Teacher Efficacy in a 1:1 Science Classroom: A Case Study
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Introduction and Background

One-to-One technology initiatives have become prevalent among school districts as a way to achieve student development of twenty-first century skills. Technology offers teachers the ability to transform the quality of instruction – to achieve a more student-centered learning environment, have more differentiated instruction, and develop problem or project based learning, and demand higher order thinking skills (Penuel, 2006). Additionally, technology integration, specifically mobile one-to-one technology, into the classroom offers many benefits to student learning. According to Lipponen (2002), technology can enhance peer interaction and group work, facilitate knowledge sharing, and distribute knowledge and expertise among the learning community.

By having technology used on a daily basis in the classroom, teachers are improving their practice as well as their students’ learning and knowledge advancement. Researchers (e.g. Keengwe, Schnellert, & Mills, 2012) have demonstrated that technology integration is essential to meet this goal, however the existing technology infrastructures are often insufficient to develop the desired outcomes of these implementations (Greaves, Hayes, Wilson, Gielniai, & Peterson, 2012). Many current classroom teachers have yet to incorporate technology into their teaching practices. Currently, there has been little research (e.g. Fleisher, 2012; Greaves et al., 2012) that examines teacher appropriation of the tablets into their pedagogy. Teachers often do not understand or have the time to spend learning about the functionality of the devices.

According to Ifenthaler and Schweinbenz (2013), a majority of teachers are open to integrating tablets and feel they would enhance their practice, but others are not confident about using a new device in their everyday instruction. In addition, how teachers actually integrate devices into their practice is often dictated by school culture (Fleisher, 2012; Greaves et al., 2012). When teachers lack the knowledge of how to use technology, their attempts to integrate technology successfully are often limited (Koehler, Mishra, Kereluik, Shin, & Graham, 2014). Others (e.g. Kim, Kim, Lee, Spector, & DeMeester, 2013) have shown that internal barriers, attitudes, beliefs and efficacy with technology still impact levels of technology integration. Internal barriers are much more personal, more deeply ingrained, and may require a pedagogical change in the individual over time in order to overcome the barrier (Ertmer, 1999). These reasons make overcoming internal barriers much more difficult than external barriers such as technology availability, technical support, and technical infrastructure.

Using a TPACK framework (Mishra & Koehler, 2006), this research project examines the classroom practice of a middle grade science teacher integration in a 1:1 initiative in the science classroom. The following questions guide our research: 1) What types of internal barriers exist within the science classroom that influences technology use and
integration by the teacher?; 2) How do internal influences effect a science teacher’s perception of his own pedagogical practices integrating technology?

Theoretical and Methodological Frameworks

This study is part of a larger design based research project (Brown, 1992) that is examining the use of iPads within specific content contexts. Design-based research emerged from the dialectic between theory and design in research, with theory suggesting an improved design and design suggesting new dimensions to theory. While theory and design can and do exist independent of one another; there is still an inherent connection between them. Design based research is an iterative process that is based upon outcomes that can impact the modification of instructional practice through monitoring and self-regulation (Schoenfeld, 2006).

A TPACK framework (Mishra & Koehler, 2006) provides the lens for this study. An educator’s TPACK or technology integration knowledge is operationalized when they identify an effective combination of curriculum content, a particular pedagogical approach and a use of a technology tool or resource to support the learning experience. Additionally, the SAMR lens (Puente, 2009) was utilized to examine how technology is impacting teaching and learning in the classroom. This model also demonstrates the trajectory that those who adopt educational technologies often take as they navigate the use of educational technologies in their teaching and learning practices.

Research Design and Methods

Study Context

Caldwell Middle School is an urban middle school in the southeastern portion of the United States. The school is a Title I school with a diverse population (N=647): White 8%, African American/Black 66%, Asian 3%, Hispanic 21%, Native American 2%, Multiracial 2%. Eighty percent of the students receive free or reduced lunch with 81% being classified as ED, 11% LEP, and 19% are identified with disabilities.

This study focused on Jake, a grade 6-science teacher. Jake earned his undergraduate degree in English education; he spent several years working outside education before returning to teaching. Jake completed his lateral entry course work to become a math teacher, as well as a Masters degree in Math education. He also completed Gifted and Talented certification. Based upon state criteria, Jake is considered to be a highly qualified teacher. He has taught middle school science for the last twelve years.

Data Sources and Analysis

Multiple sources of data collection are part of this study. These include: semi-structured interviews, field observations, lesson plans, and video data. The data collected documents the teacher’s perceptions and uses of technology, mainly the iPad, in their pedagogy. Teacher reasoning was captured through the interviews. This data supported and refuted the emerging hypothesis about the teacher’s pedagogical change concerning integrating technology into their classroom practice.

