broad impact, as the students were able to transfer their knowledge and skills from this project to many other project-based learning opportunities that were structured for them.

The professor, students, and classroom teacher engaged in meaningful dialogue about the content learned in both social studies and math, and the perceived benefits of using technology to enhance the teaching and learning. The fourth grade teacher and higher education professor in this study reflected the findings of Parkinson and Welsh (2009), that much of the success of the innovation was found in spending the time preparing for the collaboration, including how the teacher set-up the lesson prior to the session, the IVC session itself, the discussion following the session, and the culminating project.

Through discussion, the classroom teacher revealed that this collaborative effort resulted in, "…the most rewarding professional learning experience I have

participated in thus far as a classroom teacher." And, for her students, "an opportunity for my students to be involved in a meaningful learning experience, with IVC as the vehicle, whereby they deepened their knowledge of content and sharpened their problem solving skills."

Through reflective conversations with the teacher, the students reported that the IVC sessions made learning the information more exciting, and they looked forward to receiving the call. Though self-reported, the information from the students was supported by the research of Mouza (2008), the technology helped create an authentic learning context, making the learning more meaningful for the students. There was an added dimension to the lessons that simply would not be present by reading to the class while in the class or showing them a video.

The teacher saw her students genuinely excited about learning, looking forward to the sessions and what they were going to learn. The teacher said it was amazing what her students were able to remember about each state and transfer their learning in other areas of learning, such as in their writing and arithmetic. The teacher was able to use the final project as a project-based assessment in social studies, language arts, and math, and the students also mastered various technology standards. Quantifiably, 100% of the students met the objectives assessed through this project-based learning endeavor. And though she was unable to separate the learning from this project in order to directly correlate it with academic achievement on end of quarter tests, she was confident that these IVC sessions that all facilitated meaningful conversations, writing, thinking, problem solving and the projects definitely contributed to her students positive achievement results. Without a doubt, this work supported the findings of Tricia Smith (Vartek, 2012), that is, the students had increased opportunity to collaborate with their peers, provide peer tutoring, and accomplish a more complex task in evaluating the information to create a quadruple Venn Diagram.

Being actively involved in the teaching and learning of children impacted the professor's personal professional development as she strived to make the learning relevant to the students. Having conversations with the classroom teacher and the students stretched her thinking in regard to the content, teaching strategies, and relationships with the students. For the professor, the classroom connection in this project, both virtually and face-to-face, once again impacted her relevance, recency, and relational aspects of public school teaching.

Implications

The opportunities for using technology to enhance instruction are simply endless. This study adds to the research that interactive video conferencing, used as a teaching and learning tool, has a positive impact on the instructional process. Likewise, teachers must embrace technology for the purpose of instruction and learning rather than for the sake of the technology itself. It is ultimately the impact on student achievement that must be the driving force in using instructional

technology. Student achievement now must include far more than basic reading and math skills. Achievement must also encompass the critical thinking, problem solving, collaborative nature of working in the "real world" that is now a simple expectation.

The classroom teacher was elated with the partnership with the university professor. As supported by Kati Haycock (2002), cooperation between K-12 and higher education is simple essential, and this project highlights that connection. The teacher routinely used technology as a teaching and learning tool, but adding the element of working with a local university professor over an extended period of time added a new learning dimension for her, as well as for her students.

As with most innovations, this one also had its share of challenges. First, there were issues with the school's Internets ability to support Skype without interruption or delays. Through persistence, the sessions were successful, but the technological difficulties were distracting. Second, scheduling the sessions was challenging. There were differences in time zones, along with both the school day schedule and the professor's daily schedule that all had to be negotiated to make time for the sessions. Finally, the finding the time for the professor and teacher to plan each session and debrief following the sessions was never easy. It required flexibility and a conscious effort to keep the end goal and potential benefit at the forefront.

Even though the technological revolution has overtly transformed our culture in the past few decades, its impact in the classroom has not kept the same pace (Miranda & Russell, 2012). The teacher involved in this study believed that technology was important for teaching and learning, implemented various technological tools consistently in her classroom, and professed that her students experienced academic success that was directly related to using technological tools as an integral part of her instructional tool belt. As supported by Miranda and Russell (2012), it may be implied that the more teachers use technology, the more they see the value of using the technology as an instructional tool, the more confident they become, and the more likely they are to instruct students to use technology, allowing for the use of technology to positively impact the achievement of students.

Districts must focus resources on providing the professional development and support teachers need to decrease the obstacles related to technology integration (Miranda and Russell, 2012). As teachers see successful implementation of technology from their peers, they will become more likely to see technological tools as a means to engage their students in meaningful learning. Just like teachers help each other by sharing core concepts to create lesson plans, teachers can share digital files and ideas, tools, and responsibilities to spark innovation and learn from each other. It is technology implementation throughout the school career that will help American students become critical thinkers and better able to proficiently use technology in problem solving situations.

Conclusions

Teachers must first believe that technology can be used to enhance the critical thinking and problem solving skills of their students across the curriculum. They must couple this belief by embracing the challenge of finding the mechanism and time to learn the instructional uses for technology, and to implement the technology for learning purposes rather than omitting these technological tools from their classrooms. As with IVC, they may find that technological tools that have been around for some time have been perfected, making positive results for their students' learning, and positively impact their instructional planning and delivery time. Institutions of higher education must focus on preparing teachers who embrace technology as a teaching and learning tool, and public schools must provide the professional development needed by the inservice teachers so they are prepared to use technological tools in their classroom. Technology expands students' opportunities to collaborate with their peers through exploration, planning, creating and problem solving. The opportunities are absolutely endless, and expand every day. However, in many classrooms we rarely, if ever, see technology used for teaching and learning. Paper, pencils, and hardbound dictionaries are in abundance, but the tools that students are expected to use in their jobs in their not-so-distant future are locked in a closet (Kent, 2012).

Faculty from higher education have a responsibility to students. They must prepare teachers to employ teaching strategies that actively engage the learners, and expand learning expectations and opportunities by maximizing the technological tools that are available for students. The students involved in this project were able to develop firsthand technological experience that they were able to connect to their learning. Learning through listening, writing, and reading via Skype (IVC), skills that are applicable to both traditional and technological mechanisms, are transferable to future experiences, as the content knowledge learned was used to create their own products through project-based learning. The project promoted both individualized learning, as each student assimilated notes during Skype sessions and analyzed them in relation to their learning about Alabama; and collaboration, as they had meaningful class discussions and worked together to create a quadruple Venn Diagram. As this group of students promoted to the next grade, it is now their expectation to have these technological tools as an integral part of their daily education. Inherent in this statement is the question: Does their next teacher rise to the challenge? The possibilities are simply endless!

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