WHAT MAKES TEACHERS "TIK"? A STUDY OF SECONDARY TEACHER
INTEGRATED KNOWLEDGE AND CHANGE IN 1:1 iPAD CLASSROOMS

By

Erica R. Hamilton

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ABSTRACT

WHAT MAKES TEACHERS "TIK"? A STUDY OF SECONDARY TEACHER
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This yearlong, multi-case qualitative study examined the experiences of four secondary teachers who taught in a school where each student had an iPad tablet computer (1:1 iPad). The teachers taught four different subjects (i.e., English Language Arts (ELA), Social Studies, Spanish, and Chemistry). They ranged from 8 to 30 years of teaching experience. Using classroom observation, interview, and survey data, the purpose of this study was to (a) understand how teaching in 1:1 iPad classrooms changed, in any ways, how these secondary teachers thought about or enacted their teaching and (b) to identify the funds of knowledge upon which they drew when they planned and taught in their 1:1 iPad classrooms. Looking across these four cases provided multiple examples of the ways in which these different content area teachers enacted change and the funds of knowledge they used to plan and teach.

Cross-case analysis suggested that teachers enacted three types of change where technology integration was concerned. Cross-case analyses results indicate that these teachers enacted three different types of change, namely "Adding On," "Combining," or "Remaking". Additionally, teachers drew from a range of knowledge funds to justify their pedagogical moves and the changes they enacted. These funds of knowledge are presented in the Teacher Integrated Knowledge (TIK) framework. Most surprisingly, it was teachers' Knowledge of Educational Ends (KEE) that seemed most influential as a driver of technology integration choices. What teachers knew and held to be true about the educational ends of schooling seemed to shape the types of knowledge they used as well as their technology integration practices.

To all teachers, wherever they are, who use technology to improve teaching and learning and to the Watertown Public School District in particular for giving me space to learn, study, and grow.

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CHAPTER ONE

Introduction

Now more than ever before, U.S. teachers and students regularly use technology in K-12 classrooms (Lawrence, 2013). Because of this, there is also interest and investment in K-12 school technology as a means of developing students who actively participate in a knowledge and technological-based society (Lei, Conway, and Zhao, 2008). According to the U.S. Department of Education's Technology Plan (2010), "technology is at the core of virtually every aspect of our daily lives and work, and we must leverage it to provide engaging and powerful learning experiences and content" (p. 7). The authors of this plan also suggested that implementing technology in K-12 settings promoted collaborative teaching and increased student motivation and learning. On an international level, educational technology is also being implemented as a means of improving teaching and learning. Turkey recently unveiled its "FAITH initiative" in which it announced that it plans to place "tablet computers in the hands of every student from grade 5 to 12, and interactive whiteboards in every classroom" (Trucano, 2013b). In addition to Turkey, there are other countries such as Uruguay, Thailand, Peru, Kenya, India, and Portugal that are heavily invested in educational technology as a means of customizing student learning and improving their educational systems (Trucano, 2013a).

Even as classroom technological innovation and implementation continue to occur around the globe, the types and uses of technological tools often vary from classroom to classroom. Despite differences in technological tools, many believe that integrating technology in K-12 classrooms is necessary to prepare students for the future (Bai and Ertmer, 2008; Ertmer & Ottenbreit-Leftwich, 2010). According to Christensen, Horn, & Johnson (2008), integrating technology into schools has the potential to intrinsically motivate students and professionally

reward teachers. Some also argue that using technology trains K-12 students to be technologically advanced, independent thinkers and workers (Boling & Beatty, 2012). However, teaching with technology is complex and often challenging for teachers, making it an important topic of study, particularly teachers' integration of technology in K-12 settings (Mishra & Koehler, 2006; Mishra, Koehler, & Kereluik, 2009).

According to Michigan's Freedom to Learn (FTL) program which began in 2001, one-to-one (1:1) computing existed when each teacher and student was supplied with a wireless technology device that provided opportunities for "anytime and anywhere" learning (U.S. Department of Education, 2004). One way to enact this anytime and anywhere learning in K-12 settings is through the integration of 1:1 digital devices (Harbough & Cornelius-White, 2013; Penuel, 2006). Generally, 1:1 classrooms involve laptop or tablet computers. For clarity, a laptop computer is a portable computer that contains a hard-drive, screen, mouse pad, and uses a keyboard as the input device, whereas a tablet computer is a portable, single panel computer which utilizes a touch screen as the input device. When using these mobile, wireless devices, laptop computer users most often utilize computer programs whereas tablet computer users interact with applications (apps).

In both cases, these 1:1 devices contain built-in hardware and software that provide users with access to the Internet as well as tools to communicate with others, create products, and access information. Many companies produce and sell tablet computers – hereto referred to as "tablets," such as Amazon's Kindle Fire HD, Microsoft's Surface Tablet, Google's Nexus 10, Samsung's Galaxy Tab, and Apple Corporation's iPad. Of these tablets, the iPad is still one of the most popular tablets on the market today (Franklin, 2013). According to authors of the latest *New Media Consortium (NMC) Horizon Report*, the iPad is also the type of tablet many U.S.

school administrators are choosing to purchase when moving to 1:1 tablet classroom models (Johnson, Becker, Cummins, Estrada, Freeman, & Ludgate, 2013).

Benefits: 1:1 Technology

Some researchers argue that 1:1 technology will change teaching and learning for the better (Lei, Conway, & Zhao, 2008). Penuel's (2006) synthesis of research findings on studies connected to 1:1 laptop initiatives found that in some cases when 1:1 devices were employed in classrooms, there were positive effects regarding student engagement and motivation as well as an increase in students' organizational skills. Penuel also found that when teachers believed in the efficacy of the 1:1 laptops as a means of supporting student learning and providing resources that enhanced curriculum, teachers were more likely to use the 1:1 technology. This finding is supported in Ertmer and Ottenbreit-Leftwich's (2010) review of literature focused on the necessary characteristics teachers must embody that enable their employment of technology in pedagogically sound and meaningful ways.

According to Lei, Conway, and Zhao (2008), 1:1 digital technology offers teachers and students, among other things, better, more sophisticated tools that provide additional teaching and learning resources and opportunities. These resources and opportunities include access to the Internet and its resources, 24/7 accessibility, and increased communication. In 1:1 classrooms, teachers and students most often use mobile devices to support student performance, access reference and informational materials, and watch videos (Johnson, Becker, Cummins, Estrada, Freeman, & Ludgate, 2013). In addition, 1:1 digital technology in educational settings is also said to increase individual and collective productivity; promote higher level thinking and learning; motivate students to learn; and, increase student achievement (Gulek & Demirtas,

2005; Lei, Conway, & Zhao, 2008). Connected to these ideas, Lehmann and Livingston (2011) claimed that in a 1:1 laptop (and arguably a 1:1 tablet) classroom the teacher's role changes.

> In a traditional classroom, students often come to class to receive information from a teacher. But in a 1:1 laptop environment, students obtain information in a myriad of ways. The challenge then becomes to reimagine the classroom to make it the place where students and teachers come together face-to-face to create shared knowledge. (p. 78)

These authors also suggested that 1:1 computing programs offer opportunities for teachers and students to transform learning environments, in part because 1:1 technology provided students with hardware, software, and access to the Internet. Access to these tools provided opportunities to move students in "brick and mortar" settings beyond their four classroom walls. In doing so, teachers and students could use 1:1 technology to actively engage in and with their world, including communicating with others, engaging in problem-solving connected to real-world issues and dilemmas, and collaborating with others to share knowledge and build understanding.

Challenges: 1:1 Technology

Not all studies demonstrate positive outcomes of 1:1 digital technology in classrooms. For example, Cuban (2001) reported that integrating technology in the classroom had "yet to yield even modest returns or to approach what has been promised in academic achievement, creative classroom integration of technologies, and transformations in teaching and learning" (p. 189). Cuban's (2013) most recent publication further supports his earlier findings as well as the fact that most, if not all, changes teachers make in adopting a new technology, such as 1:1 laptops or tablets, often solidifies familiar and conventional teaching practices. According to Lei and Zhao's (2008) yearlong study of middle school students engaged in the first year of a 1:1 laptop program, laptops and other related technologies supported students' learning activities that

would have been impossible or more difficult to implement in a non 1:1 environment. These authors also concluded that in 1:1 classrooms student discipline problems, challenges of teaching and learning digital literacy skills, and a fear of users' dependency on information technology could negatively impact 1:1 computing, particularly in the early stages of implementing a 1:1 model.

Another study situated in a middle school setting conducted by Donovan, Green, and Hartley (2010) found that although 1:1 technology appeared to increase student and teacher motivation to use the devices, students' uses of the technology were not necessarily for academic and learning purposes. Connected to student performance, Lowther, Inan, Ross, and Strahl's (2012) investigation of Michigan's Freedom to Learn (FTL) one-to-one laptop initiative revealed that although "students from FTL schools had high interest, motivation, and belief in the benefits of using laptops, the examination of student performance did not show positive impact of laptops on students' state test scores" (p. 26). In this instance, using 1:1 laptops did not produce improvement as measured by students' standardized test scores.

Furthermore, Kinash, Brand, and Mathew's (2012) work with mobile technology and undergraduate students indicated that although participants used iPads (as well as the Blackboard Mobile Learn app) they were generally neutral about their experiences with the device and app and did not report improvements in their learning. This finding aligns with some of these scholars' previous work conducted with undergraduate students who used university-loaned iPads as part of their coursework. They concluded that "the presence or absence of mobile devices does not guarantee or preclude student learning" (Kinash, Brand, Mathew, and Kordyban, 2011, p. 342). Cuban (2013) also concluded that the presence of mobile devices in K-12 classrooms did not guarantee changes in teachers' practice, a finding supported by Ifenthaler

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and Schweinbenz's (2013) pilot study of German middle school teachers who used Tablet-PCs in their teaching.

Teachers' Uses: 1:1 Technology

According to Harbaugh and Cornelius-White (2013), there is still much to learn about the students and teachers who learn and teach in 1:1 digital device classrooms. As studies have shown, using 1:1 laptops or other mobile devices in K-12 classrooms does not necessarily lead to increased student achievement, as measured by standardized test scores. Therefore, although focusing on students and student learning in 1:1 classrooms is important, we must first understand teachers' knowledge and understanding of 1:1 technology as well as their teaching experiences teaching in 1:1 digital device classrooms.

In today's U.S. educational system, by and large, teachers still plan for and purvey knowledge to their students, which means they need to understand technology and how to use it to promote student learning and achievement. For example, according to Inserra and Short's (2012) study of U.S. secondary content teachers' teaching practices in 1:1 environments, teachers must understand the relationships between technology, teaching, and learning. If they understood these relationships, they were better equipped to use 1:1 technology in their classrooms and content areas in ways that fostered students' problem-solving skills and higher-order thinking. Zuber and Anderson's (2013) study of secondary mathematics teachers in a 1:1 laptop program also indicated that teachers' knowledge of and pedagogical beliefs about 1:1 technology's effectiveness with regard to mathematics instruction also impacted the ways in which these teachers used 1:1 technology to teach mathematics.

Straub's (2009) theoretical work focused on teachers' technology adoption also supports the connection between teacher understanding and implementation. He suggested teachers'

perceptions regarding possible uses and applications of technology impacted how much and how well they used it in their teaching and classrooms. Connected to Straub's (2009) work, Boling and Beatty (2012) focused on teachers' technology integration and found that teachers were in a better position to successfully implement and integrate technology if their integration practices were closely aligned with their instructional beliefs and philosophies. Furthermore, Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, and Sendurur's (2012) study of 12 K-12 classroom teachers known for their "award-winning technology practices" found that these teachers' beliefs and attitudes regarding technology connected to their pedagogy and practice. Specifically, teachers' beliefs and understanding regarding using technology to foster student learning and achievement positively impacted the ways in which these teachers integrated and used technology in their planning and teaching.

Teachers' understandings of 1:1 technology also impacts the ways they and their students use mobile digital devices to learn (Zhao, Pugh, Sheldon, & Byers, 2002). To illustrate, in studying the Tennessee EdTech Launch initiative where full-time K-12 tech coaches were placed in 26 schools, Lowther, Inan, Strahl and Ross (2008) found that teachers who received technical support and training in the form of on-site technology coaches were more likely to understand the benefits of technology and how to use it. As a result, these teachers "integrated more intensive and meaningful student use of technology in student-centered environments" (p. 205). In a separate study of Michigan's Freedom to Learn One-to-One initiative, Lowther, Inan, Ross, and Strahl (2012) found that when teachers understood how to use 1:1 technology, there was evidence of teachers' using additional knowledge and skills connected to their understanding of technology to foster student learning.

However, many still wonder whether teachers will and/or do adjust their teaching to use 1:1 technology in ways that promote best practice and extend and expand students' learning opportunities (Barseghian, 2012). This is an important consideration because when teachers use technology in their classrooms, their uses often do not support a student-centered instructional model but, rather, continue to promote a more traditional, teacher-centered model in which teachers direct and facilitate instruction (Cuban, 2001; 2013). For instance, even when K-12 teachers participated in professional development learning opportunities connected to integrating technology in their classroom, not all teachers changed beyond what they already knew and did (Morsink, et al., 2010/2011).

Furthermore, in an examination of literature focused on teacher characteristics necessary to utilize technology in meaningful, pedagogically sound ways, Ertmer and Ottenbreit-Leftwich, (2010) made the argument that "when teachers encounter a new innovation, they have been observed to revert back to novice practices" (p. 273). Although not all teachers do this, Ertmer and Ottenbreit-Leftwich's work showcased how and why when some teachers who tried to integrate technology into their teaching and classrooms were still more likely to do what they have already done. In other words, these teachers found ways to incorporate technology into their teaching that did not require them to significantly change how they instructed and delivered content. This has led some researcher to conclude that teachers who use technology within a traditional teacher-centered model classroom often conceive of and utilize technology as an add-on to what they already do rather than a means of changing their teaching (Cuban, 2013).

Incremental Change

Throughout history there have been many attempts to change the ways teachers understand teaching as well as how they teach, including the introduction of progressive

education (Dewey, 1916; 1938) and integration of various technologies in the classroom (Cuban, 1986; Cuban, 2013). Sometimes changes in education result in some type of fundamental change, for example changing the ways schools are funded or shifting from on-site to on-line schooling. More often, though, change in education is incremental, such as additions to current school structures and curriculum including creating new courses, adjusting class sizes, or introducing new curriculum or technological devices (Cuban, 2013).

According to Cuban (2013), incremental change may be understood to be a "modification" or "alteration" to one's teaching, such as changing the way content is delivered to students (e.g., moving from whole group, lecture-based instruction to small group, discussion-based instruction). In this instance, the teacher still teaches in the same classroom but how he teaches changes. Incremental change may also occur in the ways a teacher assesses students (e.g., shifting from standardized tests to project-based assessments). Again, she is still assessing students but doing so in a different way, in this example placing an emphasis on her students' creation of projects to showcase their understanding, development, and learning.

According to Cohen (1990) although it is most often policymakers who push for educational changes, it is regularly left up to classroom teachers to understand and enact these changes. However, teachers differ in the ways they experience and/or implement incremental changes. For example, even when a teacher values certain pedagogies and content, he may still be required to carry out particular changes such as switching from one curriculum to another, adjusting the types of assessments he uses and administers, or implementing technology in his classrooms. In these instances, others choose, sometimes with the teacher's input, what changes will occur. There are also times when a teacher experiences and implements a change as a result of a shift in her own thinking or understanding. When this happens, the change comes from

within the teacher and, as a result, she chooses to make modifications regarding how she understands and/or enacts her teaching.

According to Cohen (1990), there are two important ways teachers experience and respond to incremental change. Cohen used the metaphor of weaving, in which "the practice of teaching comprises many different threads" (p. 314). Connected to this metaphor, he posited that when a new instructional thread is introduced (i.e., an incremental change), teachers must relate it to their already established fabric of teaching.

> The new thread can simply be dropped onto the fabric, and everything else left as is. Or new threads may be somehow woven into the fabric. If so, some alteration in the relations among threads will be required. Some of the existing threads might have to be adjusted in some way, or even pulled out and replaced. (p. 314)

In other words, change requires teachers to make various modifications to their teaching fabric. Even as threads are dropped, woven in, adjusted or sometimes pulled out, many parts of a teacher's fabric often remains the same, resulting in "an uneasy equilibrium of stability and change" (Cuban, 2013, p. 170). This means that even as incremental changes occur, teachers' core teaching practices and beliefs often do not.

"The Case of Mrs. Oublier"

Connected to the ways in which teachers weave their teaching fabric when confronted with a change, Cohen (1990) shared the case study of Mrs. Oublier, someone who was "engaging…considerate of her students, eager for them to learn, energetic and attractive" (p. 311). In her fourth year of teaching second grade, Mrs. O, as he referred to her throughout the study, experienced an incremental change, namely a state-led effort to modify the way K-12 math was taught and learned. After receiving training connected to teaching for students'

mathematical understanding, Mrs. O. willingly implemented the new curriculum. From her vantage point, the curriculum positively changed her teaching and improved her students' achievement. Based on Cohen's understanding of the state's new mathematical framework and informed by the time he spent in Mrs. Oublier's classroom, though, he believed that her teaching actually remained largely the same as before she implemented the new curriculum.

As Cohen's (1990) story of Mrs. Oublier indicated, many incremental changes "preserve large elements of the old order" (p. 324). Mrs. Oublier dropped new threads onto her teaching fabric rather than adjusting and replacing threads to make room for new ones. As a result, "Mrs. O. had considerable discretion to change her teaching, and she has done so in ways that seem[ed] well-adapted to her school….her superiors celebrate[d] her work" (p. 328). According to Cohen, even as Mrs. Oublier attempted to embrace a new way of understanding and teaching, she still largely relied on old ideas, inherited practices, and what she had done in the past. As a result, the ways in which she understood and experienced the change of a new mathematics curriculum produced a "tangled" (p.312) combination of old and new practices which resulted in "mixed practice" (p. 323). Despite her claims of changes in her teaching and students' achievement, she still continued to enact teaching that was similar, if not the same, compared to what she did prior to the change in curriculum.

The reason Mrs. O.'s story is included here is because it illustrates the ways in which some teachers experience and respond to incremental changes. Teachers are often willing to make changes and they implement them in the ways they understand them. This often means dropping new threads onto existing fabric, rather than adjusting and removing threads to make room for the new ones. Although policymakers intend for incremental educational changes to lead to improved, if not transformed practices, as well as increased student learning and

achievement, this is not necessarily the case (Cuban, 2013). Mrs. Oublier's story is one example of how and why because teachers "cannot simply shed their old ideas and practices like a shabby coat, and slip on something new. Their inherited ideas and practices are what teachers and students know, even as they begin to know something else" (Cohen, 1990, p. 323).

Mrs. Oublier in a 1:1 iPad Classroom

Similar to the new mathematics framework and curriculum Mrs. Oublier sought to implement, the addition of 1:1 technology is another example of a policymaker and district-level initiated incremental change many teachers experience. Like other changes, 1:1 technology introduces another layer of complexity to teaching and learning (Cuban, 2013; Harbough & Cornelius-White, 2013). Like Mrs. O., many teachers choose to utilize 1:1 technology in ways that align with how they taught previously and in doing so, they lay this new thread on their existing teaching practice fabric (Cohen, 1990). For example, in a 1:1 classroom rather than projecting notes onto an overhead classroom screen, a teacher may require his students to use their 1:1 devices to access lecture notes and materials during in-class instruction. Or, a teacher might provide her students with .pdf versions of worksheets they are expected to complete electronically, compared to previously using pens or pencils with hard-copy versions of the same documents.

However, it is also possible that when teachers enact instruction in a 1:1 digital device classroom, they may be able to work toward making marked changes to their practice, instead of dropping threads on their teaching fabric they adjust and remove some to make room for new ones. This is sometimes called an evolutionary approach, in which a teacher's understanding and practice evolves to allow for opportunities to adjust and remove certain threads to make room for new ones. When this occurs, research indicates that these teachers will actually experience more

success in changing their teaching practices than those who choose to keep their practice the same or similar to what it was prior to the change (Zhao, Pugh, Sheldon, & Byers, 2002). Considering the different ways teachers metaphorically weave their teaching fabrics, the introduction and implementation of 1:1 technology in the classroom differs from teacher to teacher. For example, some teachers may (knowingly or unknowingly) become another Mrs. Oublier, in which they drop 1:1 technology onto their existing teaching fabric, believing they have changed a great deal, but to an outside observer the change in their fabric may be much less (or not at all) noticeable. Others may incorporate and weave in new threads with the old, resulting in changes that blend old and new pedagogy and practice together. Still others may utilize new knowledge and understanding within the 1:1 classrooms in which they teach. When this occurs, teachers remove and replace particular threads with new ones which results in teachers planning and enacting teaching in different and sometimes new ways.

Therefore, it is important to learn more about the ways in which teachers who teach in 1:1 classrooms think about and use 1:1 technology in their planning and teaching. In what ways do they use the 1:1 technology to perpetuate the same types of pedagogy and practice they utilized prior to the implementation of 1:1 devices? Or, in what ways might technology move teachers toward different practices? These are important questions and in order to gain an in-depth understanding of the ways teachers make sense of 1:1 technology in their teaching, it is important to study and learn from K-12 educators in the 1:1 schools and classrooms in which they teach.

Watertown Public Schools

One place where 1:1 technology has been implemented is Watertown Public Schools (WPS) (pseudonym), a suburban Midwestern school district that implemented 1:1 technology as

part of a bond-based technology initiative. WPS's bond-based 1:1 technology initiative represented an incremental change and one of the results of this district's technology initiative was that teachers and students had more hardware and software available. For example, in terms of hardware, every classroom in the district was equipped with a ceiling-mounted overhead projector, classroom speakers, and a teacher work station which included a desktop computer and inputs for an iPad. The bond also provided secondary teachers and students with school-owned iPads which they use on and off site during the school year. These iPads also contained numerous teacher and student selected application (apps) to connect users to the Internet, access information and texts, play games, and complete school work, among others.