Interview data was transcribed and analyzed using HyperResearch. Researchers coded
the transcripts using a grounded theory, constant comparative method (Strauss & Corbin, 1998). Open coding was utilized to develop the initial codes. Once the data was saturated with codes, a second level of coding was completed and axial codes were identified. These codes were organized into broad categories or core codes (Strauss, 1987) which provided a framework to analyze the data. At least two members of the research team coded transcripts and inter-rater reliability of 0.90 was calculated.

**Results and Discussion**

The findings reported in this proposal are preliminary and based upon interview data and classroom observations. Even at this early stage, a number of interesting findings have emerged about the science teacher’s internal barriers. These barriers include teacher’s own knowledge about technology, teacher’s perception of his technology practice and the value placed upon the technology itself.

Through the interview and classroom observations the science teacher, Jake, exhibited limited technology knowledge and the educational opportunities afforded by technology. In a study by Koehler et al. (2014), the researchers found that teachers’ lack of technology knowledge often limits their attempts to integrate technology successfully. Jake cited several reasons as to why he was not integrating the iPad into his classroom instruction. His reasons included not knowing what apps were available, the lack of time to learn about the new technologies (apps), and better professional development. During the interview Jake continually had to ask for clarification on various types of technologies he was questioned about:

*Jake (science teacher): Ok virtual worlds...would that be like a sim simulation?*

*Interviewer: It could be a sim simulation, it could also be something...have you ever heard of Quest Atlantis?*

*Jake: Quest for Atlantis?*

*Interviewer: No, Quest Atlantis*

*Jake: Quest Atlantis, I’ve not heard of it.*

Jake’s limited knowledge was echoed in his comments about professional development. He stated on numerous occasions that “we have a surplus of technology and a lack of hands on training”. This is a key point in successful technology integration. Previous studies have suggested that teacher professional development needs to be technology and content specific (Mueller et al., 2008; Paraskeva et al., 2006), hands on (Judson, 2006; Paraskeva et al., 2006), and promote positive interaction with the technology (Kim et al., 2013; Mueller et al., 2008; Vannatta and Fordham, 2004). It was clear from his interview and observations that this was not occurring at Caldwell.

Teachers own ideas or perceptions of how the technology could be used in the classroom was a second internal barrier. When teachers only see the technology as a tool they must use as opposed to a device that could enhance their instruction it limits the use
of the device. This barrier can also keep teachers in the Substitution level of the SAMR model and prevent them from advancing into the higher levels of integration that create authentic learning experiences for students. These perceptions of what is “technology” and what is “not technology” has an impact on both Jake’s planning and pedagogical practices. It influences how he thinks about using technology in his own practice. This limited knowledge and experience of what is available lends him to stick with websites, videos, applications that he is comfortable using.

Individual barriers can also include the teachers’ perception of how they and others around them are using the technology in their classroom instruction. What was observed was that the teachers’ perception of how they use technology was often different than their actual practice. During Jake’s Circle of Influence Interview he indicated that iPads, QR codes, and Specific websites such as Bob the Alien, Enchanted Learning, and Pete’s Powerpoint Site were the most influential technology pieces on his teaching practice. Jake placed these four items the closest to the circle, which indicated a higher influence on practice. He justified the placement of the iPads due to the fact that “we are trying to be a one on one.” These websites were not the websites that were observed being used in his classroom. Jake regularly used Brainpop, Discovery Learning, and Quizlet to support his instruction. Despite this, he did not indicate these items as being influential components of his classroom pedagogy on his circle of influence.

How technology is valued at Caldwell Middle School has created an interesting dynamic between technology use and pedagogy. According to Jake, the teachers have been instructed by the administration that the iPad should be used 45 minutes a day during the 60 minute class period. There is however, no emphasis on the pedagogical quality, instead the focus is on the technology and the duration of use. Jake stated in his interview that:

There are sometimes that I find myself trying to just come up with an activity that will use the iPad where something else could be just as effective if not more effective.

Until direct connections to the content areas are made for the integration of technologies, such as iPads, as a pedagogical tool, a teacher like Jake will continue to push back against the integration, relying on traditional methods and pedagogies.

Conclusions and Implications

Jake, the science teacher in this study, presented internal barriers based upon his own experiences with technology and teaching. These barriers have shown that teachers may need varying level of support when trying to implement a one-to-one initiative in a school. The data is demonstrating that there is a distinct difference between teacher’s perception of technology use in the classroom and teacher’s actual practice; what teachers mentioned about technology integration during interviews was not always observed in practice. Second, teachers are not aware of all the ways technology can be incorporated into lessons in an authentic manner. The expanding of teachers’ comfort zones and the way they utilize the iPad in their classroom will be a slow process as teachers began to experiment with new ideas only after they experienced a model lesson.
It is our hope that continued work in the classrooms will reveal areas of professional development that can be offered to the teachers. In addition, as this design experiment evolves we endeavor to have a positive impact on students’ learning. Ultimately, our goal is to help students and teachers use technology in effective ways that transform teaching and learning in each of the content areas.

References