Lei and Zhao (2008) call for additional research to examine teacher uses and outcomes as well as teacher learning with regard to 1:1 technology initiatives. Part of this research, they suggested, should focus on ascertaining how, when, and why teachers choose to integrate 1:1 technology into their content area(s) as well as particular factors that contributed to teachers' perceptions and usage. WPS's addition of hardware and software in the form of 1:1 iPads presented opportunities to study and understand the teachers who used 1:1 technology. Therefore, given their 1:1 initiative and WPS's willingness to allow me to study teachers in their 1:1 iPad classrooms, I designed and implemented a case-based study of four secondary WPS teachers focused on answering two questions. First, *according to these teachers, in what ways, if any, does teaching with 1:1 iPads change how they think about or enact teaching?* Second, *when teaching with 1:1 iPads, what funds of knowledge do secondary teachers use when planning and enacting their instruction?*

CHAPTER TWO

Literature Review and Theoretical Framework

Educational Technology

Technology is the creation of and knowledge related to tools humans use to adapt to and control the world in which they live (Borko, Whitcomb, & Liston, 2009). Based on survey results from the U. S. Department of Education connected to the types of educational technology K-12 educators have and use, the term "technology" was narrowly defined "as computers, devices that can be attached to computers, networks and computer software" (Gray, Thomas, & Lewis, 2010, p. 2). However, when connected to education, Januszewski and Molenda (2008) suggested that "educational technology," conceptually, is "the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" (p. 1). When utilizing this conceptual definition, educational technology includes analogue tools (e.g., pencils, chalkboards, overhead projectors) as well as newer, digital tools (e.g., Internet, email, video games, laptop and tablet computers). Although analogue educational technologies are already embedded in almost all levels of the nation's public school system, the potential for digital educational technologies continues to expand (Borko, Whitcomb, & Liston, 2009).

A specific type of digital educational technology is information communication technology (ICT) which is "used for accessing, gathering, manipulating and presenting or communicating information. These technologies could include hardware (e.g., computers and other devices); software applications; and connectivity (e.g., access to the Internet, local networking infrastructure, videoconferencing)" (Toomey, 2001, as cited in Lloyd, 2005, p. 3). ICT includes the various digital technologies themselves as well as the ways in which these

technologies interact and connect with one another through hard-wired or wireless connections. ICT connects classrooms, school buildings and humans locally and worldwide, and it is an important element of educational technology (Lloyd, 2005). ICT, such as laptop and tablet computers, also has the potential to change the classroom and school environment, altering the ways educational professionals understand and execute administrative, teaching, and learning tasks (Harbough & Cornelius-White, 2013). Furthermore, educational technology, particularly ICT, offers opportunities for teachers and students to expand communities of learners and learning (Law, 2010).

K-12 Teachers and Educational Technology

According to the International Society for Technology in Education's (ISTE) Standards (2012) regarding teachers' uses of technology dictate that K-12 educators must continue to learn about and use new and existing technology. These uses should promote student learning, achievement, independence, and responsible use, among other things (Borko, Whitcomb, & Liston, 2009). However, how and why teachers use analogue and digital educational technologies in their classrooms often depends on the contexts in which they teach. It also depends on specific teacher characteristics, such as educators' pedagogical stances toward constructivist teaching, higher or lower levels of confidence with regard to using technology, and the efficacy of incorporating technology in the classroom (Hennessy, Ruthven, & Brindley, 2005; O'Dwyer, Russell, & Bebell, 2004). Furthermore, technology continues to change (Straub, 2009) which means that the ways teachers think about and use educational technology(s) also change, making it an important area of study.

Teachers' uses of educational technology are also complex (Windschitl & Sahl, 2002). When teachers use technology, one hope is that technology will shift teachers' pedagogy and

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make their teaching more student-centered (Hennessey, Ruthven, & Brindley, 2005). For example, Hughes (2005) found that when teachers understood and learned about content-specific examples regarding how to use certain technologies in their classrooms, teachers placed a higher value on the technology itself and could more readily imagine how to use it in their own content area(s) to promote students' learning.

This hope, though, is not always realized. In a study Judson (2005) conducted of 32 classroom teachers, even when teachers claimed to have student-centered beliefs about teaching and learning, they did not necessarily use technology in ways that supported these beliefs. Similarly, Gorder (2008) analyzed survey data from 174 South Dakota K-12 teachers regarding their integration and use(s) of instructional technology. These teachers' responses indicated that although they used technology to deliver instruction, their uses of technology remained teacher-centered. In other words, even when integrating technology into their teaching, teachers did not plan for or incorporate student use of technology, nor did these teachers use technology to extend students' learning or connect ideas across content. Similarly, incorporating technology into schools and classrooms does not necessarily mean that teachers' pedagogy and/or their practices shift or change at all (Hughes, 2005; Windschitl & Sahl, 2002).

Given the steady influx of technology in K-12 classrooms that enables direct access to a wealth of information and tools, Wagner (2008) suggested that teachers must be reoriented from *teachers being the source of information* to *teachers being facilitators of learning*. To do so, teachers must integrate technology into their classrooms and content areas in ways that promote student thinking, foster students' independence and interdependence, and afford students opportunities to work alone and collectively in order to further learn and develop skills. Like

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educational technology, K-12 teacher knowledge related to educational technologies and its uses is also constantly expanding (Borko, Whitcomb, & Liston, 2009).

As teachers' knowledge of educational technology continues to increase, there is also a push for teachers to use as much technology as possible. Part of this "push" is for teachers to use technology to prepare students for their futures. One way teachers are expected to do this is to train their students as technologically advanced independent thinkers and workers (Boling & Beatty, 2012). Given this, educators need to not only know and understand their content, they also need to understand the ways in which educational technology can transform the delivery of content as well as facilitate students' learning (Spires, Wiebe, Young, Hollebrands, & Lee, 2009).

1:1 Technology in K-12 Classrooms

In conjunction with the recent proliferation of educational technology as well as the desire many have to see more technology incorporated into educational settings, there is an increased emphasis on integrating 1:1 technology in K-12 schools and classroom. This desire is often the case because 1:1 technology in educational settings is purported to increase productivity, promote higher level thinking, motivate students, and increase student achievement (Gulek & Demirtas, 2005). As a result, teacher and student access to technology, in and out of schools, continues to increase. For example, in educational settings in 1981 the ratio of students to computers was 1:125 but by the year 2000, the ratio was 1:5 (Cuban, 2001). Today, in many cases, the ratio of educational technology to students and teachers is 1:1 (Johnson, Becker, Cummins, Estrada, Freeman & Ludgate, 2013). As evidence, the latest trend of using 1:1 digital devices is the use of tablets, in which all students and teachers possess and use these wireless, Internet-connected, hand-held devices for teaching and learning (e.g., Fronick, 2012; Lamendola,

2012). However, in the midst of adopting a 1:1 device model many teachers often use these devices at the same time they are figuring out the affordances and limitations of the technology(s).

The addition of ubiquitous digital technology in a classroom (i.e., 1:1) in and of itself does not add value. Rather, it is how the 1:1 digital technology is applied, which includes teachers' understanding and uses of 1:1 technology (Lehmann & Livingston, 2011). Therefore, we must study teachers' thinking and enactment related to their use(s) of 1:1 devices (Spires, Wiebe, Young, Hollebrands, & Lee, 2009). Environments that comprise 1:1 technology include laptops for every teacher and student (Windschitl & Sahl, 2002) and mobile laptop carts or handheld digital devices utilized by everyone in the classroom (Hew & Brush, 2007). According to Crichton, Pegler, and White (2012), there is a lot of "hype" connected to handheld, 1:1 technologies (e.g , laptops, smart phones, tablets, etc.), one reason being the extensive and expensive marketing and publicity (Hedman & Gimpel, 2010). Most recently, there appears to be a lot of "hype" regarding the iPad, one of the many 1:1 digital devices being adopted in large quantities by many U. S. school systems such as Los Angeles Public Schools (Strauss, 2013), Baltimore County Public Schools (Dance, 2013), as well as Fresno Unified School District, Alexandria City Public Schools, and Lake Tahoe Unified School District (Wilson & Gielniak, 2012). Adoption of 1:1 technology in K-12 settings continues to increase and according to a recent press release from Futuresource Consulting, shared by PR Newswire (2013), almost ten percent of K-12 students worldwide will possess and use a 1:1 digital device by the year 2017.

Evidence and use of 1:1 technology integration in K-12 schools continues to appear in local and national news (e.g., Cetrone, 2012; Curtis, 2012; Fielder, 2014; Herold, 2013). However, according to a series *The New York Times* conducted, not everyone is confident that

more technology makes things better, nor do all teachers know how and when to use it well (Richtel, 2012). Despite this, one of the reasons 1:1 technology is being widely adopted is because many people believe, "using laptops and tablets will transform traditional teaching" (Cuban, 2012, p. 1). At this point, however, it is unknown whether this is or will become the case. In earlier studies, Cuban (2001) found that integrating technology into the classroom did not necessarily change the way teachers taught. Separately, Christensen (2008) focused on the uses of classroom technology, computers in particular, and found that although teachers integrated the technology into their classrooms, the technology did not necessarily increase project-based and/or student-centered teaching practices. To some degree, this was due to the fact that "schools have crammed the computers into the existing teaching and classroom models. Teachers have implemented computers in the most common-sense way – to sustain their existing practices and pedagogies rather than displace them" (p. 84). In other words, teachers used technology (i.e., computers) to perpetuate pre-existing teacher-centered pedagogy and practice(s) rather than using technology to shift themselves and their teaching to student-centered pedagogy and practice(s).

Even though teachers are in charge of planning for and structuring students' learning, teachers do not all experience, think about, or use 1:1 technology in the same ways (Bebell & Kay, 2012; Garthwait & Weller, 2005; Kozma, 2003). When teachers considered themselves active participants within a 1:1 initiative, as teachers in Sprenger's (2010) study of Pennsylvania teachers who participated in a 1:1 laptop initiative did, participants reported that being part of the initiative changed some of the ways they taught. The decisions teachers make and the ways they think about and use 1:1 technologies in their classrooms is important to understand, particularly as humans forge ahead into an era of increasing ubiquity of 1:1 technology in K-12 schools.

Additionally, teachers and students are the end users of 1:1 technology in schools and their experiences with these initiatives and the technologies warrant study.

Drawing on other scholars' work, Straub (2009) outlined various stages of teachers' use(s) of technology. The first stage (i.e., stage zero) is when teachers are aware of a particular technology but do not use it. The last stage (i.e., stage six) is when teachers focus on ways to improve technological implementation and use, extending it to meet students' needs and learning. Straub's (2009) stages offer a way to examine, understand and, loosely, classify teachers' rationales for and actual uses of technology in their classrooms. Straub's (2009) stages are included as evidence of how some scholars focus on and conceptualize the ways in which teachers *use* technology. However, this scholarship does not often account for the ways teachers *understand* or *think* about technology, which is an important pre-cursor to teachers' actual uses because understanding and thinking most often informs use (Inserra & Short, 2012; Zuber & Anderson, 2013).

Scholars continue to study the ways teachers understand and use technology in their classrooms and there are a variety of ways to conceptualize educators' ideas and uses, sometimes studying levels of confidence with technology and at other times examining particular beliefs regarding technology (Ertmer & Ottenbreit-Leftwich, 2010; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). However, unlike studies of teachers who were identified as possessing a strong sense of self-efficacy regarding technology and technology integration (e.g., Becker & Anderson, 2001; Pattee, 2011), this study centers on teachers identified not for specific characteristics, beliefs, or uses of technology but, rather, because they taught in a 1:1 technology context in which all teachers were expected to use 1:1 educational technology (i.e., iPads),

regardless of their subject areas, years of experience, previous experiences, teacher knowledge, or how much they knew about the device and/or how to use it.

Teacher Knowledge

No matter what or who teachers teach, they need knowledge (Shulman, 2004a). The knowledge one needs to teach is dependent on one's possession of and access to various types of knowledge (Glaser, 1983; Putnam & Borko, 2000; Shulman, 2004a, 2004c). According to Grossman and Richert (1988), teacher knowledge is the "body of professional knowledge that encompasses both knowledge of general pedagogical principles and skills and knowledge of the subject matter to be taught," (p. 54). Connelly, Clandinin, and Fang (1997) suggested that teacher knowledge also includes teachers' "personal practical knowledge," which is located in a teacher's practice and is knowledge teachers acquire from previous teaching and life experiences in order to makes sense of present and future situations. Teachers construct knowledge about schooling, teaching, and learning (Cochran-Smith & Lytle, 1993) and this knowledge is acquiredand learned over time (Wilson & Berne, 1999).

This need for continued learning is, in large part, because developing new skills and knowledge for classroom application is a multifaceted, complex endeavor (Borko, 2004; Garet, Porter, Desimone, Birman, & Yoon, 2001). Therefore, teacher knowledge is a concept that embodies many aspects of what educators need to know and be able to do and it forms the foundations for teachers' thinking and actions (Borko & Putnam, 1995). It is also situated within the contexts of schools, classrooms, teaching, and communities (Moll, Amanti, Neff, & González, 2005; Putnam & Borko, 2000; Shulman, 2004b, 2004c). The knowledge teachers develop over time also informs the plans they prepare, the decisions they make, and the practices they enact.

Within their own teaching and classrooms, teachers draw upon their knowledge to communicate information to students about subject matter (Loewenberg Ball, Thames, & Phelps, 2008). Using their teacher knowledge and given the contexts in which they teach, educators are expected to regularly identify what and how to teach the students in their classroom (Kennedy, 2005; Lampert, 1984). Moll, Amanti, Neff and González (2005) suggested that teacher knowledge must also include a contextual understanding of their students' out-of-school settings, particularly their homes. In this way, the cultures of students may be invited into the teaching and learning processes that occur within schools and classrooms. According to these researchers, understanding the contexts in which students live and work broadens teachers' understanding of their students and increases teachers' knowledge about teaching and learning processes with their particular students. With regard to the types of knowledge a teacher uses when planning for and teaching, Shulman (2004a) argued "that there exists an elaborate knowledge base for teaching" (p. 226) and Shulman sought to outline and define particular funds of teacher knowledge used to develop and support student comprehension and learning. In doing so, he developed seven "categories," also referred to as "funds" of teacher knowledge (Table 1).

Table 1.

Shulman's (2004a) "Categories of the [Teacher] Knowledge Base" (p. 227)

Content Knowledge;
General Pedagogical Knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend subject matter;
Curriculum Knowledge, with particular grasp of the materials and programs that serve as "tools of the trade" for teachers;
Pedagogical Content Knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding;
Knowledge of Learners and their Characteristics;
Knowledge of Educational Contexts, ranging from the workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures;

Table 1 (cont'd)

Knowledge of Educational Ends, purposes, and values, and their philosophical and historical grounds

In this list contained in Table 1 (cont'd), Shulman provided descriptions for five of the seven categories. In this instance, he did not provide descriptors for content knowledge and knowledge of learners and their characteristics. However, elsewhere he described content knowledge as "the knowledge, understanding, skill, and disposition that are to be learned by school children" (p. 228). Shulman also defined knowledge of learners and their characteristics as a teacher's understanding of the individual and collective students in their classroom. Moll, Amanti, Neff and González's (2005) also suggest that teachers' knowledge regarding their students should be "strategic" and such knowledge, if it is to benefit teachers' practice and students' learning must also include knowledge of students' lives in the homes and community(s) in which they and their families live. These researchers' work makes clear that the contexts in which students live and learn are an important part of teachers' knowledge.

Although by no means an exhaustive list, Shulman (2004a) argued that his seven funds of knowledge illustrate the ways in which teaching is a complex endeavor. These funds also support the idea that teachers need multiple ways of knowing in order to teach for student comprehension and understanding. In parsing out and defining seven different funds, Shulman sought to make clear that *the knowledge bases teachers needed dealt directly with the purposes of education as well as the methods and strategies for educating students*. Teachers need to know a great deal and they enact their teaching based on what they know because "formal knowledge can provide ways of thinking and alternative solutions, but the teacher must [also] decide what the specific situation requires" (Feiman-Nemser, 2012, p. 34). This often requires multiple ways of knowing and doing, as captured in Shulman's (2004a) seven categories as well as Moll, Amanti, Neff and

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González's (2005) work focused on teachers' funds of knowledge, particularly those funds, such as knowledge of learners and knowledge of educational contexts, associated with the contexts in which students live and learn. Messing's (2005) findings from a study of teachers involved with the "Funds of Knowledge Project" also supports the notion that teachers have multiple ways of knowing and doing.

Moll, Amanti, Neff and González (2005), Messing (2005) and Shulman (2004a) highlight the fact that teaching requires multiple ways of knowing because teachers work in different communities, schools, and classrooms and they teach various subjects and students. Within their classrooms, teachers' various knowledge funds often guides the instructional decisions they make (Sztajn, Confrey, Wilson, & Edgington, 2012). As a result, teachers should not rely on just one fund of knowledge when they plan for and/or enact teaching. Instead, when teachers plan for student learning and teach, they often (although not always consciously) intertwine and integrate the knowledge they have regarding the purposes of education with their understandings of methods and strategies. To illustrate the use of this integrated knowledge, Shulman (2004a) shared the case study of Nancy, who was a veteran high school English teacher with twenty-five years' experience. As a result of utilizing multiple funds of knowledge almost all the time, "not much happened in the classroom that did not pass through Nancy, whose pacing and ordering, structuring and expanding, controlled the rhythm of classroom life" (p. 219).

In his discussion of a lesson Nancy taught connected to the novel *Moby Dick*, Shulman reported that when Nancy planned and when she taught, she drew upon multiple knowledge bases, often combining and relying on more than one at a time, something Leinhardt and Greeno (1986) termed, "schemata," namely a "complex knowledge structure composed of interrelated sets of organized actions" (p. 75). In Nancy's case as well as other teachers' planning and

teaching, the knowledge she and others rely upon results in "interrelated sets of organized

actions" (Shulman, 2004a, p. 219). Spiro, Feltovich, Jacobson, and Coulson (1995) termed this

process of knowledge application and integration "cognitive flexibility". According to Shulman

(2004a), Nancy demonstrated and utilized cognitive flexibility to draw upon and integrate

multiple funds of knowledge. He explained, "whichever work she was teaching, she understood

how to organize it *[i.e., content knowledge; curriculum knowledge]*, frame it for teaching *[i.e.,*

general pedagogical knowledge; pedagogical content knowledge; knowledge of learners and

their characteristics]; divide it appropriately for assignments and activities *[i.e., content*

knowledge; curriculum knowledge; pedagogical content knowledge; knowledge of learners and

their characteristics]" (p. 221). Nancy's planning and enactment of teaching illustrate the ways

in which a teacher draws upon multiple and varied knowledge bases, often simultaneously.

> Nancy's pattern of instruction, her style of teaching, is not uniform or predictable in some
>
> simple sense. She flexibly responds to the difficulty and character of the subject matter,
>
> the capacities of the students (which can change even over the span of a single course),
>
> and her educational purposes. (p. 222)

Nancy's case provided an image of the integrated nature of teacher knowledge at work in one

experienced teacher. It also provides a model for the ways in which teachers can develop and

utilize various funds of knowledge, such as Shulman's seven bases, which means that "teaching

like Nancy's can become typical instead of unusual " (p. 222). The hypothesis is that when

teachers seek to know more and integrate and use what they know (i.e., employing cognitive

flexibility), they will improve their teaching and more readily contribute to their students'

learning and growth. Shulman does not include references to Nancy's "personal practical

knowledge" (Connelly, Clandinin, & He, 1997) or to Nancy's specific knowledge of students'

cultural and personal experiences and lives outside school (Moll, Amanti, Neff and González (2005). However, embedded within this example is evidence of Nancy drawing upon multiple funds of knowledge as she teaches and assesses her students' learning. Nancy's example demonstrates that teacher knowledge is flexible, multi-faceted, and necessary for teachers and their teaching.

Teacher Knowledge and Technology

Shulman's (2004b) funds of knowledge also "underscore the need for teachers to be continuous learners" (p. 513). This need to be continuous learners is the case because over time what teachers need to know and be able to do changes. Throughout their careers, teachers must intentionally and continually add to one or more bases of knowledge (Shulman, 2004a). In doing so, teachers employ cognitive flexibility (Spiro, Feltovich, Jacobson, & Coulson, 1995). However, in addition to utilizing one or more of these seven funds of knowledge, it is possible that a substantial change may occur in schools, teaching, or learning which requires the creation of a new and different fund of knowledge. Over the last thirty plus years, one such change has been the widespread interest in and integration of technology in classrooms and teaching (Cuban, 2001; 2013). This change resulted in additional knowledge teachers need to acquire and use.

Given the time and context in which it was written, Shulman's (2004a) work does not include a knowledge base specifically connected to technology. Due to more recent educational technological expectations and changes, including the increased integration of technology in K-12 classrooms, Koehler and Mishra (2005; 2009) and Mishra and Koehler (2006) argued that teachers also need "technological knowledge". They explained that since the 1980s technology has played an important role in K-12 education because of the increasing availability of new, and

mostly digital, technologies as well as the growing requirements for understanding about and learning how to apply these technologies to teaching.

However, Mishra and Koehler (2006) did not add a technology-related knowledge fund to Shulman's (2004a) original list of seven knowledge bases. Instead, they focused on Shulman's work with pedagogical content knowledge (PCK) because

> pedagogical content knowledge is of special interest because it identifies the distinctive bodies of knowledge for teaching. It represents a blending of content and pedagogy into an understanding of how particular topics, problems or issues are organized, represented, and adapted to diverse interests and abilities of learners, and presented for instruction. (Shulman, 1987, p. 8, cited in Mishra & Koehler, 2006, p. 1021-1022)

Mishra and Koehler (2006) reasoned that using PCK was important because "it is valued as an epistemological concept that usefully blends the traditionally separated knowledge bases of content and pedagogy" (p. 1022). As a result, Mishra and Koehler (2006) and Koehler and Mishra (2009) focused on and examined the interplay between content knowledge, pedagogical knowledge, and technological knowledge. At the center of this interplay is technological pedagogical content knowledge (TPACK), a particular type of knowledge teachers utilize when they integrate content, pedagogical, and technological bases of knowledge (Figure 1).
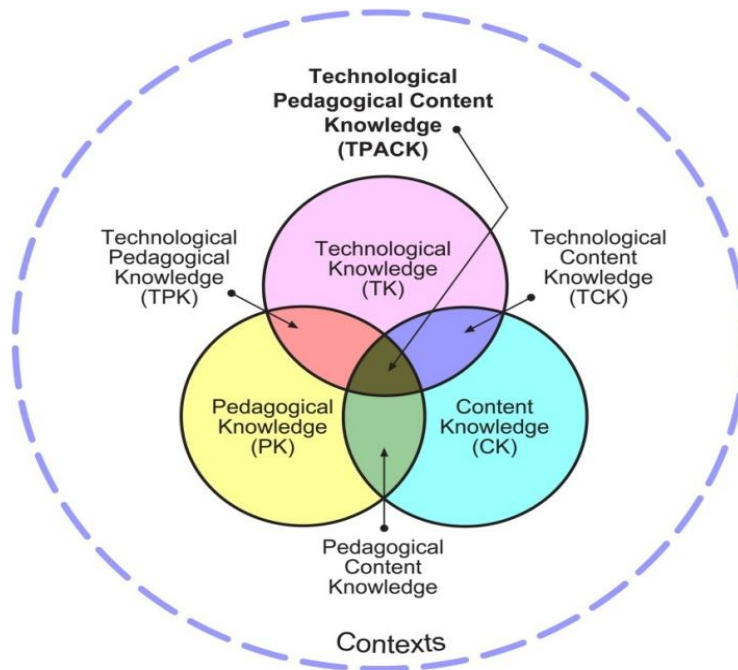
Figure 1. Koehler and Mishra's (2009) Technological Pedagogical and Content Knowledge

(TPACK) framework (source: http://tpack.org and reproduced by permission of the publisher, ©

2012 by http://tpack.org)

     According to Koehler and Mishra (2009), TPACK is the metaphorical "sweet spot" for

teachers when they plan for and teach with technology. This is because when utilizing their

TPACK, teachers utilize cognitive flexibility (Spiro, Feltovich, Jacobson, & Coulson, 1995) and

engage all three knowledge bases at the same time. Doing so enables them to create content-

centered, learning-appropriate, and technologically-enhanced learning opportunities. Koehler and

Mishra's (2009) work with TPACK is a theoretical framework focused on the thinking and work

teachers do when they access and integrate technological knowledge with their pedagogical and

content knowledge. For example, when using TPACK to examine teachers' knowledge when

teaching with technology, "effective teaching requires knowledge of both the activity

structures/types that are appropriate for teaching specific content and the manners in which

particular technologies can be utilized as part of the lesson, project, or unit design" (Harris,

Koehler, & Mishra, 2009, p. 406). Mishra and Koehler (2006) suggested that using the TPACK framework provides opportunities to further understand the "complex web of relationships that exist when teachers attempt to apply technology to the teaching of subject matter" (p. 1044).

Koehler and Mishra (2009) also posited that technology integration in K-12 educational settings requires teachers to know and understand the relationships between pedagogy, content, and technology. For example, if a teacher chooses to integrate an interactive white board during a particular lesson, she must combine her understanding of the content she wants to teach, the best way to teach that content to her students, and the best way to effectively utilize the interactive white board to promote student learning. In this case, the teacher's content and pedagogical knowledge is integrated with her technological knowledge to support and extend her students' learning. When drawing upon TPACK teachers plan their instruction based on content-specific pedagogy, which is aided by carefully selected and implemented technologies (Harris, Koehler, & Mishra, 2009).

In addition to including another element of teacher knowledge, namely technological knowledge, the TPACK conceptual framework allows researchers to identify relationships between particular elements of teacher knowledge and teachers' integration of technology in their content area(s) (Harris & Hofer, 2011; Mishra & Koehler, 2006). According to Harris and Hofer (2011), when a teacher uses TPACK she utilizes technology according to the content and type of learning activity selected. To illustrate, for a review activity connected to the study of World War I (WWI), a secondary social studies teacher may want to ensure her tenth grade students' conceptual and factual understanding of the events leading up to World War I. To do this, she could require them, individually or in small groups, to utilize a web-based timeline creator such as TimeToast ([www. timetoast. com](www.timetoast.com)) or an online concept map maker such as or

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Bubbl (www. bubbl. us). The content centers on the facts and events connected to the start of WWI, which informs the technology she chooses to use, in this case a web-based timeline maker or concept map generator. Whether the implementation of the activity is individual or group-based is determined by the teacher's pedagogical understanding of her students' needs and learning styles. In this instance, the teacher's content knowledge, technological knowledge, and pedagogical knowledge worked together during the planning and teaching of this review lesson.

However in K-12 classrooms, teachers who use and teach with technology draw upon and integrate more than TPACK. Teaching requires many different types of teacher knowledge, particularly in classrooms in which teachers and students use technology (Margerum-Leys & Marx, 2000). For instance, in the example regarding the high school social studies teacher and the WWI unit review lesson, in addition to utilizing TPACK, it is likely this teacher will also draw upon other funds of knowledge outlined in Shulman's (2004a) original list. For example, she may access her knowledge of standards and curriculum, including the school-mandated end-of-unit test her students must take, in which they have to create a timeline similar to the one they complete in the review activity. She may also utilize her knowledge of educational contexts, including the expectation her school administrators and students' parents have of her and her colleagues regarding the district's mandated use of technology, due in part to the passage of a recent bond which outfitted the high school with laptop computers for student use. Of course, there are additional funds of knowledge this teacher may also access, depending on her specific circumstances. So, although this teacher utilizes TPACK in her planning and teaching, more than likely she also draws upon other funds of knowledge when she plans for and teaches with technology.

Teachers' reliance on multiple funds of knowledge is supported by other researchers' work, in which teachers' rationales for and uses of technology in their teaching connect to a variety of knowledge funds beyond TPACK, including knowledge connected to legislators and policy makers, district and school contexts, as well as teacher experiences and beliefs (Bai & Ertmer, 2008; Ertmer, 2005; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Groff & Mouza, 2008). When planning and teaching, teachers must utilize their existing skills and multiple knowledge bases, which influences how they think about and use technology in their classrooms (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). According to case study work conducted by Hughes (2005), the degree to which teachers developed and implemented new (and expanded) technology-supported pedagogy depended in part upon a number of different bases of knowledge teachers acquired and used. Not only are there multiple knowledge bases upon which teachers must draw when they teach with technology, as illustrated in the previous example with the high school social studies teacher, educators often draw upon multiple knowledge bases at the same time because of the integrated nature of teachers' knowledge and teaching.

Theoretical Framework

What Makes Teachers "TIK"?

According to Koehler and Mishra (2009), "teaching with technology is a difficult thing to do well…. it requires continually creating, maintaining, and re-establishing a dynamic equilibrium among all components [i.e., TPACK]" (p. 67). However, TPACK does not represent all the components. In addition to TPACK, teachers must also draw upon other funds of knowledge when teaching with technology (e.g., knowledge learners, knowledge of educational contexts, etc.). The addition of 1:1 classroom technology makes these additional funds even

more apparent. For example, unlike having one document camera, computer, or interactive white board in a classroom or occasionally taking students to a computer lab to complete a project, in 1:1 classrooms technology is in the hands of every person in the room, all the time. Teachers' uses and integration of multiple funds of knowledge in these classrooms is more ostensible because the nature of 1:1 technology is that it extends beyond one-time, teacher centered uses. This technology also has the potential to be used by teachers and students every class period as well as beyond the confines of the classroom and school day. Furthermore, teachers in 1:1 classrooms must also utilize various funds of knowledge in conjunction with their ideas and beliefs about how to use 1:1 technology.

The work of teaching is based on various funds of knowledge and experience (Shulman, 1987), informed by an understanding of *what* needs to be taught, *who* needs to be taught, *how* they need to be taught, *where* they need to be taught, and *why* they need to be taught (Feiman-Nemser, 1983). When integrating technology into the classroom, the TPACK framework may be used to consider and plan for *what* that should be taught as well as *how* it should be taught. The TPACK model also depicts a dashed circle labeled, "Contexts". Connected to this outer "contextual circle," Koehler and Mishra (2009) acknowledged that "teachers operate in diverse contexts of teaching and learning" (p. 62). Presumably, then, in the TPACK model "Contexts" is intended to capture *who*, *where*, and *why* of teaching (Figure 2). However, within the TPACK framework, including Koehler and Mishra's explanations and discussions of it, "Contexts" is not specifically addressed or defined, nor are there particular funds of knowledge connected to the "Contexts" in which teachers teach. However, according to previous research focused on teacher knowledge, context matters (Messing, 2005; Moll, Amanti, Neff and González, 2005), particularly as it informs teachers' understanding of the places in which they teach, the content

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they must teach, the colleagues with whom they teach, and the students for whom they are responsible to teach (Lave & Wenger, 1991). Moreover, teacher knowledge and by extension teachers' actions, are rooted in particular contexts (Bruner, 1996), making contextual knowledge an important part of what teachers need to know and be able to do within the classrooms in which they plan and facilitate student learning.
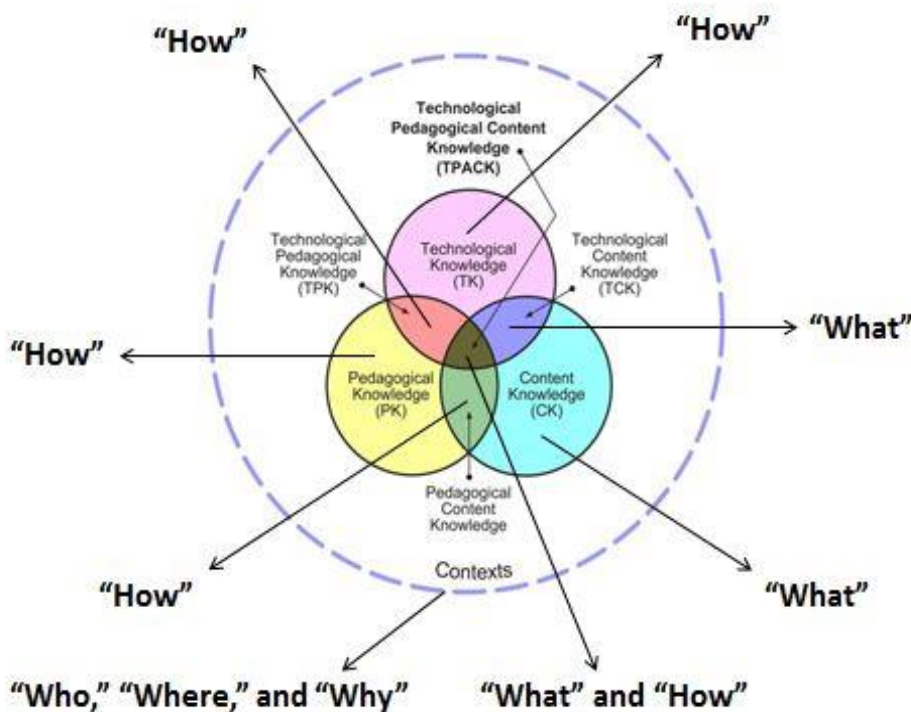
Figure 2. Koehler and Mishra's (2009) Technological Pedagogical and Content Knowledge (TPACK) framework with "How", "What", "Who", "Where", and "Why" identified

In some ways, the TPACK framework most readily applies to the processes involved in accessing existing knowledge as well as acquiring new knowledge to plan for student learning using technology. This makes sense given that the TPACK framework was initially conceived of and developed during Koehler and Mishra's (2005) study of a faculty design course in which college faculty and graduate students worked together to develop online courses. They explained

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that TPACK was a "way of representing what teachers need to know about technology" (p. 131) (i.e., *what* and *how*). It is not a framework that includes specific references to the types of knowledge teachers need to have and use focused on their learners (i.e., *who*), the classrooms, schools, and communities in which they teach (i.e., *where*), as well as their reasons and rationales for education and their role(s) within the larger educational system (i.e., *why*). In their initial study, Koehler and Mishra focused on the content knowledge participants employed, which focused on what needed to be taught (i.e., *what*) in these online courses. They also looked at the technological and pedagogical knowledge participants utilized to figure out how to use technology to communicate and facilitate particular online learning experiences (i.e., *how*). Their study did not include an analysis or discussion regarding their participants' knowledge focused on their individual students (i.e., *who*), the contexts (i.e., *where*) in which they intended to teach, or the particular purposes (i.e., *why*) these participants kept in mind when planning these online courses.

Teachers' knowledge is comprised of multiple funds and according to Ronau and Rakes (2012), when teaching with technology, contextual knowledge (i.e., *who*, *where*, and *why*) plays an important and integral role in teachers' knowledge, which supports the idea that the four knowledge bases from Shulman's (2004a) work not included in the TPACK framework are still important. In Shulman's (2004a) work, contextual knowledge includes knowledge regarding students in the classroom (i.e., knowledge of learners and their characteristics), particular curriculum and standards teachers are required to teach (i.e., curriculum knowledge), the school, district and community in which teachers teach (i.e., knowledge of educational contexts), as well as a teacher's individual beliefs and philosophies about the purposes of education (i.e., knowledge of educational ends).

During the process of designing this study as well as during data collection and analysis, I maintained a socio-cultural perspective regarding teacher knowledge, which included a recognition that teachers' knowledge of various contexts (e.g., classroom, school, community) mattered and that teachers drew upon various funds of knowledge when planning for and enacting their instruction (Bruner, 1996; González, Andrade, Civil, & Moll, 2005; Lave & Wenger, 1991). Furthermore, Shulman's (2004a) seven knowledge bases as well as Koehler and Mishra's (2008) technological knowledge and their TPACK framework aided my thinking regarding particular labels for the funds of knowledge upon which teachers drew. At the same time, separately these scholars' work did not readily allow for a means of capturing or articulating the integrated nature and complexity of teacher knowledge within a 1:1 tablet classroom. For example, it became evident that in addition to possessing and utilizing TPACK (Koehler & Mishra, 2009) this study's participants also drew upon and applied other funds of knowledge. In addition to their TPACK, case study teachers used other funds of knowledge to make decisions about their teaching before, during, and after they taught.

As I attempted to make sense of the types of knowledge and the teaching I observed in the participants' classrooms as well as what I learned during interactions and interviews, it became apparent that these teachers utilized more than the funds highlighted in the TPACK model. In fact, in addition to addressing the "what" and "how" of their teaching, case study teachers also focused on *who*, *where*, and *why* when they planned and taught. Along with TPACK, these knowledge funds also impacted how these teachers planned for and enacted their teaching. For example, they utilized their knowledge of local, state, and national standards and expectations (i.e., Curriculum Knowledge; Knowledge of Educational Contexts). They also drew upon particular content and/or grade level standards and benchmarks, including departmental

"common assessments" and "anchor assignments" their students were required to complete (i.e., Curriculum knowledge; Knowledge of Educational Contexts). Moreover, these teachers regularly considered what they knew about their students – in and out of the classroom – (i.e., Knowledge of Learners), as well as their own philosophies about teaching, learning and the broader purposes of education (i.e., Knowledge of Educational Ends).

Mishra, Koehler, and Kereluik (2009) suggested that "as educators, we need to develop flexible and robust knowledge frameworks that are not dependent on the specific affordances of a particular technology, but rather connect to powerful ideas about teaching and learning" (p. 49). As a result, I sought to create a model of teacher knowledge that identified five elements of knowledge (i.e., *what*, *how*, *who*, *where*, and *why*) teachers used when they planned for and enacted their teaching. Given this, I created the Teacher Integrated Knowledge (TIK) framework in which I utilized Shulman's (2004a) seven knowledge bases along with Koehler and Mishra's (2009) technological knowledge. The TIK framework utilizes the same names (e.g., Content Knowledge, Pedagogical Knowledge, etc.) and some of the general ideas for the knowledge bases contained in Shulman's (2004a) and Koehler and Mishra's (2009) work, with the exception of the addition of the word "standards" to Shulman's (2004a) "curriculum knowledge". Adding the word, "standards" reflects more recent policy shifts and added expectations that teachers are supposed to have knowledge of and utilize standards, particularly the *Common Core State Standards* (National Governors Association Center for Best Practice & Council of Chief State School Officers, 2010). To provide further clarity regarding each base as well as aid in the data analysis process, I maintained Shulman's (2004) ideas connected to each category. However, to clarify meaning and add specificity to the ideas and knowledge funds contained in this model, I generated specific definitions for each of the eight knowledge bases contained in the TIK

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framework. As a result, although the terms are aligned with Shulman's (2004a) and Koehler and

Mishra's (2009) work, the definitions for each are my own. These definitions also integrate and

reflect a socio-cultural perspective (Vygotsky, 1978) in which knowledge is understood as

constructed and developed over time. It should also be understood that the funds of knowledge

contained in the TIK theory are not necessarily static. Throughout their career, teachers continue

to add to these funds. Additionally, the TIK funds of knowledge are not necessarily inclusive of

all knowledge teachers may need to know and use when teaching and planning. Rather, these

funds are intended to capture the broader, contextually-based types of situated knowledge

teachers employ when they plan for and facilitate students' learning.

Table 2.

Definitions of TIK Theoretical Knowledge Bases

Knowledge Base	Description	Type of Knowledge
Content Knowledge [CK]	Knowledge of specific subject area knowledge, including major and minor content areas.	*What*
Pedagogical Knowledge [PK]	Knowledge of general developmental, age, and grade level learning theory(s) connected to how students learn best.	*How*
Technological Knowledge [TK]	Knowledge of technology, including what technology is, what it does, and how to use it.	*How*
Pedagogical Content Knowledge [PCK]	Knowledge of learning theory(s) related directly to specific content area(s) and the pedagogical skills/strategies that work best to teach specific content and content-based skills.	*How*
Standards/Curriculum Knowledge [SCK]	Knowledge of school, district, state, and national standards, (e.g., CCSS, NextGen, etc.), curriculum (e.g., professionally developed and distributed materials and teacher-generated), and assessments (e.g., Smarter Balanced, PARCC, College Board AP, district, and department/grade-level tests, etc.).	*What*

Table 2 (cont'd)

Knowledge of Learners [KL]	Knowledge of classroom students (e.g., grade level(s), ability levels, prior knowledge, post-secondary aspirations, lives outside school, etc.).	*Who*
Knowledge of Educational Contexts [KEC]	Knowledge of contexts, including school(s), district(s), community, state, and national contexts (e.g., rules, values, expectations, cultural norms, policies, etc.).	*Where*
Knowledge of Educational Ends [KEE]	Knowledge of educational purposes and values, including using education to promote democratic citizenship, improve students' standardized test scores, preserve economic stability, generate student awareness and understanding of self and/or world, and prepare students for college and work.	*Why*

Using these definitions in Table 2 (cont'd), I created a visual to represent the TIK framework (Figure 3). In this version of the TIK framework, *who*, *where*, and *why* are highlighted to show how the TIK theory moves beyond TPACK and includes elements.

CK = Content Knowledge
PK = Pedagogical Knowledge
TK = Technological Knowledge
PCK = Pedagogical Content Knowledge

KL = Knowledge of Learners
SCK = Standards/Curriculum Knowledge
KEC = Knowledge of Educational Contexts
KEE = Knowledge of Educational Ends
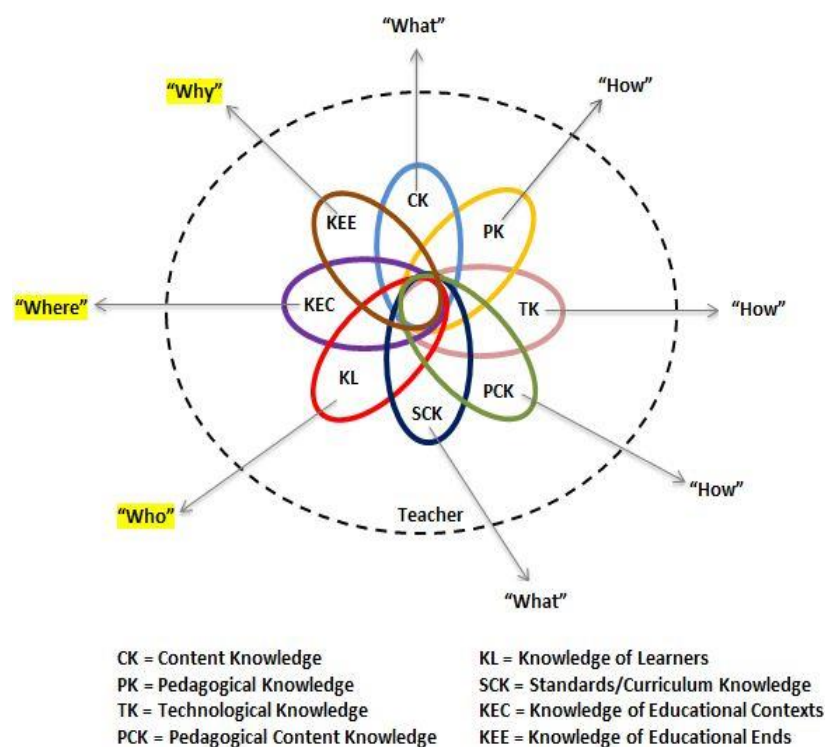
Figure 3. Teacher Integrated Knowledge (TIK) with "who," "what," and "where" highlighted

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In some ways, the TIK framework image (Figure X) is modeled after Koehler and Mishra's (2009) TPACK visual. For example and for consistency, the TIK colors used for Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK) are similar to those utilized in the TPACK visual. There is also one dashed outer circle surrounding the various knowledge funds. In terms of the layout of the funds in the TIK model, rotating clockwise the order of funds keeps TPACK together (i.e., CK, PK, TK, and PCK) with the additional funds following after. The remaining four funds are ordered according to Shulman's (2004a) original knowledge base list.

However, the TPACK and TIK frameworks are different in some important ways. In the TPACK model, the overlap between the three funds has a specific meaning. However, in the TIK framework, the particular order or location of the funds is not important. Rather, it is the ways in which a teacher draws upon these funds (and combinations of funds) that matters. Additionally, the TIK framework includes additional elements connected to teachers' knowledge and their teaching, specifically *who*, *where*, and *why*, highlighted in this visual for emphasis. As noted earlier, *who*, *where*, and *why* are important types of knowledge bases teachers must possess and draw upon when they teach with technology, making it important to specifically include them along with *what* and *how*, contained in the TPACK model.

Additionally, instead of an outer circular dashed line representing "Contexts," as is the case with the TPACK image, the dashed outer line in the TIK image represents the individual teacher. Koehler and Mishra (2009) do not explain why they chose a dashed circle to represent "Contexts". However, in the TIK framework the inclusion of a dashed line is important because there are open spaces between these dashes, symbolizing the ways in which teachers constantly

take in information. As teachers take in information, they make choices regarding the application

of one or more knowledge funds or combinations of funds.

In the TIK framework, the various funds of knowledge are represented by separate

colored lines, illustrating that each fund of knowledge is separate but may be used in conjunction

with one another, given that a teacher's knowledge is flexible and may be combined or linked

with other funds. In this way, the various TIK fund combinations also highlight the integrated

nature and cognitive flexibility of teachers' thinking and knowledge (Spiro, Feltovich, Jacobson,

& Coulson, 1995). The TIK framework demonstrates one possible combination of knowledge

fund intersections, in which a teacher utilizes all eight funds at the same time. Realistically,

although all eight knowledge bases are pictured connecting to one another in this diagram,

participants did not necessarily draw upon all eight funds at the same time or to the same degree.

As a result, the TIK theory also affords opportunities to visually represent the ways in which a

teacher draws upon and integrates knowledge bases to varying degrees when thinking about,

planning for, and executing particular teaching acts.

When employing the TIK framework, the reasons why this study's teachers planned and

taught the ways they did were informed by various knowledge base combinations. For example,

when deciding between using one of two iPad apps focused on particular content, one case study

participant relied on his Content Knowledge (CK) integrated with his Standards/Curriculum

Knowledge (SCK), Technological Knowledge (TK), Knowledge of Learners (KL), and

Knowledge of Educational Ends (KEE) (Figure 4). To represent this combination of knowledge

funds using the TIK framework, the funds upon which the teacher did not draw are represented

by grey, dotted ovals, demonstrating that although these funds still existed within the teacher's

head, in this instance he drew only upon particular funds to make his choice between the two apps.
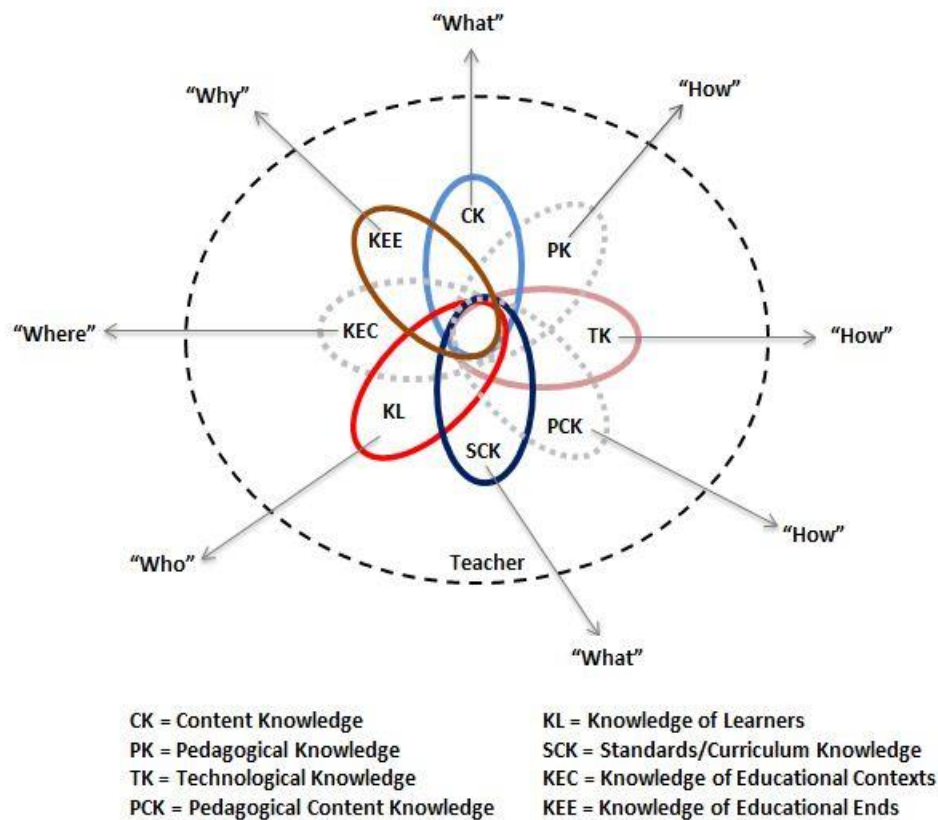
Figure 4. TIK Model (visual to represent a teacher's integration of Content Knowledge (CK), Standards/Curriculum knowledge (SCK), Technological Knowledge (TK), Knowledge of Learners (KL), and Knowledge of Educational Ends (KEE))

In a different instance, noting that there were too many students using their 1:1 devices for non-educational purposes, another case study teacher drew upon and integrated his Knowledge of Learners (KL) and Knowledge of Educational Ends (KEE) and decided to tell his students to put their iPads away during a whole class discussion (Figure 5). As noted earlier, the funds upon which the teacher did not draw are represented by the dotted, grey outlines.

"What"

"Why"

"How"

CK

KEE

PK

"Where"

KEC

TK

"How"

KL

PCK

SCK

"How"

"Who"

Teacher

"What"

CK = Content Knowledge
PK = Pedagogical Knowledge
TK = Technological Knowledge
PCK = Pedagogical Content Knowledge

KL = Knowledge of Learners
SCK = Standards/Curriculum Knowledge
KEC = Knowledge of Educational Contexts
KEE = Knowledge of Educational Ends
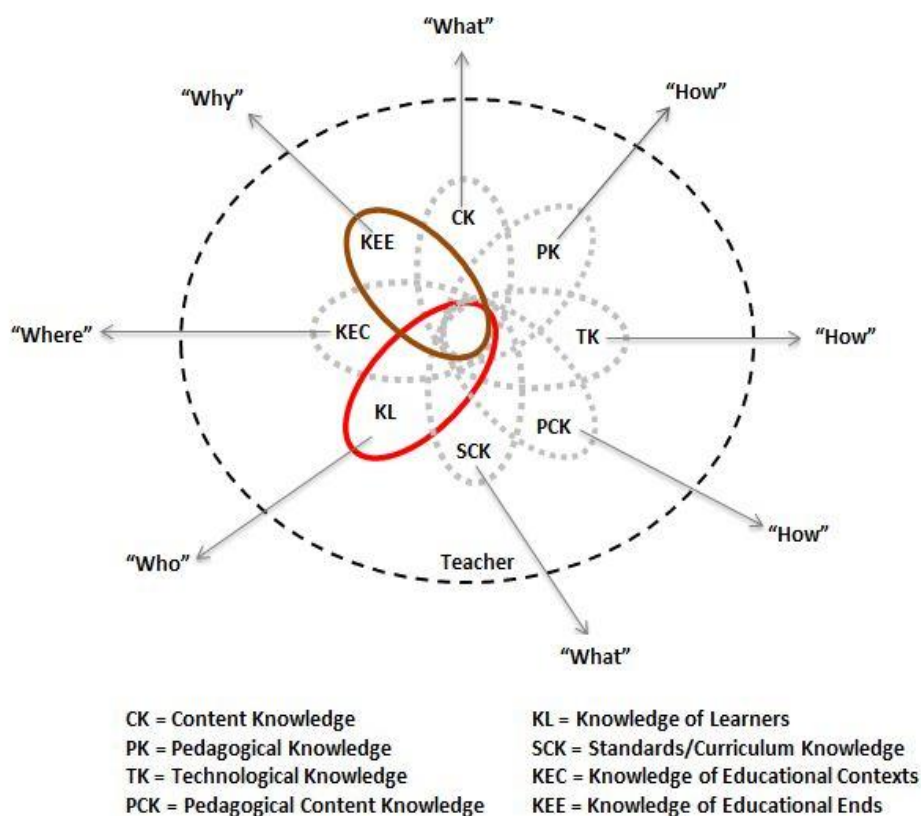
Figure 5. TIK model, (visual to represent a teacher's integration of knowledge of learners (KL) and knowledge of educational ends (KEE))

In both cases, the rationale(s) for teachers' decisions to use or not use 1:1 iPads for a particular lesson, or more generally, required teachers to draw upon more than one fund of knowledge, illustrated by these two versions of the TIK theory "in action". These are just two potential combinations the TIK theory can be used to illustrate regarding the knowledge bases upon which teachers draw upon when teaching in their 1:1 classrooms.

The TIK theoretical framework is a flexible framework that is not intended to highlight the absence or presence of particular funds of knowledge. Rather, this framework offers a way of understanding, identifying, and representing the relative influence in which various funds of knowledge are integrated. In every instance, these funds of knowledge and their integration may be unique to the individual teacher. The TIK framework provides a means of identifying,

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understanding, framing, and analyzing the ways in which teachers think about and use 1:1 technology, specifically the elements of *what*, *how*, *who*, *where*, and *why* (Figure 6).

CK = Content Knowledge
PK = Pedagogical Knowledge
TK = Technological Knowledge
PCK = Pedagogical Content Knowledge

KL = Knowledge of Learners
SCK = Standards/Curriculum Knowledge
KEC = Knowledge of Educational Contexts
KEE = Knowledge of Educational Ends
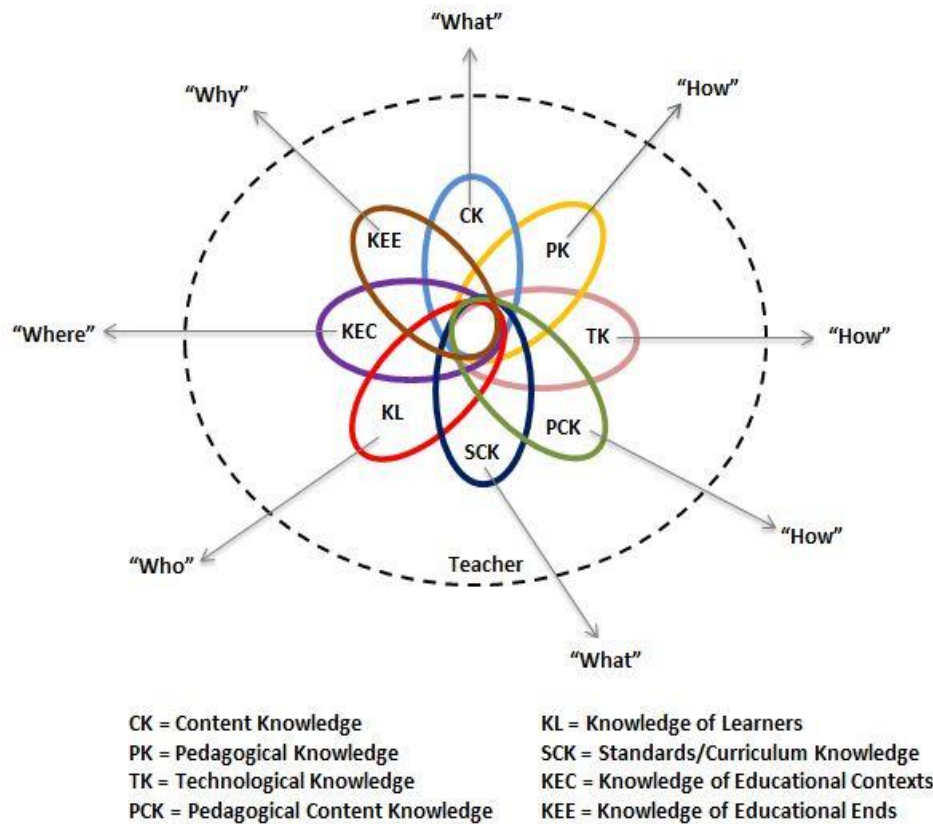
Figure 6. Teacher Integrated Knowledge (TIK) theoretical model

As a result, the TIK theory illustrates the possible intersections and combinations of knowledge bases teachers employ when thinking about, planning for, and executing the act of teaching within 1:1 classrooms. Metaphorically, the TIK framework may also be used to answer, at least in part, the question, "What makes teachers "TIK" when they plan and teach?" As a result, I applied the TIK theoretical framework to this study's data, analyses, and findings to understand the types of knowledge funds as well as the combinations of funds each participant utilized when planning for and enacting their teaching within the 1:1 classrooms in which they taught.

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Looking Ahead: The Structure of the Remainder of this Dissertation

As stated earlier, this is a study about four secondary Watertown Public School District (WPS) teachers and the changes they made as well as what they knew and did as a result of teaching in 1:1 iPad classrooms. Even though this study took place during the second year of WPS's 1:1 iPad initiative, by their own admission these teachers were still learning and figuring things out regarding their teaching with 1:1 iPads. In some cases they adjusted their practice and perspective and in others they further solidified core tenets they already held to be true about the ways their students learned specific content, as well as what and how they defined their job as teachers. The remainder of this dissertation focuses on the study and its findings. The third chapter describes the method, study design, and data analysis. Chapters four through seven contain the four individual case studies, and the eighth chapter contains a discussion of the findings. The final chapter centers on this study's implications and limitations as well as considerations for future research.

CHAPTER 3

Method

This yearlong, multi-case study focused on four teachers' perspectives of and experiences with teaching in 1:1 iPad classrooms. As such, I set out to answer two questions:

1.) According to these teachers, in what ways, if any, does teaching with 1:1 iPads change how they think about or enact teaching?

2.) When teaching with 1:1 iPads, what funds of knowledge do secondary teachers use when planning and enacting their instruction?

In connection with the first question, I looked for evidence of incremental change (Cuban, 2013) and to answer the second question I employed the TIK framework to identify and understand the funds of knowledge these teachers accessed when they planned and enacted their teaching with 1:1 iPads.

Setting and Participants

Watertown Public Schools. During the 2012-2013 school year, there were approximately 5,700 K-12 students enrolled in the Watertown Public Schools (WPS) district, located in Watertown, a suburban U. S. Midwestern town (all names and locations are pseudonyms). It is a growing district, evidenced by the opening of a sixth WPS elementary school at the beginning of the 2012-2013 school year. This same school year, at the high school level, Watertown High School (WHS) enrolled approximately 1,900 students and employed 97 full and part-time faculty members. Located in an area that supports agriculture and industry and boasts many residential neighborhoods and parks, Watertown is described by many as a family-friendly community with a "small town feel". Most residents of the Watertown community also

support WPS, as evidenced by regular renewals of millage rates and the passages of most bond proposals connected to funding WPS initiatives and building projects.

Using funds from the most recent bond-based initiative implemented two years ago, WPS central office district administrators invested in technology upgrades and purchases for K-12 students and staff. According to its annual budget, since the 2010-2011 school year WPS has spent over 1.5 million dollars on technology. In the first year of the initiative (2011-2012), the district purchased and installed interactive white boards in K-2 classrooms across all six elementary schools and updated laptop and desktop computers throughout the district. Additionally, WPS administrators bought and distributed iPad 2s to every staff member and all students, grades 9-12. At the beginning of the second year, when this study took place, WPS middle school students (i.e., sixth-eighth grades) received iPads and WPS administrators provided each elementary grade level team of third-fifth grade teachers with class sets of iPads, to be shared between same grade level classrooms in each building. This amounted to three classroom sets of iPads in each of the six elementary buildings for third–fifth grade teachers and students.

The purchase and integration of this technology, particularly iPads across WPS schools in grades 3-12 highlights this district's technological investment in 1:1 technology. The goal, paraphrased from the district website, was to provide students with one-to-one portable computing devices so they may engage in collaboration, creation, and critical thinking.

Site selection rationale. Given their investment in 1:1 technology, WPS and Watertown High School (WHS) in particular was a desirable site for this case-based study. First, by the time this study took place, potential participants had at least one year of experience with 1:1 technology in their classrooms. Second, this 1:1 iPad initiative was school-wide so all WHS

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teachers and students had experiences with 1:1 technology, offering the potential for a broader range of participant responses and experiences than would be found in a study focused on a 1:1 pilot initiative or a case study of a single teacher. Furthermore, choosing a site in which 1:1 technology is not brand new or currently being implemented avoided studying teachers initially implementing a 1:1 initiative.

Participants. Participants in this study were WHS secondary teachers who taught using 1:1 iPads, in their case iPad 2s (important because this generation of iPads has a built-in camera users may utilize to capture still and moving images, something evident in data collected for this study). Only WHS teachers who previously taught with 1:1 iPads were included. I could have focused on teachers who have taught in 1:1 classrooms for many years or less experienced teachers who were "digital natives" (Prensky, 2001) and more likely to be technologically savvy. However, the majority of teachers experiencing the current shift to 1:1 tablet models are experienced teachers, making them an important demographic to study. Therefore, this study was designed to focus on experienced teachers still in the early stages of a 1:1 tablet initiative and who agreed to participate in this yearlong study.

WHS case study participants. Case study participants were recruited via an individual email sent to them during the middle of September 2012. Potential participants were also informed they would receive a $100. 00 amazon. com gift card at the conclusion of the study. WHS teachers with at least one year of teaching experience at WHS were invited to join as case study participants, which dropped the pool of potential applicants from 97 to 87. Eleven volunteered, so I utilized purposeful sampling (Creswell, 2008) to identify those with six or more years of teaching experience.

The rationale for identifying teachers with six or more years teaching experience is based on Russell, Bebell, O'Dwyer and O'Connor's (2003) finding that after six or more years "teachers have become comfortable with curriculums, schools, and other aspects of teaching, [so] they have the time and energy to invest in exploring ways to use technology in their classrooms" (p. 308). This left eight teachers. I then used stratified, purposeful sampling (Cohen, Manion, & Morrison, 2007) to get a cross-section of teachers who taught different content areas, increasing the diversity of participants' backgrounds, experiences, and perspectives. As a result, four participants were selected with experience ranging from seven to more than 30 years. Once this selection process was completed, I sent emails to the 11 volunteers, indicating their selection status. The four case study teachers selected taught chemistry (Ralph Peterson), Spanish (Tim Donaldson), AP Psychology (Josh Tucker), and English language arts (Brian Avery). Names of the district, school and participants are pseudonyms. Although all case study participants are males, this study's focus is not on potential ways gender influences these teachers, their experiences teaching in 1:1 iPad classrooms, or the funds of knowledge they utilize when planning for and executing student instruction.

Data Sources

Case study methods allowed me to explore four secondary teachers and their experiences teaching with 1:1 technology. Multiple case study design, such as the one employed in this study include multiple data sources and variables of interest in order to gain an in-depth understanding of participants and events. These sources also lend themselves to data triangulation, not necessarily as a means of generalizing findings but, rather, contributing to theoretical and holistic understandings of the case(s) (Denzin & Lincoln, 2008; Yin, 2009). For this study, I employed two primary and four secondary data sources to frame the study's findings and answer the

research questions posed. I utilized the secondary sources as a means of contextualizing and solidifying primary source data.

Primary data sources. The two primary sources include classroom observations of case study participants throughout the year (10-15 per participant) and four semi-structured interviews with individual case study participants (45-90 minutes each).

Classroom observations. One primary data source for this study was classroom observation. Observation enables researchers to collect first-hand, open-ended information through observing people and places in a particular research site (Creswell, 2008). Its advantages include recording information as it occurs, studying specific enactments and/or behaviors, as well as examining and studying individuals. To accomplish these three things, I observed each teacher teaching in his classroom 10-15 different times during the school year. Observations took place between October 2012 and May 2013. For each observation, I asked participants to identify times and days they planned to use their iPads. As a result, these classroom observations were targeted observations in which I sought to be strategic about observing times and classes when these teachers (and students) used their iPads. Doing so also enabled me to look for evidence of examples teachers' shared in their responses to interview questions and the initial online survey as a means of corroborating and/or identifying previously shared ideas and examples.

For almost all observations, I observed two or three classes, doing so to further contextualize these teachers and their teaching as well as see participants teach different classes and engage and interact with different sets of students. As a result, I was able to observe and record contextual data as well as human behavior which included interactions between participants and students as well as teachers' enactments of teaching with or without the 1:1 iPads (Newby, 2010).

During classroom observations, I did not employ a specific observation protocol. Rather, to guide my observations I used the information teachers provided during interviews, the content of their course syllabi, curriculum, and assignments they provided, as well as my own background knowledge of technology and secondary teaching and learning. Using what teachers said they did as well as the reasons why they did what they did also informed what I looked for during on-site observations. At certain points, these observations also enabled me to identify and examine teachers' uses of various funds of knowledge, as captured in the TIK framework. Specifically, these funds of knowledge connected to their use (or lack thereof) of the 1:1 iPads.

To add to and strengthen observation data collected, at some points during observations I took digital photographs of the school and participants' classrooms to capture the participating teachers' school and classroom environments (students did not appear in any images) (Yin, 2009). I also took digital photographs to document some examples of teacher and student iPad use (e.g., iPad images teachers projected on their overhead screens, written directions and information on teachers' white-boards, students' laboratory experiments) and examples of teacher and student iPad use (e.g., electronic worksheets, electronic projects, and displays). Because this study focused on teachers, no identifiable student information appears in any of the digital images captured.

Semi-structured interviews. A valuable means of investigating educational settings is studying those who work and function within the educational system(s) of interest (Ferrarotti, 1981, as cited in Seidman, 2006). As was the case with this study, when the researcher's goal is to understand and identify the experiences of those in education as well as the meanings they make of their experiences, interviewing is an appropriate and often desirable mode of inquiry (Seidman, 2006). Therefore, results from semi-structured interviews was another primary data

source for this study. I conducted four semi-structured, one-on-one interviews (Appendix A) with each case study participant at various points during the 2012-2013 school year (i.e., October 2012; December 2012-January 2013; February 2013-March 2013; March 2013-May 2013).

Combining ideas from Seidman (2006) who suggested a three-stage interview process and Weiss (1994) who stated that most researchers reach a saturation point by the fourth or fifth interview with most participants, I chose to conduct four interviews with each participant, for a total of sixteen interviews. This spacing and number of interviews enabled me to look for patterns over time and compare participants' self-report data, captured in interviews, with the classroom observations I conducted. During these interviews I asked closed and open-ended questions related to the research questions (Creswell, 2008). Both types of questions were included to elicit teachers' experiential knowledge (Kvale & Brinkmann, 2009; Newby, 2010) connected to teaching in 1:1 iPad classroom environments. Each interview lasted 45-90 minutes and provided access to teachers' thoughts and ideas as captured in their own words and ideas.

Secondary data sources. The four secondary sources include: 1.) case study teacher responses to an online survey; 2.) case study teacher-generated artifacts (e.g., website content, assignments, lesson plans, student work, syllabi, etc.); 4.) WPS district communication regarding 1:1 technology; and, 5.) researcher's field notes and analytic memos captured before, during, and after data collection.

Online survey. According to Greenlaw and Brown-Welty (2009), "surveys are an integral part of an evaluator's toolkit [and] they can be an effective means of collecting subjects' opinions, demographics, or feedback in a straightforward and potentially low-cost manner" (p. 464). Surveys also offer researchers access to more participants, affording an additional means of data collection and analysis (Wright, 2005). Moreover, web-based surveys enable researchers to

collect responses from large groups, with the added benefit of relatively easy dissemination and decreased response time, not to mention convenient and secure storage options as well as opportunities for in-depth analysis, depending on the content of the survey (Greenlaw & Brown-Welty, 2009; Granello & Wheaton, 2004; Lalla & Ferrari, 2011).

Case study online participant survey. This online survey contained twenty five closed and open-ended questions, which included biographical questions as well as questions related to case study participants' experiences with and thoughts about teaching in 1:1 iPad classrooms (Appendix B). I used this survey as a means of gathering initial biographical information about each participant, so that I did not need to ask those questions during the first interview. The case participant survey was administered through Survey Monkey, a web-based survey portal and remained open until all four participants completed the survey (i.e., early October 2012). The four teachers' survey responses provided a base from which I could begin to build individual case reports.

Case study teacher-generated artifacts. The use of teacher-generated artifacts is included as a source of data because it enabled participants with additional opportunities to offer support for and evidence of their experiences, thinking, and teaching in their 1:1 iPad classrooms (Creswell, 2008). These artifacts included teachers' course syllabi, class website links, course assignments, curriculum materials, and examples of student work (with identifiable student information removed). During interviews teachers often referred to one or more of these artifacts as a means of representing and extending their ideas. As a result, these artifacts provided additional representations of case study teachers' work, ideas, and content.

WPS district communication regarding 1:1 technology. Since WPS first rolled out its 1:1 technology initiative for all high school students in August 2011, WPS has provided

communication to news media, parents, and community members. Generally, this communication has been in the form of district blog posts, online videos, and parent and community electronic newsletters. All of this communication is available on the world wide web, with the majority of it posted on or linked to the district's website. This communication was important to this study because it provided yet another way to contextualize the district and its teachers (Corbin & Strauss, 2008; Creswell, 2008; Newby, 2010). Furthermore, analyzing these district-generated data allowed for an additional means of comparing and contrasting case study teachers' responses and ideas with those communicated through "official channels" by the district, particularly related to the 1:1 initiative and the district's communicated expectations for WHS teachers' uses of and teaching with 1:1 iPads.

Researcher field notes and analytic memos. Prior to the start of the study, I generated analytic memos, something I continued to produce during data collection and analysis. These memos functioned as a means of capturing my own ideas and thoughts throughout the study as well as conceptualizing data (Miles & Huberman, 1994). Additionally, field notes captured during interviews and classroom observations provided a means of capturing information, thoughts, ideas and questions during classroom observations. These notes were used to further triangulate data collected for each participant and case record (Yin, 2009).

Design

Meaning is not one-dimensional. Rather, it is constructed (Crotty, 1998) because human situations are filled with multiple meanings and interpretations and within qualitative research, many truths and experiences often exist (Newby, 2010). As Geertz (1973) notes, the qualitative researcher's purpose is to "somehow first grasp and then to render" (p. 10). Doing so more readily allows the researcher to identify and capture the depth and complexity of participants'

perspectives and experiences (Denzin & Lincoln, 2008). Complexity is inherent in research and should not be overlooked or minimized (Geertz, 1973). Qualitative researchers seek to recognize and honor the complexity of studying humans at the same time attempting to understand and learn about the nature or meaning of individuals and their experiences. When studying others and their experiences, qualitative researchers often see themselves as active participants in the research process and function to understand and illuminate others' subjective meanings and experiences (Denzin & Lincoln, 2005; 2008). Qualitative research also offers researchers opportunities to spend time in the field learning more about human activity and thought (Corbin & Strauss, 2008), something I did throughout the 2012-2013 school year when I spent time observing and interviewing these four teachers who taught in 1:1 iPad classrooms.

Throughout this study, I employed an interpretive research paradigm because within qualitative research, reality is constructed and subjective (Erickson, 1986; Geertz, 1973). In her explanation of interpretivist research methods, Glesne (2011) explained that researchers who employ interpretative frameworks are ones who recognize that individuals and locations as unique and they offer opportunities for multiple and multi-layered interpretations. Using an interpretivist approach enabled me to focus on four specific people (i.e., secondary teachers) in a particular social circumstance (1:1 technology in their classrooms and teaching). Doing so allowed me to gather data and then interpret and understand what I saw, heard, read, and learned. Throughout the data collection and analyses processes, I looked for and examined patterns and uniqueness in participants' perspectives, uses, and course content related to teaching in their 1:1 iPad classrooms (Glesne, 2011).

Case study. To answer the two questions posed, I employed a case study method because the questions posed drive the method(s) selected (Creswell, 2008; Yin, 2009). Although not used

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for generalizability, case studies provide "coherence, depth, development, and drama" (Weiss, 1994, p. 33). Moreover, utilizing case study method is important to do when studying complex phenomena in real-life contexts (Yin, 2009). Case study is also an appropriate method when the researcher has little or no possibility to control the event(s) being examined. In this case, I focused on teachers and their teaching within the real-life contexts of their classrooms and the school in which they taught, and as a researcher I did not attempt to control the events and/or the individuals I examined.

According to Yin (2009), there are three purposes for case studies: exploratory, descriptive, and explanatory. For this study, I employed a descriptive, multiple case study design because this method lends itself to contemporary events and includes multiple participants and perspectives (Yin, 2009). Multiple case study method enables researchers to focus on the peculiarities of each individual in order to tell stories (Gould, 1987, as cited in Haas Dyson, 1995). Including multiple teachers afforded opportunities to collect and examine additional evidence across more than one case (i.e., teacher), making the study and its findings more robust (Herriott & Firestone, 1983, as cited in Yin, 2009).

These four teachers functioned as the individual cases within this study. According to Stake (2004), local meaning is also important. In this study the similarities and differences between these four WHS case study teachers and the ways they thought about and used 1:1 iPads in their teaching as well as the contexts in which they taught, played a role in the process of data analysis and generation of this study's findings. Using a multiple case study design enabled me to situate this study in a localized context, namely WHS, as well as connect it to the larger 1:1 technology movement occurring at the state and national levels. Furthermore, according to Flyvbjerg (2006) case studies are a form of narrative and good case studies are read and

understood as narratives. Therefore, it is up to the researcher(s) to identify and understand the stories that exist and to tell them well. As Stake (2004) explained, the purpose of a final case study report is not to represent the world, but to represent the cases. This is because each case tells its own story (Yin, 2009), as evidenced in chapters four through seven. Each of these chapters focuses on one of the four participants.

In separating out each case as well as discussing cross-case findings in chapter eight, I sought to emulate case study work done by Kennedy (2005) and Michie (2005) who studied practicing teachers in K-12 schools. Kennedy (2005) utilized case study methods as part of her work focused on teachers and educational reform. Among other things, she included case-based vignettes and examples drawn from her time in teachers' classrooms and interview data to highlight particular points regarding reasons why some teachers were unable or unwilling to change teaching methods or adjust philosophical stances, despite educational reform requirements. Similar to Kennedy's use of case study, I also sought to understand the choices WHS teachers made and the reasons why they taught the ways they did, doing so by including vignettes connected to each participant that illustrated their choices and reasons. In this study, these vignettes connected directly to the incremental changes that occurred in their teaching and to the funds of knowledge they drew upon as a result of teaching in 1:1 iPad classrooms.

Connected to case study, I also drew upon Michie's (2005) work, in which he studied five young teachers of color (under the age of 30) who taught for change in urban schools. In his work, Michie devoted one chapter to each participant, in which he invited readers into these young teachers' classrooms. In his writing, he assumed the voice of an observant narrator who shared what he saw and thought, occasionally inserting his own life connections as a way to help readers understanding the ways in which he interpreted and understood these teachers and their

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motivations for creating change in urban schools. In addition to case study methods, Michie also used elements of portraiture (Lawrence-Lightfoot & Hoffmann Davis, 1997) to create literary portraits of each teacher. In these portraits, he provided images and descriptions of the teachers, their classrooms, teaching styles, personalities, and motivations for teaching in urban settings. He also identified the ways in which they sought to generate positive change in their respective schools.

Related to Michie's (2005) work, I also employed elements of portraiture (Lawrence-Lightfoot & Hoffmann Davis, 1997). Specifically, as a researcher in these teachers' classrooms I sought to "capture the richness, complexity, and dimensionality of human experience in social and cultural context, conveying the perspectives of the people who are negotiating those experiences" (p. 3). In addition to constructing each case and using data to build individual case reports and, more loosely, portraits of each participant, I also sought to include the perspectives of these teachers, particularly as they shared their reasons for using and not using 1:1 iPads.

Both Kennedy (2005) and Michie (2005) studied teachers in school contexts and in their books told teachers' stories and experiences in honest and respectful ways. In doing so, these authors contributed to work focused on educational reform (Kennedy, 2005) and implementing change to improve urban education (Michie, 2005). At the same time, their texts draw attention to and honor the complexity of participants' lived experiences and stories, in and out of the classroom. In the same way, in creating and sharing individual portraits of each case study teacher focused on their experiences with and ideas about teaching in 1:1 classrooms, I sought to recognize the inherent complexities connected. To do this, I used these cases as a means of metaphorically putting names and faces to teachers' lived experiences in 1:1 classrooms, in

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particular highlighting the types of knowledge upon which they drew as well as the ways in which incremental changes occurred and why.

Data Analysis

To analyze this study's data, I relied on Cuban's (2013) definition of incremental change and the TIK theory (discussed in chapter two). During the coding process, I first assigned descriptive codes (Miles & Huberman, 2004) to the data. After this initial round of coding, I generated descriptive case reports for each participant. Then, I re-examined the primary data sources and applied interpretive codes connected to incremental change and the TIK theory. For incremental change, I included only those instances in which participants specifically referenced change regarding teaching in 1:1 iPad classrooms. Connected to the coding process with the TIK theory, I applied interpretive codes aligned with one or more of the eight funds of knowledge (discussed later in this section).

For incremental change, I focused on two ways in which incremental change was evident, namely use and rationale. Identifying and examining teachers' uses and rationales allowed me to look for possible incremental changes so that I could more readily hone in on whether teaching with 1:1 technology changes, in any way(s), how these secondary teachers thought about their teaching and how they taught.

Use. When looking for evidence of *use*, I focused on when, for what purposes, and how often, if at all, these secondary teachers used iPads in their teaching. Specifically, I looked for how, when, and why these four teachers used the iPads when they planned, talked about, and taught lessons. For example, if a teacher identified an iPad app or website he wanted to use as part of a lesson or unit, I sought to observe and understand how he and his students used the app or website during that lesson or unit. In doing so, I attempted to capture what the teacher's uses

of that app and website looked and sounded like as well as the interactions that took place when the teacher incorporated it into his teaching and students' learning. Connected to use, I also included when teachers talked about specific elements of the iPad or applications they used or considered using in the future, as well the ways in which these teachers responded to their students' uses of the iPad in class (often connected to classroom management). Also included within use is evidence of when they chose not to employ the iPad. Their non-use was important to document because it further contextualized incremental changes.

To illustrate the coding process connected to use, the following interview excerpt from May 2013 was coded as evidence of use because it contains information regarding one way ELA teacher, Brian Avery used the iPad to change the format of his course materials from hard copy to electronic .pdf files.

> The delivery of materials – it's changed in that it's digital but there's no difference. It still looks just like if I had photocopied it. So the delivery of the material has changed but the materials haven't. And I think that's the fundamental difference between transformative technology based learning and just technology based learning. Because when we began last year, a paperless classroom seemed like that was the apex of one-to one technology. When in fact, that was like a lowest level of learning. But you have to start somewhere. (Interview four)

Another example of interview data coded as "use" connects to Ralph Peterson, who teaches upper level chemistry courses. In March, he shared his experiences with a new time lapse app he tried out to document evaporation rates. At the time of the interview he had not yet used the app with his students. However, this excerpt reflects his use of an iPad application as well as his hopes for future student use.

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We did a one day training where we brought in the Apple trainers. A lot of that stuff was focused on the [iPad's] picture taking capabilities and all that. I have started to experiment – this weekend I downloaded an app for time lapse photography on a balance to look at evaporation rates. It's something I'm tossing around in my head to set up as an inquiry piece for next year because we're doing all the inquiry stuff with [name of a local science-research institute]. And it worked. I was able to get some pretty usable data from it.

I set the iPad onto a balance there with a beaker of water and every hour it flashed a picture of the mass. And as the water evaporates the mass falls off. I let it go over the weekend. So I got 24 data points. I left it here on the balance. I had started it Friday. I came into work Saturday morning so when I came in the custodian had shut off the lights and I've had to restart. [So, I set it up again and] I picked it up Monday and got the data from it. I just did it with water but I think we could do it with alcohol and other solvents and compare the rates. You can compute how many molecules are evaporating per second. Our kids should be able to do that pretty easily. It gives them a visual; it ties in with the technology a little bit.

Rationale. The second way I sought to identify incremental change was identifying *rationale*, in which I identified what rationale, if any, these secondary teachers provided for using 1:1 technology in their teaching. For example, when a teacher chose to use a particular app or website with his students during a lesson, not only did I want to see and understand when and how the app or website was used (i.e., use), I also looked for evidence regarding why the teacher chose that specific app (i.e., rationale). In other words, when looking for evidence of rationale, I sought to identify and understand the reason(s) why teachers did what they did.

In some instances, use and rationale went "hand in hand" because when I looked for and worked to document a teacher's use, I also sought to identify and ascertain the rationale behind the use. For instance, this was the case with the excerpted example from Ralph Peterson regarding how he used the time lapse photography app. At the end of his explanation, there is evidence of rationale because based on his experiences. According to Ralph, it was an easy to use app, provided a visual, and connected to technology. Therefore, this portion of the excerpt was also coded as rationale because it contained his reasons for using this particular app. Another example of data coded as rationale connects to Josh Tucker's explanation regarding why he still employed a similar teaching style to what he used prior to implementing 1:1 iPads. This March 2013 interview excerpt was coded as evidence of rationale because he also provided specific reasons for not using the iPad as well as why he chose to limit his AP psychology students' use of iPads.

> I think I still do things the way I've done them for a while. Lecture based. I still teach pretty much the same way that I did. I think for some teachers, it's become more of they flip it [their instruction]. They move around. They do less lecturing. I don't feel comfortable doing less. I don't know which the students would prefer, but again, I'm still not to the point where I'll let them learn from this thing [iPad]. So that hasn't changed. I still think it's [course content] better coming from me than them going and finding it.

Identifying and coding data in which teachers did *not* use the iPad enabled me to further understand the rationale(s) behind why a teacher might choose not to employ 1:1 iPads. In some instances, this coded data provided additional insight into why changes did or did not occur within these teachers' 1:1 iPad classrooms.

Teacher Integrated Knowledge. I also used the TIK theory to identify ways in which

these teachers drew upon and integrated different combinations of one or more of the eight

knowledge bases. During the interpretive coding process, I coded for evidence of the various

knowledge bases these teachers used in connection to making decisions about when, how, and

why to use (or not use) 1:1 iPads in their teaching. Using the descriptors contained in the TIK

framework (Figure 7), I examined content in which participants talked about (interviews) or

demonstrated (observations) potential uses of one or more funds of knowledge.

CK = Content Knowledge   KL = Knowledge of Learners
PK = Pedagogical Knowledge   SCK = Standards/Curriculum Knowledge
TK = Technological Knowledge   KEC = Knowledge of Educational Contexts
PCK = Pedagogical Content Knowledge   KEE = Knowledge of Educational Ends
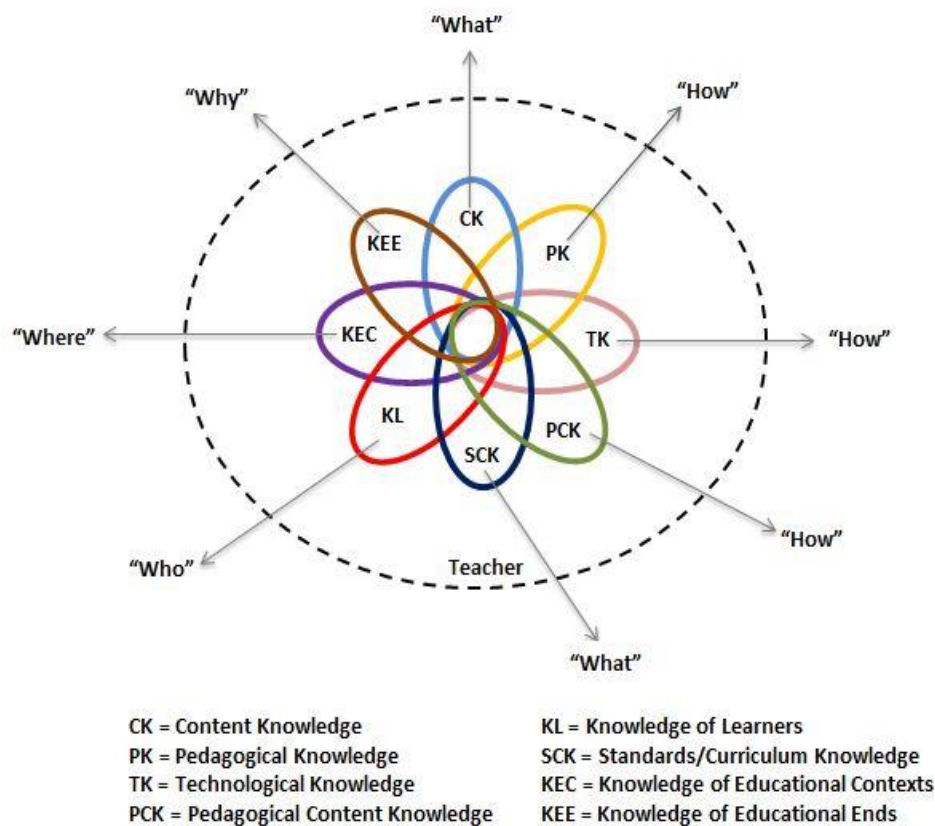
Figure 7. Teacher Integrated Knowledge (TIK) theoretical model

As an example of this interpretive coding process, there was a point during the first

interview in October 2012 with Spanish teacher, Tim Donaldson when he described himself as a

"non-textbook teacher". He followed this description with a short explanation why this term fit

him as well as one of the ways he used the iPad to share content with his students. As evidenced in the quote below, he incorporated multiple funds of knowledge, including Knowledge of Educational Ends (KEE), Standards/Curriculum Knowledge (SCK), Content Knowledge (CK), Pedagogical Content Knowledge (PCK), Knowledge of Learners (KL), and Technical Knowledge (TK).

> "I've always been kind of a non-textbook teacher *[KEE]*. I'll track with the content, because as a department, we've chosen the curriculum *[SCK]*. So I'll use the vocabulary and the grammar *[SCK and CK]*, but the exercises and stuff – not so much *[PCK and KL]*. The nice thing about the iPad, though, is if I do want something for them from the book, I can just take a picture of it and post it and the kids could have it without having the book *[TK]*."

This coded example highlights the ways in which the TIK theory connected to Tim's description of himself. This coded excerpt also shows that Tim drew upon more than one fund of knowledge to describe himself and how he used the 1:1 iPad to communicate content to his students. Applying these funds to instances in which participants discussed or demonstrated the ways they used 1:1 iPads in their classes enabled me to further understand the types of knowledge and knowledge type combinations that potentially contributed to participants' planning and enactment of their instruction.

Researcher's Role

Researchers often use their connections to gain access to sites and participants (Lofland, Snow, Anderson, & Lofland, 2006). This study is no different, because in addition to the school-wide implementation of 1:1 technology at Watertown High School, I utilized my connection as a former WPS employee to gain administrative approval for this project. Before returning to

graduate school to pursue a Ph.D., I spent eleven years as a high school English teacher at Watertown High School. I loved my job and developed friendships with faculty members. Even though I no longer teach at Watertown High School, my family and I still live in the Watertown Public School district and my children currently attend elementary schools within WPS. Moreover, I am still friends with many of my former WHS colleagues. Therefore, I am connected to WPS and its faculty, in large part because of my role a former employee and as a current resident of the WPS district and parent of two WPS elementary students.

At the same time, when I left WHS to pursue graduate studies I became connected to and engaged in work and academic scholarship outside WPS and by the time I conducted this study I had been gone from WHS for four years. The distance of four years' time more easily enabled me to take on the role of researcher, rather than that of a former colleague or employee. Throughout this study I sought first and foremost to function and think as a researcher. For example, when conducting observations I sat in a student desk, at the teacher's desk, or in chair located in the back of the room. When appropriate, I walked around their classrooms and in Ralph Peterson's case, a laboratory as well. When suitable to do so, I also interacted with students and teachers.

During these observations I mostly functioned as a non-participant observer (Creswell, 2008). In other words, when I visited these teachers' classrooms I observed and recorded what happened. I did so without becoming involved in the specific activities of teaching and learning. However, there were a few instances when students asked me questions or requested my help on something they were working on. When appropriate, I provided responses and assistance. However and similar to Clandinin (1985)

as a researcher, I cannot enter into a teacher's classroom as a neutral observer and try to

give an account of her reality. Instead, I enter into the research process as a person with

my own personal practical knowledge. My knowledge of teaching interacts with that of

my participants (p. 365).

Therefore, as much as I worked to remain in the role of "researcher" throughout this study, I

recognize that my background as a former WHS teacher played a role in how I thought about,

analyzed, and interpreted the data. Additionally, my own knowledge of teaching and the WHS

district inevitably contributed to my understanding of the participants, the school, and the ways

in which I understood and analyzed this study's data.

Four Teachers

Teaching occurs within and between humans operating in various contexts. As a result,

students, teachers, classrooms, schools, and districts are all different. For the purposes of this

study it should be understood that teachers and teaching are not all the same, nor are the students

they teach or the classrooms and schools in which they teach identical (Hammerness, 2006;

Kennedy, 2005). Teaching is a complex endeavor in an ill-structured domain (Koehler & Mishra,

2009), and even in the same school, no two teachers teach in exactly the same ways. In the

following four chapters, I introduce readers to each WHS teacher, highlighting evidence of

incremental changes and some ways in which these teachers utilized one or more fund(s) of

knowledge as they considered when, how, and why to (or not to) integrate 1:1 iPad technology

into their teaching.

These four educators reported that they cared about their students and sought to teach

students particular content and skills as a means of preparing them for life in and beyond school.

Naturally, they differed in personality, teaching styles, and personal background, which exerted

influence on the ways they taught and thought about their teaching. They also differed in the ways they thought about, understood, managed, and chose to use the 1:1 iPads (and other technology) in their teaching, not to mention the ways they viewed the introduction of 1:1 iPads as an opportunity to think about and possibly change their teaching.

The following case study chapters (i.e., four –seven) are ordered by participants' years of teaching experience, in which the most seasoned teacher is discussed first and the last case chapter focuses on the one with the least amount of teaching experience. Given this ordering schema, the first case focuses on high school chemistry teacher, Ralph Peterson, a 30-plus-year teaching veteran. The second case centers on Tim Donaldson, a Spanish teacher with 17 years' experience. The third is that of Josh Tucker, an AP psychology teacher who has spent his entire15 year career in the WPS district. The fourth case centers on Brian Avery, a second-career English teacher who finished his ninth year teaching during this study.

CHAPTER FOUR

"Nuts and Bolts: It's All Chemistry"

Ralph Peterson

I'm conveying knowledge to the kids. That's probably the classic definition of what goes on here. That's how I was taught and that's generally how I've taught all these years. Student centered is where the student is ultimately the source of information. I think our one-to-one is leading us in that direction.
Ralph Peterson (Final Interview, March)

Ralph Peterson: Teacher and Teaching

In his twenty-ninth year of teaching at Watertown High School (WHS) and certified to teach math and science, during this study he taught four sections of Honors Chemistry (mostly sophomores and juniors) and one section of Advanced Chemistry (juniors and seniors). According to Ralph, his students were interested in pursuing science, technology, engineering, and mathematics (STEM) related degrees in college, which is why they took his classes. Prior to teaching at WHS, Ralph worked for two years as a chemistry lab technician for a pharmaceutical company, during which time he also went back to college to become a teacher.

Although some students occasionally called him, "Mr. Peterson," he was most often referred to as "Mr. P." by students and "RP" by colleagues. In addition to the five rows of student desks, Ralph's room contained two white boards, one at the front of the classroom and one behind his teacher lab station. His lab counter, where he often stood when he lectured also housed a sink, desktop computer, document camera, and piles of notes and papers. His teacher desk, next to his lab counter, contained a desktop computer and numerous papers and piles, overflowing with all sorts of things. "Despite what it might look like, I'm an organized person," he told me during one of the first classroom observations in the fall. "I know where everything is, even if it takes me a minute or two or more to find it. I have a system, even though it's

sometimes a messy system." His classroom also housed a number of metal file cabinets, bookshelves brimming with older science textbooks and science-related content all of which were reflective of what he amassed during his almost thirty years teaching high school math and chemistry.

In the initial survey in September, when asked to choose one word to describe himself, Ralph responded with the word, "BUSY." In addition to teaching, he was also the long-time science department chairperson and school union representative. In fact, for more than twenty years he has been the "go-to-union guy" in the district and when this study took place he also served on the district's executive union board. When we talked about being "busy" during the first interview, Ralph showed me the agenda items contained in the Google calendars he used to keep track of his classes, personal agenda, and science department meetings. I also learned that Ralph often stopped by his classroom on the weekends to work or check on things, and during the week he regularly came to school early or stayed late, whether for meetings, to facilitate the afterschool Chemistry club he voluntarily advised, or to help his students.

Similar to many of his colleagues, Ralph's story of 1:1 iPad learning, teaching, and integration demonstrates a teacher's interest in learning about tools and applications to support what he did and how he taught. For example, throughout the school year, Ralph and his students used a free online chemistry textbook and its supplemental materials as the basis for units and students' class work. Ralph also encouraged his students to utilize graphing calculator iPad apps to solve chemical equations, and in the middle of the year he worked with the WPS district technology coach to design and use Google Forms to collect his students' answers for the laboratory portion of their first semester exam. Ralph's story also highlights the ways in which

an educator's central goal and purpose for teaching function as the main filter for deciding if, how, when, and in what ways to use mobile 1:1 technology in his classroom.

"I'm Enthused by the Content Itself"

Ralph's confidence in his content knowledge and his interest in chemistry and related subject areas such as math was evident in all four interviews as well as classroom observations. When asked how he added to his content knowledge during the first interview in October, Ralph shared, "There's not a lot left to learn about my content area, so now it's finding the best resources for my content area." During this same interview he later explained, "I take last year's lesson, try and throw out the worst ten percent and bring in ten percent new. If I could do that every year, I figure I'm improving things."

Toward the end of the final interview in March, Ralph described himself as a "geek at heart." He elaborated, "I'm enthused by the content itself. It's interesting. It's fun. So I can convey my interest in it." During this interview, he also observed that in order for him to share his knowledge and enthusiasm with his students, his class functioned as a teacher-centered classroom most of the time. "I'm the one conveying knowledge to the kids. That's probably the classic definition of what goes on here. That's how I was taught and that's generally how I've taught all these years."

During the second interview in early January, when asked how he used the iPad to share knowledge and generate students' interest in chemistry, Ralph relayed an experience he had with an iPad app connected to teaching his students to read labels on chemical products.

> We do a lab where I'm teaching kids to read a label on a chemical product and there's an MSDS app. MSDS is Material Safety Data Sheet. Every chemical product in the workplace is required to have one of these onsite. They tell you how to safely work with

it and safely dispose of chemicals. As consumers, I wanted kids to know that. So I had

them download this MSDS app and all of a sudden this guy, who had a relatively obscure

app out there, he called me up and said, "I'm getting hundreds of hits off of this school."

He wanted to know what was up with it. All of a sudden he noticed a huge hit in his

number of hits. He called me back a couple weeks later and asked for some feedback. I

was okay with that. It's largely something that's pdf.

This experience provided Ralph an opportunity to use an iPad app to teach his students about

reading and understanding chemical labels and he had an opportunity to use his knowledge of

chemistry and teaching to provide an app creator with feedback. Ralph also used the iPad's

Internet connectivity to share course content with his students. For example, he uploaded all of

his PowerPoint slides for each lecture on his class Google site as well as electronic versions of

class worksheets and assignments. So, when Ralph taught some of his students used their iPads

to view the PowerPoint slides or worksheets from Ralph's lectures as he talked aloud to the

class.

In addition to teaching content and computational skills related to chemistry, Ralph also

sought to generate interest in chemistry, as illustrated by the following excerpt from one mid-

October classroom observation. After Ralph took attendance at the beginning of his first hour

Honors Chemistry class, he announced, "Alright. I think I have everyone. Let's get started."

"What's this element?" he asked, projecting the letter "W" on the screen from his

document camera.

"Tungsten," a student responded.

"That's right and it's a 'W' because the German word for tungsten is 'wolfram' which starts with a 'W' so that's why the letter for this element is a 'W' and not a 'T'. How many of you have downloaded a periodic table app on your iPad?"

One student raised his hand.

Ralph acknowledged the raised hand and encouraged his class, "You should definitely download one or two and take a peek. These can be very helpful."

"Next thing. Here's an equation you need to solve," he told students at the same time he projected an equation on the screen via his document camera and overhead projector. He "froze" the projected image and he and his students busily and independently worked to solve the problem.

After a few minutes, Ralph started talking again. "Alright. What did we end up with?" After a student responded with an answer, Ralph shared his own hand-written work via his document camera and overhead projector. "See, this is how you get the answer." *During classroom observations, Ralph routinely worked on the problems he provided his students, showing them his answer during or after they discussed the correct outcome.*

"Let's move to nuclear radiation," he told students, as he stood at the back of the classroom and used a remote clicker to move to the next slide. "Anyone know who the first researchers were for radiation?"

No answer. The next slide showed a black and white image of man and a woman. "Pierre and Marie Currie" he said, as he also explained ionizing and non-ionizing radiation. "We'll watch a short video about them in a little bit."

As part of his explanation, he used modern day cell phones as an example of non-ionizing radiation. "Cell phones produce a form of non-ionizing radiation, known as radio frequency

radiation. Can this cause damage [rhetorical question]? Cell phones cause detectable changes in humans' body temperature but the effects are still unknown."

Moving to another slide, Ralph went on to explain the three properties of radiation, namely alpha, beta, and gamma and then turned out the lights and showed a short Discovery Education video clip about the Curries, specifically Marie Currie's work and scientific contributions. After the video, most of the students who had their iPads out were still following along with Ralph's PowerPoint slides, looking at their iPads rather than the overhead screen and writing in answers on their hard copy unit study guides.

"Alright, today we're going to tackle balancing nuclear equations," he stated, referring to another PowerPoint slide. After briefly discussing beta emissions, he announced, "We're going to stop the PowerPoint here for today. Pull out your iPads and go to my website. Find unit four and pull up the 'nuclear balance' word doc." For the remainder of the hour, students worked independently and in small groups on the problems contained on that nuclear balance worksheet.

Reflecting on how he conveyed his knowledge and interest in chemistry to students, he shared during the first interview in October, "Each day I usually try and review something from the previous day and try to link them back a little bit. The more times you hit something, the better their chance of remembering it." He continued, "I know what the kids need to know and I'm getting them there. I tell people that I close the classroom door and when it's just me and the kids, I'm fine." During the last interview which took place in March, he revisited what he thought he did well, not only connected to his content but also as a teacher. "I'm good at the technical stuff. I'm good at getting math across to kids. I started out my career as a math teacher. So I think I'm pretty good at that."

"Get Kids Prepped for College Chem"

Ralph and his wife have three grown daughters, all of whom took high school and college chemistry courses. During classroom observations and interviews, Ralph often referenced his daughters' experiences in their undergraduate chemistry courses when he talked about his own work, which – in his words – was first and foremost to prepare his students for freshmen level college chemistry courses. During the first interview in October, he shared

> My goal in both this class and the advanced class is really to get kids prepped for college chem. College chem, so many kids get into it and they get weeded out. Colleges use it as a weed-out for the medical field and engineering fields. It's sad but that's the case. I want kids to be prepared for that, so that's my goal. The state doesn't necessarily have the same goal! And I worry about the NextGen [Next Generation Science Standards] stuff. They have whittled the content down. If I take this current honors chem course, it's about a third of that. Now they [NextGen] want it to go in deeper through inquiry and they want us to blend in some engineering stuff and have the kids actually constructing stuff, which is really cool. I don't dispute the need for those, but if I take out a third of this course, kids aren't prepped for my next course, the AP. They're not prepped for what I know the college content is. That scares me.

So, when Ralph talked about the purposes and how often he and his students used the 1:1 iPads in his classroom, unequivocally Ralph's primary goal was to prepare his students for college chemistry and if he chose to use the 1:1 iPads, the goal for its use was college chemistry preparation.

Connected to college preparation, at one point he talked about the possibility of having a spectrometer available for his students, because when he and a colleague visited a local college chemistry class a few years ago, they watched undergraduates use spectrometers during a lab

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exercise. Citing this visit during the second interview in January, he explained, "I'm trying to prep kids for that first year in college. I'm looking for what things they're going to be expected to be able to do there." He also recalled previous students who returned to tell him how much they learned in his class. During the third interview in February he shared one example of this.

> What I'm teaching the kids, what I'm hoping they walk out of my class with, my goal is, particularly out of advanced chem, they ought to be able to waltz right through a first year chem class easily. And the reports I get back are pretty much that way. [A student from last year] stopped by from a local college and he's just waltzed right through his first year. So that made me feel good.

For Ralph, this experience and the affirmation it generated further supported the teaching methods and approaches he used to teach his courses.

One way Ralph sought to prepare his students for college chemistry was through class lectures and labs. When asked to define and discuss the type of classroom-based instruction he facilitated, whether student or teacher centered, he responded in the final interview in March by saying,

> I think teacher centered means I'm probably leading the instruction. I'm conveying knowledge to the kids. That's probably the classic definition of what goes on here. That's how I was taught and that's generally how I've taught all these years.

During this interview, he went on to talk about how 1:1 iPads as well as the WPS district's K-12 science department's recent commitment to pursue inquiry-based learning through a local research institute helped move him toward more student-centered teaching.

> Student centered is where the student is ultimately the source of information. I think our one-to-one is leading us in that direction. Kids now have that device – yesterday I gave

them a set of terms and said, "You guys look up these definitions. If you don't find it in your book, go online for it." [With the iPad,] they can do that now and it's a little bit easier that way. The other side of that is we've got the [Research Institute] folks coming in and that pushed [us] toward inquiry. It's more toward the student centered focus.

As he noted not long after this during the final interview, the testing conditions he employed further supported his emphasis on college preparation.

I have clear expectations of when you can have it [the iPad] out and when you can't. I've done a good job around testing days. They know that come major tests they have to take all their technology in the back room and dump it. That's good practice for college, too. You're not supposed to have your cell phones and devices out at that time.

Although students did not appear to use their iPads or phones when taking tests, as soon as some students turned in their completed assessments, they returned to their desks and started using their iPads or phones.

Not only did Ralph expect students to pursue math and science, he also connected their learning to technology. For example, when he talked about using technology to prepare students for college, Ralph also discussed specific tools such as spectrophotometers and pH probes. He also talked about the fact that he and his department members were now required to identify, purchase, and use only products which worked with the iPad. This was a fact reiterated during the second interview in early January when he shared, "Again, I'm trying to prep kids for that first year in college. I'm looking for what things they're going to be expected to be able to there." As a result, Ralph made sure that any tool he or his students used, which included the iPad, was geared toward preparing his students for upcoming college chemistry classes.

"I Didn't Anticipate That"

Although Ralph indicated that he liked using the iPads, he also shared some of his frustrations with the device and teaching in a 1:1 iPad classroom. One of Ralph's frustrations with the iPad was its inability to load and play Adobe Flash-based content. As a result, one of the reasons he did not often use the iPad was because of the incompatibility between Flash-based content and the iPad. For example, during the first interview in October Ralph shared that he spent his time trying to "find stuff that fits the technology we have. There's not a lot of iPad compatible apps. There's a ton of stuff online for computers, but it's all Flash-based." During the second interview in January, Ralph shared similar sentiments. "Most of the simulation stuff for chemistry isn't Flash compatible. Science is one of the early adopters of computer technology so there's a rich bank of stuff that is Flash based out there. It just doesn't work for us."

Ralph commented about the lack of Flash during many classroom observations and all four interviews. During the final interview in March, he shared that with 1:1 iPads students "have access to that whole wide world web or sources out there [but] I wouldn't hardly use it [the iPad] if it didn't have Internet on it, [especially] with the lack of usable Flash."
He revisited this idea again later during the same interview when he explained,

> I thought we were going to have access to all these nice apps and stuff and I'd seen the
> simulations on PC's and I thought, "I'd be able to work a lot of that in." And in that
> respect, that hasn't been fulfilled. Just because of the lack of Flash.

For Ralph, the lack of Flash was a consistent theme throughout the study and influenced how he thought about the iPad and, to some degree, how and why he chose to use or not use it in his teaching.

Another unanticipated frustration Ralph experienced with the iPads connected to classroom management. In addition to class-related applications, many students also used their

iPads to surf the web, play games, and communicate with their friends using chats and social media, something observed in all four case study participants' classrooms (to varying degrees). During the initial interview in October, Ralph relayed one of the ways he attempted to manage students' misuses of their iPads during his classes.

> Yeah, the kids are quick to pull out the games. Especially when you give them free time to work. And it gets worse later in the day. It's very much like it was in the first days of cell phones – kids hiding it in their lap and texting back and forth. It's no different from the cell phones; it's still a distraction to kids. [During lectures] I try and point them out. I've got a clicker for my Power Point that's got a red laser and I'll shine it on them. Then they know that I'm seeing them but I'm trying not to break the whole flow of the class if I can avoid it. If I call somebody out, we're going to lose everybody.

During classroom observations, Ralph did not use his red laser to manage students' iPad use. He did, however, talk to students when he walked around the room during in-class work time, telling them to shut their iPad down or close out of a particular app.

During the second interview in early January, Ralph explained that "You have to be willing and able to tell the kids to put it [their iPad] down." A few sentences later he continued, "I'm laid back enough. But the kids still have expectations that they're expected to do." The implementation of 1:1 iPads also prompted Ralph to move around more his classroom during his lectures, as he explained in this interview, "If anything, it's [the iPads] forced me out from behind my desk out here [in his classroom] a little more to monitor." Ralph continued,

> My kids are good enough that if I just tell them [they will stop]. The ones that get too obnoxious, I just walk over and take it for the hour. I haven't had that big of an issue to have to go that extent. But I'm lucky; I've got the top tier kids. It would be different if I

were in a lower tiered class. If I notice it [iPad misuse], I'll say something to them. I'm

more concerned with helping the kid who wants to learn than trying to play patrolman.

Later during this interview he shared,

> The iPads aren't going away. That's why we have to train them to use the technology
>
> responsibly. They're going to be adults sitting in a board room or a team meeting – you
>
> can't be whipping out your phone and texting. Teaching kids to use that stuff is all not
>
> related to chemistry but it's still related to teaching kids and culturing the students.

Ralph recognized that his teaching needed to extend beyond Chemistry to address students'

appropriate digital device behavior.

During the last interview in March, Ralph also talked about an increase of students'

distractibility as a result of the 1:1 iPads, something he did not initially anticipate and something

he found frustrating.

> I didn't anticipate the classroom management issues that it [the iPad] has posed. The
>
> access to things like Instagram and all the other instant communications. I kind of
>
> thought they would be locked down from that. I guess I'm disappointed that kids have
>
> gotten so much access. We used to fight them a little bit with cell phones. There would be
>
> two or three kids in the class – now every kid has access to that.

He continued, explaining how students' distractibility with regard to the iPad affected his

teaching.

> And I didn't anticipate that….It subdivides my attention a little bit. I've had this numerous
>
> times – kids, you know – swiping. You know they're gaming. And I'm trying to work
>
> through a ten step problem. I know I have to stop and discipline that kid and stop it

because he's taking down three other kids who are all leaning over his shoulder to see

what it's doing. It's just another level of distraction for me and for the kids.

Although Ralph talked about teaching students how to manage their digital device behavior and

shared how students' iPad uses were sometimes problematic and distracting, classroom

observations revealed that he generally allowed students to use their iPads as they pleased, as

long as a student's use did not interfere with his teaching or other students' ability to pay

attention during class.

"You Can't Just Watch Other People Do It"

During the third interview in February, Ralph remarked that the materials his students

accessed online using their iPads could not substitute for in-class, teacher-based instruction. In

addition to the iPad's lack of Flash-based compatibility, Ralph also foregrounded in-class,

teacher-centered instruction.

A lot of kids still need you to step through stuff with them. They need to see it – I hope

they need to see it live and I think a lot of them really do. That bottom 50% in my class

who struggle with mathematics – that's where the issue really is, the math side of things.

They need more hand holding through the process. The top 50% of kids is a lot better at

doing that on their own. They're more capable of doing that in a self-directed fashion if

you get the right set up.

He continued, explaining that the "right set up" was

Almost a prescribed program. You read this and do this, read this and do this. And if you

can document that you can do these skills, you'll get through most of it. Frankly, part of

what a live teacher does – we explain stuff and it avoids that work of reading the stuff. I

think the kids are just reading less and less and when you're there to explain it to them it

avoids the necessity of having to read it. A lot of our kids, if they applied themselves and read through this stuff [online textbook content] they could go on and do the work on their own. But so many of them avoid that reading. I don't know if they don't like to or they just don't have the habit or it's just easier to listen to me explain it. I don't know.

When asked a follow up question related to using and viewing online resources via their iPads such as videos to learn more about Chemistry, Ralph explained that even if Flash worked on the iPad he was still unsure that accessing online content by itself would enable his students to learn what they needed to learn. He shared that videos could be used as a supplement but not a replacement for in-class learning experiences.

If I show these kids three videos from Kahn Academy or my own videos that have them do this skill, is that better than having them read this? Or seeing the videos and actually reading – which is a rare beast. You know, if they see Mr. P do it and read it, they're far better off than just watching it. I really think that combination of watching someone explain it and either previewing that with the reading or reviewing that with the reading, I think the strongest learning will take place. And you've got to follow that up with some hands on practice, too. You can't just watch other people do it.

For Ralph, being able to take time during class to show his students chemical reactions and how to solve chemical equations was valuable, and for the most part the ways he taught reflected his commitment to providing in-class instruction and models. He lectured, provided opportunities for students to apply and practice what they learned, and facilitated lab exercises in which students worked in pairs to complete and document experiments and chemical processes. At the same time, Ralph noted the current shift towards "inquiry-based teaching" within science,

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something further motivated by Watertown's participation in a local research institute's inquiry-based teaching program.

> With that said, we've got to adopt into the inquiry. You can't just not change anything. I feel like there are some people in the department who just want to not change and wait it out. We're not going to get away with not changing.

With the move toward inquiry based teaching, Ralph actually felt more, not less, responsible for showing students what they needed to know.

> During the final interview in March, Ralph reported that he facilitated a teacher-directed classroom, in large part because that was what he believed his students needed to learn best.

> Right now I'm still largely teacher centered. I'm trying to give the kids more responsibility to come up with their own information, but particularly with the mathematical stuff, they need a lot of guidance. Two thirds of the kids need a lot of guidance.

Later in the same interview, he noted that even with the integration of the 1:1 iPads, in terms of his teaching he had not changed all that much.

> I don't think I've changed a lot of content at this point. I give the kids three pieces of memorization throughout the course of the year. They have to learn the equipment so they can work safely, they have to learn some ions and they have to learn some of the elements. Those are just foundational pieces that I don't think the iPad changes. Even now, I was doing some problems first hour – kids that have holes in those bricks are struggling. They just don't get it.

Especially for those students who "just don't get it," Ralph intentionally kept his classroom and teaching "teacher-centered." According to Ralph, this enabled him to ensure that he was, most often, the one showing students what they needed to know and do.

"I'm Not There Yet"

At the end of the study, Ralph concluded that even with 1:1 iPads he struggled to give students more responsibility for their learning, one of his goals. However, in terms of achieving this goal, Ralph explained, "I'm not there yet." During the first interview in October, Ralph shared his perspective of the iPad and teaching in 1:1 iPad classrooms. "If I had a big beef about the devices, it's that there's no time. There's just not enough time to do it all." He also explained that his schedule and life outside his classroom made it sometimes difficult to find enough time to "play" with and learn more about the iPad. During the study, he utilized his class Google calendar and posted course content, including study guides, lab worksheets, and resources to his school Google site, something he talked about during the first interview in October. "I use Google Sites. We were trained in that before any of the other stuff. I had everything set up in Google Sites and doggone if I was going to reinvent that wheel!" According to Ralph, it was up to his students to access his site and download course materials. "The [download] format doesn't matter. The kids can add it on their iPad. I'm good with it." Ralph also responded to students' emails, particularly if students missed class. He also asked students to use graphing calculator apps as well as some periodic chart apps.

Later in the first interview he shared, "On the whole it's [the iPads] positive, I guess. I still want time to play with it [the iPad]." A few minutes later he talked about the limited amount of training he had prior to teaching with the iPads.

I blame a piece of this on the district for having limited training. We did one in-service on

Google Sites three years ago. Training on that [the iPad] is very limited. Trying to cover

it with people like [the district K-12 tech coach] going around from place to place - that's

putting out fires, in my opinion.

He went on to talk about the types of training teachers had during the first year the 1:1 iPads

were implemented, the year prior to this study.

I think people were just up to their ears. I don't know. I have downloaded so many apps

on this device. But do I ever have time to investigate them? I don't have time! And part

of that is, in private industry when they bring in something like that [1:1 iPads] – I hate to

say it but they pull you out of your job and you get trained on it. And it's intensive and

you're expected to use that.

He continued, explaining that the training he received connected to using and teaching with 1:1

iPads took place "outside of the job."

Our training for this stuff is outside of the job, it's on your own, it's ad hoc and there's no

real expectation that we'll use it. We've trained in Google Sites, we've trained in Edmodo.

We just did all this hit and miss stuff. I don't feel there's been a concerted effort to get

people on the same page.

The challenge of finding the time to search and explore also came up in subsequent interviews,

as did the idea that changes would continue to happen in education, whether teachers liked it or

not. As Ralph shared in the final interview in March,

You can't just not change anything….we're not going to get away with not changing. I

think that change is going to happen. We just have to decide if we're going to be on the

train or not. The change train is coming. If you want to try and push against it, go ahead!

You're not going to stop it.

As a result of the "change train," Ralph often felt like there was more to learn and do, oftentimes more than he could (or wanted) to learn or do.

During the second interview in January, Ralph talked about using Socrative, an online assessment website which also has an iPad app. "I saw Socrative at one of the things we did. It looked cool. I think I could use it but I wear a lot of hats [at WPS] and I don't have enough time to get it set up." He went on to discuss the fact that he did not have enough time to explore, learn, and further implement the iPad into his teaching. "I've got a ton of apps on my iPad and not enough time to investigate them all, [mostly] generic teaching tools." He explained that until his students could compute mathematical equations manually and until he knew how to do and use an app or tool, he did not want to introduce it to his students.

> [The app] Lab Timer we've used a little bit. It's just an online timer. There's a molar mass calculator on here, which I'm probably ready to show the kids. They now know how to do it [calculate molar mass manually] so I feel comfortable giving them the electronic tool once they know how to do it manually. I don't want to give them the electronic tool before they know how to do it manually. E-clickers are on there [the iPad], [the app] Whiteboard is another one. Itunes U – I've debated, I've gone Google –. [I've thought about using] Nearpod [another iPad app] – doing that for my Power Points. There's some other molecular drawing software – a lot developed for colleges or for private industry and aren't really suited for high school. Some of them are. But again, the learning curve is kind of steep sometimes. So how much time to devote to that is an issue.

Additionally, Ralph shared that not only did he struggle to find time to learn about new apps and iPad tools, he was also hesitant to take time away from content instruction. "I do want them [students] to be exposed to it [technology and 1:1 iPads]. Real self-serving, I don't want to give my instructional time in chemistry away to teach how to use the technology."

Ralph Peterson: Concluding Thoughts

Ralph's purpose for teaching and his goal, namely preparing students to take and pass college chemistry courses, directly impacted how much he and his students used 1:1 iPads in his class. As he shared in February, in response to how teaching with 1:1 iPads impacted the actual teaching of chemistry, "Nuts and bolts – it's all still chemistry. I don't think it's [the iPad] significantly changed the chemistry side of things. The content is still there. I don't think it's changed a ton." As a result, Ralph's enthusiasm for his content as well as his desire to prepare students for college strongly factored into if, how, when, and in what ways he and his students used the 1:1 iPads. Additional considerations Ralph relied on to make these decisions connected to his frustration regarding the iPad's inability to display Flash-based content and his students' misuses of their iPads during his classes. Moreover, the ways in which Ralph did or did not use the iPad also aligned with his belief that students learned chemistry best in teacher-centered classrooms in which a teacher, in this case Ralph, showed students what they needed to know and do.

CHAPTER FIVE

"Crossing Over from *I Can't* to *I Will Try* to *I Can*"

Tim Donaldson

In general, I like the iPad but do find that it is not a replacement for the teacher connection.
Tim Donaldson (Survey Response, September)

Tim Donaldson: Teacher and Teaching

A 20 year veteran teacher, Tim taught in multiple states before being hired to teach

Spanish and history at Watertown High School (WHS) fifteen years ago. During the year this

study took place, he taught four sections of required honors Spanish Two and one elective

Spanish Three class which consisted of two native speaking freshmen, as well as sophomores,

juniors, and some seniors. According to information Tim shared during the first interview, many

of Tim's four sections of honors Spanish Two students (i.e., freshmen, sophomores and a few

juniors) were identified by the high school guidance department as college-bound. Almost all of

his Spanish Three students considered themselves "college prep" students. Throughout the

school year, his students' work was displayed on his classroom walls and bulletin boards,

supplementing the colorful posters highlighting Spanish architecture, culture, language, and

heritage. He also had pictures of his family and some of his own children's art work hung up

near his desk, located in the back of the room.

In Tim's classroom, students' desks were often arranged in six rows of five, all facing the

front of the room where students looked at a white board or projection screen. He started each

class directing students' attention to a short, hand-written agenda on the white board. When not

providing direct instruction, Tim encouraged his students to work in pairs or small groups,

during which times Tim walked around his classroom, looked over students' shoulders, and

talked quietly with them. At other times, Tim stood at or near his teacher station, a tall, desk-

cabinet on wheels, upon which sat a desktop computer and which contained a small input rack where he connected his desktop computer and iPad to his classroom's overhead projector and speakers.

Tim's story of 1:1 iPad learning, teaching, and integration, like others in this study, demonstrates a teacher's willingness to learn and try something new. For example, during this study Tim learned about and employed some new apps, websites, and assignments. One app connected to students using "spaceships" during a test review activity and another enabled students to post and read peers' responses to Spanish music. A website Tim employed enabled students to search for and view video-based content connected to what they learned and during this study he and his colleagues created and implemented a video-based assignment focused on legends and heroes. Tim's experiences also reveal a dichotomy, for while he recognized and embraced the progressive, student-centered promises 1:1 devices offered, his planning and teaching often remained similar to how it was prior to the integration of 1:1 iPads.

"Just a Different Tool"

During the first interview in October, Tim talked about how his role as a teacher shifted as a result of the iPads. "I think I've shifted more of the paradigm to kid-responsible and I'm here to facilitate." He continued, "I felt a lot of responsibility before [1:1 iPads] because there wasn't stuff that I had available to everybody and knew that everybody had access to it." Tim viewed himself as a facilitator because with 1:1 technology, all students could access and use websites and applications to complete their work. If he required students to use technology, he no longer had to also figure out how to give students access to certain tools or sites. However, many of Tim's iPad uses enabled him to do what he had done before but with a mobile device or, in Tim's words, "a different tool." At the end of the study, during the last interview in May Tim

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concluded that even though he taught in a 1:1 iPad classroom, his teaching had not really changed.

> I don't think there's much difference in what I teach, the pacing in which I teach, the expectations that I have for the outcomes on their side….So now, we're using the iPad to present, using the iPad to research, we're using it to write – before it was pen and paper and making a poster or a PowerPoint to present the ideas. But the process, I think, is pretty much the same. It's just a different tool.

The idea of a "different tool" was evident throughout the study. For example, he no longer solely used his classroom desktop or home computer to send and receive emails or access the Internet. Instead, he often chose to utilize his iPad to do these things, and since the inception of the 1:1 iPads, which also resulted in the district's "paperless policy," Tim utilized electronic versions of many previous hardcopy worksheets. With their finger or a stylus pen, students completed these worksheets on their iPads and when required to submit their work most often sent it to him as an attachment via email.

Tim also used the app, Grooveshark to access world music playlists, particularly Spanish and Latin American music. Although he used music CDs in the past, he often streamed music from these playlists during class when students were working. Moreover, instead of writing down information, Tim's students sometimes used their iPads to take digital pictures during class of course-related information.

Sometimes Tim used his iPad to project images on his pull-down screen. For example, he used a photo app to show students pictures that corresponded to vocabulary words they needed to learn. He employed these images to provide students with a visual of each word (e.g., "mostaza" – *mustard* corresponded with a picture of a line of yellow mustard on a hotdog). Using a call and

response activity, he said each vocabulary word aloud and students repeated it back to him. At the end of the activity, Tim told his students that in addition to looking up the words and obtaining the correct spelling, they needed to use their iPad to find and save pictures of each vocabulary word, using these pictures as prompts for studying and memorizing the words. According to Tim, in previous years before the implementation of the 1:1 iPads, students would have created hand-drawn pictures connected to their vocabulary words or cut pictures out of old magazines. Although it is a different tool, many of the things Tim had his students do with their iPads mirrored previous activities, something he reiterated during the fourth interview in May.

> I think pretty much the classroom runs about the same. I've mentioned this over the course of the study – I think of it [the iPad] more as a place for the kids to obtain information and stay in the know of what it is we're doing in the classroom.

He concluded his observation, saying "I'd say it's still mostly the teacher gives you the content, idea and students can explore in some manner." In this way, Tim's instructional format was relatively similar to what it was prior to having 1:1 iPads.

"Most Kids Aren't Self Monitors"

Not only is the iPad "just another tool" for teaching and learning, it is also another device teachers have to monitor. For Tim, having 1:1 iPads in his classroom added additional aspects of classroom management, specifically management of students' technical issues and misuses of their iPads, the latter most often because students struggled to monitor themselves. Prior to the iPad, Tim assisted students with potential technical issues when they used one of the school's two computer labs, but when he taught in his own classroom, unless a student struggled to use the classroom technology (e.g., document camera, desktop computer, or overhead projector), he did not have to address technical issues.

However, with 1:1 iPads in his classroom, this changed. Although not enough to stop a lesson, there were times when a student could not open an app, their iPad would "freeze", or it would not work because they had damaged it in some way, the result most often being a cracked screen or a damaged "home" button. During the third interview in March, Tim explained, "The biggest complaint I get is, 'My iPad crashed,' or 'I cracked the screen and I can't see it,' or, 'It's got to be in the technology office.' It's just the hardware piece of it. Sometimes their software crashes". Tim most often practiced patience when these "tech glitches" happened. During this same interview, he shared the following.

> I tend not to make a big deal out of it. I guess if I were to see repeat offenders – I do have one kid in my first hour class who came to me complaining once again, "I couldn't do it because I couldn't email it myself." I said, "Why can't you email it to yourself?" He said, "Because my email is broken." I said, "That's been broken since before Christmas." He goes, "I know, I just have to take it to tech." I'm like, "Yeah! Take it to tech!" So there is the occasional student, but most of the time they're pretty straightforward. Life happens and we just deal with it.

With regard to individual student management issues, during some of the classroom observations I saw Tim's students use their iPad for non-Spanish related work during class time (e.g., checking Instagram, sending emails, surfing the web, checking grades, posting instant messages, taking and posting pictures of themselves/peers, etc.). When students engaged in this "off-task behavior," I often saw Tim speak quietly with them, telling them to close whatever app or program they were using and get back to work. However, during one of the classes I observed, Tim took a student's iPad away. When I asked him about it later during the first interview in

October, he explained that the student was working on something else on his iPad and when Tim noticed that the student was off-task, he asked for the student's iPad.

> He was over here in the corner. He's one of those kids that's kind of arrogant about it, like, "Oh, I can do that later." And he probably can but he's distracting the person next to him and we can't afford that. I try not to make too big of a deal of it because I don't want kids to feel bad. It's not any worse than the kid who is doodling on the paper. It's just more obvious now [with the iPad] and there's so much visually that they can be distracted.

Tim also commented about some of his students' inability to turn of the notifications on their iPad, so some students checked their email, Instagram feed, and instant message feed, among others, which Tim believed to be distracting to teacher and students alike.

> During the last interview in May, he noted that occasionally he had to stop teaching to deal with a student who was paying more attention to their iPad than the class.

> Some of it is kids have learned to self-monitor some of it. And other parts of it are, I've just come to terms with some of the kids that are going to be on their iPads unless they realize that they have to focus right here. And if they don't realize it, that's when I step in and say, "Okay, this is a time right now where we need to do such and such " - like if I don't tell kids during presentations to put their stuff away, many of them are going to be using their iPads to message whoever because they're bored.

In Tim's experience, what students did changed, at least when they used their iPad for non-Spanish related work, but the fact that students were sometimes off-task in his class was nothing new. As Tim said later in this same interview, "when you introduce a bunch of kids to a device that is on 24/7 and connected all the time, I hate to say it but most kids aren't self-monitors."

"Equal Access"

During the second interview in December Tim explained that because all WHS students have and use iPads now, "they can access information when they want it. To me, that is key." In fact, the idea of "equal access" was a theme that emerged multiple times during the course of the study. As he shared during the first interview in October, "I now have a great equalizer, in a sense. I now have as much available to me as so-and-so. Whether I choose to use it, I may or may not." Shortly after he said this, he followed it up by explaining

> So accessibility – I think kids have much more accessibility than they used to, which, to me, is the huge plus of the one to one. It's reviewable to kids. They can now get it in class, take it home and review it seven times, and then get it. Some kids are slower learners, so seeing it over and over or finding different ways [helps them]. I had a kid who, just before the test, decided he didn't understand the direct object pronouns. So he went online, found a site that explained it in a way that made sense. And part of me is going, "Gosh, I went over that 12 times in class." But the reality was he needed a different input. He found it and that's what I like – kids, accessibility, some sense of review.

In some cases, the way his students accessed information and learned content also changed, as was the case with the student who conducted a quick web search on his iPad prior to a test.

Tim also used the word "equalizer" and phrase "equal access" when he talked about how teaching in a 1:1 iPad classroom changed his own teaching. For example, he shared that he expected more from students now, in large part because they had iPads which provided them with access to all course information. During the October interview he reported,

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I felt a lot of responsibility before because there wasn't stuff that I had available to

everybody and knew that everybody had access to it. Even if I had a web page, it didn't

matter because only those who had access to it would be able to use it.

According to Tim, one of the most noticeable access-related tools involved using the course

management system, Edmodo to communicate and share course content with his students.

Although not required by WPS or his administrators, Tim decided to try Edmodo, in large

part because some of his colleagues previously tried it and liked it, and because it has a similar

interface and look as the popular social media site Facebook. Furthermore, the more Tim used it,

the more he liked what it could do and what he could do with it, as far as regularly sending out

course reminders and sharing content. As he shared toward the beginning of the study during the

first interview in October, Edmodo "makes things easily deliverable. I can post on Edmodo

pretty much anything I want and then it's there. So they've got the accessibility piece, but I can

also deliver something instantly. I don't have to wait until tomorrow".

Beyond reminders and content related to homework assignments, Tim also used Edmodo

as a virtual space for him and his students to share content they found related to the course. To

illustrate, during one class period, when he walked around the room and checked in with his

students regarding a vocabulary assignment they were working on, he noticed at least four

students using the same website on their iPads, one with which he was not familiar. He spent

some time with the students who were using the site, looking over their shoulders as they

worked. The more he saw, the more he realized that the rest of his students could also benefit

from using the site. So, he asked a student to email him the link to the site and after class he

posted a link to the site on Edmodo so that all of his students had instant and equal access to the

site and its resources.

Thanks to the embedded camera in the iPad, he now assigned video-based projects because everyone had the same tools. This was a departure from student groups writing and performing live scripted narrations, skits, or short stories during class. Although Tim still implemented some of these live student performances (he still believed students needed real-time, peer-to-peer practice using their Spanish language skills), his students sometimes used their iPads to create, record, and edit some of the previously live performance assignments.

During the final interview in May, Tim again revisited the idea of "access" and what changed as a result of teaching in a 1:1 iPad classroom. Toward the end of the school year, Tim's Spanish Two students created and presented short, two minute "future biography" projects focused on their future goals and aspirations. In addition to the "front of the classroom" presentation component and students' required use of their iPads to showcase their futures – in words and images – Tim intended that the project would also provide students with opportunities to demonstrate their use of specific vocabulary as well as communicating in the future tense. This was accomplished because everything students shared, textually and verbally, focused on their future goals and aspirations (e.g., what they wanted to do after they graduated from high school; if they desired children and, if so, how many; where they hoped to live; the places they wanted to visit; and, the dreams they hoped to realize).

In May during the last interview, Tim reflected on this video assignment, including the content and quality of students' presentations. He explained that even though students had access to the same technology and tools, his students still varied in the final products they chose (e.g., Keynotes, Corkulous Boards, Prezis, etc.) as well as the quality of their presentations.

I do look at the iPad as a good opportunity for the students. You know, with the rubric we were using for the presentations this week, it didn't focus a lot on the presentation skills,

but it was interesting and yet somewhat disappointing. There's a few [students] that

played around with some of the "make it pretty" presentation stuff and others were much

more – and it kind of matches their personality – done, as opposed to, "What else can I do

with this?" Everybody had access to it, though. There wasn't a lot of goodies attached

with most of the presentations. There were a few that incorporated a little video of

themselves playing a game or whatever it was that they threw in there, but everybody had

access to that. Even as a teacher, I have access to that [apps] and putting stuff out there

for kids. So I appreciate one-to-one in that sense.

The idea of equal access was also evident in the ways Tim talked about students' abilities to

access course content during this final interview, in this case connected to locating and gathering

images for their future biography presentations.

It [the iPad] does open up a commonality for kids. Commonality across curriculums. We

can all, when we're putting together a presentation, most of the kids thought of taking a

picture of the photo album that [their] Mom put together. Some were wondering, "Well, I

don't know how to get digital pictures of –". But it [the iPad] did open up the possibility

that, even if a student didn't have a digital camera when they were growing up, there are

probably photos somewhere that they can at least snap a picture of [with their iPad]. And

I coached a few kids on how to do that. So it made everybody throw something up there

[on their presentation].

Not long after this statement, Tim connected the idea of equal access to students' (and teachers')

abilities to connect with course content and instructors outside of the classroom and school day.

And I think that [equal access] stands for any project or anything else. I might not be able

to listen to this video right now, but I can wait until tonight when I am done with work, or

I'm sitting in class and I'm completely freaked out because of what just happened last

hour – with the iPad, now students have the ability to via wifi [and their iPad], to contact

their teacher [via email] and say, "Hey, Mr. Donaldson I missed.....". So it equalizes even

their ability to access teachers and addresses students' needs in a bunch of different

scenarios.

According to Tim, how and to what degree his students used the iPads differed but the fact that

every student started with the same device was a positive aspect of teaching in a 1:1 classroom.

"Language is not an Isolated Thing"

At the beginning of the school year in September in the initial survey, the one word Tim

chose to describe himself as a teacher was "caring." He shared that he valued helping students

understand that learning a language connected them to the larger world as well as new people

and cultures. Throughout the study he also reiterated that his job as Spanish teacher was to help

students make connections between what they learned in his class and the world in which they

lived. In some senses, his job was to provide students with connections to their world through

second language study. "I care to see my students learn to love learning and to become a person

with the character qualities that will make them a good neighbor, consumer, boss, and

community member someday." In his initial survey response he also wrote about the fact that

learning a world language is a social experience, something he worked to create when he planned

and taught. During the first interview in October he said,

When I look at all my classes, it looks pretty social. If you walk in you might be like,

"Are they doing anything in there?" And there really is some learning going on, but it's

very social. And the reason why is because I just don't see language as an isolated thing.

Latin would never be my thing because there's just no point to it.

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Tim also described his teaching as "interactive" and stated that the iPad does not always do a good job facilitating the types of interactivity he seeks to promote. During the interview in March he stated,

> From the teaching side of things, most of the time I don't do a lot [with the iPad]. I will pull a YouTube video or a song. I will pull content – like, we did in the last unit and I pulled some stuff together and said, "Here, look at this stuff." But a lot of times, because I want the class to be interactive, the iPad just really doesn't afford that interactive piece. Today they're sitting groups walking through this conversation. Even though when you walk in it just looks like they're writing something, there's a lot of language that's going on. Each group I talk to I say, "This is your practice run at this conversation." So doing that via the piece of technology just doesn't make sense. This really is a face-to-face experience, so 80% to 90% of the time I'm going to opt to not have the technology because I just don't want it to get in the way.

In addition to using the iPad to foster interaction, Tim concluded that the iPad does not help students learn a language. He continued, saying "You can download an app and say, 'Okay, I'm going to learn Spanish,' and you'll hit the wall pretty quickly. You'll learn some vocabulary but you won't ever interact". Earlier, in December during the second interview, Tim suggested that some iPad apps were best suited as "travel apps," rather than apps for learning a language or to use in a classroom.

> I encourage them to use "Word Reference" [an online website and app]. They have an app for it, but a lot of them choose things like iTranslate and My Language. I've shown them in the past how those really do fall short but those are really more of a travel app.

[I'd use those apps] if I'm stuck in Mexico [to ask], "how do I get whatever?" as opposed to making a decent sentence out of something.

I also think they've blocked Google Translate here. But kids find 'work arounds' for everything. I really discourage them from doing that, and I think most of the kids have said "okay" to that. We had an assignment not long ago and a lot of them spent a great deal of time doing Google translation. They were really poor and I showed them that. I have a list of stuff that I'm going to use for review prior to the exam of things that just didn't match up. Like, there's a bazillion ways to say, "to leave" in Spanish – which one did you need? Those apps really don't teach them that.

Tim's goal was to provide students with opportunities to learn the language and then practice using their knowledge. When asked the question in October during the first interview, "How do students learn best in your content area?" Tim explained that his class was

Kind of hands on. We're up and moving around, speaking, doing stuff with the language. There is the component of manipulating the verb and making it look right on paper. Some of today was some checking of that. But by and large, I think they learn best if they're using the vocabulary, using the verbs and doing something with it.

The idea of "interactivity" also arose later in this interview when Tim described his first hour Spanish Three students. Because he had them the first hour of the school day, Tim explained that he thought they tended to have less energy than students in his other class periods.

My third year students, the first hour of the day, I think they would be totally happy if I said, "Everything is on Edmodo. Fill out the worksheet and send it in." They could live in isolation and never speak Spanish. That's just not workable. So I don't like it [the iPad] in that sense because it can become sort of a closed door for some students.

As a result, during many of the classroom observations Tim often told students to put their iPads away or flip them over on their desks because they needed to spend time talking and working with their peers.

"What Is Good for Kids?"

In addition to providing students with opportunities to interact with one another, Tim often assessed the ways in which he used 1:1 iPads in his classroom, and technology more generally, by considering the question, "What's good for kids?" He also recognized that unless he knew what he was teaching and how he wanted to teach, it probably would not be "good for kids." To incorporate the iPad into his teaching, he needed time to play, learn, and plan but for him, this was not always easy to do. Between teaching full-time and focusing on his family outside of school, he was not always able to do enough learning on his own nor scaffold students' learning as well as he wanted to, at least not when using the iPad. He explained during the interview in December,

> I just think with one-to-one, it's going to be more valuable the more time you have to frontload your assignment. Whether it's being able to use Skype or being able to use some music in a legitimate way to learn some Spanish or being able to have kids produce stuff, the more you do on the front end, you're going to get better stuff in the end. It's just obvious – anything you plan well tends to do better. But specifically for me with technology, it's not a, "I can make it happen" kind of opportunity. You might be able to fly pretty freely on any given lesson because you've taught it so many times in a typical classroom, but unless you are very adept with technology and have this huge bank of knowledge, it's going to be hard to come up with something that's technology based that's really more than just a visual experience.

For Tim, teaching in a 1:1 iPad classroom meant that in addition to everything he was already

working on and doing, he had to learn about the iPad and figure out how and when to use it in his

teaching. Later, during this same interview he explained,

> I think that's my biggest learning curve. There's still content that I'm learning and
>
> obviously the more I teach the more I realize that there are a thousand ways you can do it.
>
> There might be ten of them that are really good and the others are not so good. But yeah,
>
> pedagogically and content-wise I'm much more comfortable – I'm not necessarily
>
> uncomfortable with technology, it's just that it comes back to the time management and
>
> how much time do I want to devote to grading, preparation, and making it something
>
> that's meaningful.

This means that in 1:1 classroom, the answer to the question, "What is good for kids?" is more

complicated, given the additional options made available through the 1:1 devices.

As a teacher, one of Tim's goals and one of his jobs is to his foster students' learning and

independence. Tim also explained that one of the objectives of 1:1 computing in the classroom is

for students to learn how to be digital citizens as well as practice digital citizenship. This was

something Tim talked about specifically connected to a new video-based project he and his

department colleagues implemented this year. The project required each student to create and

write their own "leyenda" (*legend*), a short tale/myth about a character (e.g., person, animal, god,

or imaginary creature) who encounters something or someone and engages in a conflict. By the

end of their leyendas, students were expected to resolve the conflict. With a script in hand, which

Tim had already read, edited, and graded, students were instructed to use an app on their iPad to

create a video or presentation. This project was supposed to include words and pictures and at

the end of the unit, each student stood up in front of the class and presented their project. Each

student's presentation was supposed to last about two minutes (plus or minus), and some students' projects were iMovies with audio and video images. Others were presentations, such as Keynotes in which students stood up front and read their leyenda aloud to the class as they scrolled through their presentation.

Connected to the leyenda project, the iPad provided students access to millions of images from which they chose to download and use. For Tim, this was one of the benefits of the iPad, in that it provided students with access to various applications and the Internet. At the same time, more access meant more responsibility for students and teachers alike, something Tim was still trying to figure out. In fact, when he reflected on his students' leyenda presentations, Tim indicated that he had not thought about requiring students to cite the images they used, in part because this was the first time he had done this assignment and also because it had not occurred to him. He also explained that many of his students' presentations could be better, as far as the visual/audio quality. As he stated some of his observations, it became clear that he wrestled with ways to make this project "good for kids" and was already re-thinking parameters for the next time he assigned it.

However, even when the activities Tim used centered on what he believed was good for kids technology integration did not always go well. This occurred during an activity in which Tim's Spanish Three students used technology (i.e., personal cell phones and iPads) as part of a unit focused on social events. One of their assignments was to create individual posters (on their iPads) of local events, such as an Opera concert, hockey game, or a botanical garden display. Once they created these e/posters, they posted them to their class kidblog.org site, a private site Tim previously created. On this particular day after taking attendance, Tim started the class by asking students to go to their class kidblog.org site. As they sat in their seats, he told them,

"Practice your conversation. You need to find one of your peers' posters on kidblog." Then, he

told them to work in pairs or small groups and discuss their peers' posters in Spanish ("Un poco

Ingles, ok" – *a little English is ok* – he added).

After these small group discussions, Tim read aloud some phrases written on his white

board aloud (e.g., "Lo siento, pero…." – *I'm sorry, but….*) and students repeated the phrases

back in unison. He also wrote four last names on the white board, *Los Augilar, Los Flores, Los*

Reyes, and *Los Chávez* and divided students into each family group. He also reviewed the

upcoming activity's dialogue format, which was projected on the overhead screen (Figure 8).

Prueba Oral: Hacer Una Invitación

Persona Uno: marca el número de un/a estudiante en clase

Persona Dos: ¿Bueno? / Diga / Dígame

Persona Uno: Buenos días. / Buenas tardes. /Buenos noches. Habla [tu nombre].

                 ¿Se encuentra / Me puede comunicar con [nombre de la persona que llamas]?

Persona Dos: (no eres tú) Sí. Un momento, por favor…(consigues la atención de esta persona)

                 (si eres tú) ¡Hola [nombre de la persona que te llama]! ¿Cómo estás? / ¿Qué pasa? etc.

Persona Uno: responde y continúe la invitación usando uno de los pósteres (no uses el tuyo)

Figure 8. Tim Donaldson's Spanish Three in-class dialogue assignment

On Tim's signal, the first student (Los Aguilar family member) used her cell phone to

dial one of her peer's numbers (Los Reyes family), who was sitting across the room in her

"family group." The goal was to use the students' event posters as a springboard for ideas

regarding what places and events people might attend. At the same time, the activity's purpose

was to get everyone to talk using the phrases (Figure 8) and vocabulary they had learned.

The first two conversations were relatively uneventful, although one student accidentally

hung up on his peer. However, the third conversation, focused on an Opera production in a local

city, generated an echo in the room and during the fifth conversation the echo between the two

cell phones was unbearable. After asking Tim if they could hang up and "just talk across the room," the two students finished their conversation without cell phones, holding up their hands to their ears, with thumbs and pinkies extended to signify imaginary telephones. After eight conversations, every student in the room had talked at least one time.

After class, Tim indicated that he did not realize that the cell phone feedback and echoing would be a problem. He also shared that although the phone element of the activity was a "flop," it still turned out alright because the actual point of the activity was to provide students with opportunities to dialogue in Spanish with their peers, using specific vocabulary and phrases. So, in his opinion, he was still able to do what was "good for kids" despite the technical issues.

In connection to a unit on Spanish dance and culture, during the third interview in March, Tim reported that he wanted to use technology to promote his students' learning because it would allow them to access additional resources and provide more opportunities to share their learning and dialogue with their peers.

> I talked to you before about the Spanish Three [class] and we're trying to get going with
> the music thing [unit on Spanish music and dance]. One of the things that they can do is
> they can watch YouTube videos – not so much here [it is blocked at WHS], but at home
> they can watch a video that I post. I could [also] upload it to Teacher Tube and they could
> have it there. Or they could watch it at home, which is what I'm going to have them do
> anyways because it's going to be sort of in a flipped sense.
>
> We'll kick it off with a video, probably with flamenco or some other genre of
> music from the Latin world and then they'll watch a video and respond to it. I choose to
> do that because I don't have an expert to stand in front of the classroom. I'm not an expert

on flamenco. But watching and hearing and seeing the dance and hearing the guitar and the sound kind of has an impression for kids.

When asked how (and if) students would respond after watching these videos, he elaborated further.

That's what I'm still kind of up in the air on. I had considered Voice Thread and I've been checking that out a little bit. I'm just not sure I'm ready to dive into it. I know others have said that it seems pretty easy. I'm just not exactly sure. I've been looking at a couple more things. There's a little thing called Padlet or Wall Wisher - I like that [Padlet] but I think that also has a flash base to it. I haven't tried much with that on the iPad. But that was another one that I had thought of. But I want them to have something where they can respond privately but yet they will see other people's comments. And my hope with that is to use technology to help kids build their collective knowledge in flamenco or meringue or whatever style we're doing. [I want to do] more than just, "Here, fill in the notes." And they'll fill in the notes but I want them to take that next step and take some ownership and use the technology to do that.

Having students take these "next steps" and "ownership" was a way Tim tried to do what was good for his students, in this case employing the iPad as an additional resource for students to view and learn about Spanish culture as well as a tool with which to interact with their peers via their class Kidblog site.

The answer to "what is good for kids?" was also evident in Tim's attitude toward teaching and learning. In response to a question on the initial survey regarding what he found most satisfying and enjoyable about teaching, Tim explained that his "greatest satisfaction comes when a student crosses over from 'I can't' to 'I will try' to [finally] 'I can'." In some ways,

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Tim's own 1:1 iPad integration and teaching within a 1:1 iPad classroom followed his second and third descriptors, in which he adopted an "I will try" and an "I can" attitude with regard to what he knew and did in conjunction with iPad technology and applications.

In many cases, when he tried new things and implemented them, he did so because he believed it would be good for his students. For example, he was open to learning and willing to implement new tools and ideas, such as incorporating the use of student blogs using the website, kidblog.org. He also required his students to post content-related comments to a private, online classroom "virtual wall" using the website, padlet.com.

Sometimes the implementation of new ideas and technology went well and sometimes they did not, for one reason or another (e.g., school Internet connection was down, the site or app did not work well or allow students to complete their work, students' assignments were lower quality than expected, etc.). During the third interview in March, when asked about using technology to foster his students' learning, Tim responded by saying,

> I want to do more with technology than I did before. I have a vested interest in a class of
>
> thirty kids who are sitting here with an iPad going, "Why do we have to have this?" So
>
> I'm interested in making something that's available for them to use on the iPad. Plus my
>
> own personal experience – I get excited when I hear [about] something. I may not get to
>
> use it or I may not use it well or soon, but I'm like, "Well, that sounds neat!" And given
>
> enough time, I may employ some app or some activity that is very much an app-based
>
> kind of implementation of something. So for me, it's at least moved me beyond knowing
>
> it's there to really wanting to do more with it. But I keep coming back to if it's good for
>
> kids. Is it the best way to get it out there? In a conversational setting, is it the best
>
> method?

Throughout this study, there were instances in which Tim chose to save ideas or apps connected to the iPad for later use, either because he did not have time to learn or work with a particular app or aspect of the iPad, or there was not enough impetus to change his current practice. This meant that sometimes he used the iPad and in other instances, he did not use it.

Tim Donaldson: Concluding Thoughts

For Tim, often the determining factor for choosing to use or not use the iPad centered on what he believed was good for his students. He was willing to try new things with the iPad, as long as he perceived them beneficial for his students' learning. During the third interview Tim pondered the tension between using technology in schools to support what has already been done or, instead, using it to do something completely different. For Tim, teaching in a 1:1 iPad classroom involved learning about possible tools and websites, in order to support his teaching and students' learning.

> I've been exposed to a whole lot – I've taken classes on one-to-one technology, I've obviously been in it for a year and a half here, and there's so many things that I subscribe to or I've logged into – I ran into [the website] Scribbler today [online] and I'm like, "When did I have that?" So I just see some of these things and I don't remember why I did it. So maybe the next step for me would be to kind of unpack the slew of things that I have and say, "Which one or two would I like to more with," and actually go at it from the other angle of, "How can I force this piece of technology into my teaching?" rather than, "How can my teaching fit into this technology?

Although "fit" and "force" are different and mean different things in terms of technology integration in K-12 classrooms, throughout the study it did not appear that Tim actively "forced" iPad technology into his teaching. Throughout the study he learned about and integrated different

tools, websites, and iPad apps into his teaching. When he thought about and enacted his own

teaching, Tim drew upon knowledge and employed methods that supported what he already

knew about content, pedagogy, curriculum, and students. In this way, he "fit" 1:1 technology in

when he perceived it as beneficial. In other words, he used technology in his teaching when he

thought it would improve and enhance his students' learning.

CHAPTER SIX

"On Ready. On Set. Go!"

Josh Tucker

"You know what? You don't have to have this [the iPad] to pass this class."
Josh Tucker (Interview One, October)

Josh Tucker: Teacher and Teaching

In Josh Tucker's classroom it was easy to identify the subject he taught. Laminated

covers of *Time* and *Newsweek* magazine covers affixed to the walls near the ceiling formed a

border around his room, highlighting everything from addiction, schizophrenia and memory to

autism and gender biases. By the time this study took place, Josh Tucker had been teaching for

16 years, all in the WPS school district. For the first few years at WHS, Josh taught multiple

social studies classes including basic and applied psychology. However, for the past 10 years he

has taught Advanced Placement (AP) Psychology, which consists of juniors and seniors as well

as a few sophomores. During this study he taught five sections of AP Psychology.

Josh was well-liked by many students, evidenced by the fact that near the end of this

study the WHS senior class invited him to be the faculty speaker at their graduation (an

invitation based on student vote). Although he had turned down previous graduating classes'

invitations due to his fear of speaking in front of large groups, this year he agreed to speak and

"face his fear" in order to find his own "arena of high achievement," two things he talked about

in the speech he delivered. Throughout this study, it was evident that one of Josh's own "arenas

of high achievement" was his students' academic success, reflected in the high percentage of

WHS students who passed the AP test and earned college credit.

Josh and his colleague Jon, who started teaching the same year Josh did, both taught AP

Psychology and worked closely together to plan course content and assessments which would

enable students to pass the AP test in early May and earn college credit. When asked about their pass rate, Josh shared that the previous year's approximately 200 students earned an average score of 3.7. The approximately 200 students who took the AP test during the school year in which this study took place produced an average AP test score of 3.8. According to Josh, students need a score of a four or five to earn college credit, although some colleges still offer credit for a score of three. Prior to in-class test review work time, the assistant varsity football and JV tennis coaching sides of Josh often came out as he said aloud to his students, "On Ready. On Set. Go!" This phrase served as a verbal reminder of his students' purpose in Josh's classes, namely *learn the material, pass the AP test, and earn college credit*.

Josh's story of 1:1 iPad learning, teaching, and integration demonstrates his commitment to helping his students prepare for and pass the College Board's Advanced Placement Psychology test. As a result, he continued to look for new ways to help his students learn and study AP content, including exploring Quizlet, an online flashcard and test review website and implementing in-class AP test preparation using the online student response system, Socrative. The goal with these e-resources as with other tools he employed, such as regularly assigned textbook chapter readings and study guide packets aimed to help his students learn and retain information to take and pass the AP test. Josh believed he was a successful teacher whose students were successful on the AP exam. This success provided for why he did not frequently use the iPad. In his experience, 1:1 iPads had not yet proven to improve his students' achievement on the AP test.

"The Teacher Needs to Build the Structure"

At WHS, Josh was an "early adopter" of various technologies, integrating PowerPoint and using online video clips long before most of his peers did. Moreover, prior to their

widespread use he secured a classroom set of "responders" (also known as "clickers") which he and his students used on test review days. Josh also implemented and used Moodle years ago when it was still "new," although he stopped using it after student misuse. However, these technologies still allowed Josh to remain up front and in charge of his students' learning. During the first interview in October, Josh reported that in many ways his content and teaching was a "canned deal." He did not require his students to use their iPads to learn information because he still felt more comfortable finding and delivering content to his students. He explained,

> I'm not at the point where I'm like, "Over the weekend get on your TED [video-based
> app]." I normally will find it and bring it to them. I use Zite [an app], too. I just subscribe
> to the psychology and mind part of the magazine. I have found probably eight to ten little
> nuggets of things I wanted to fit in. Like at night, I'll just get on [my iPad] and see what's
> new.

When asked if his students could use their iPads to search for information and use them to learn, Josh reported that the majority of his students were either not motivated enough or too busy to use their iPads to find what they needed to know and learn. "The majority of them, I don't know that they would get on that thing [iPad] and really want to know because they've got so much to do. They've got so much assigned to them already."

During the final interview in May, Josh described his sense of felt responsibility to set up structures for students' success. When asked about how he structured his classroom and teaching, he responded that it was

> Teacher-centered. Very teacher-centered [because] I just don't trust the motivation of the
> students. So just for them to be self-motivated or on task – I think it would work for some
> of them and I think they would like it more, and maybe even go deeper into some of it for

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the real motivated. But I think for the unmotivated, they have to have structure. And they're not very good with structure, I don't think. I feel like the teacher needs to build that structure….I say that all the time, "You've got to have this, you have to know this." Later in this interview he reported, "in the AP class, I try to drive it. Because I kind of know where the test is going so I…cover the units in this order…rather than a free for all." As evidenced in classroom observations and interviews, to avoid this "free for all" Josh chose a teacher-centered approach and structure, which often did not include the use of 1:1 iPads.

One instance in which Josh did integrate 1:1 iPads connected to WHS's newly identified "reading goal". Josh and Jon implemented the use of Socrative, an online quizzing website which allows teachers to post questions and share them with students. The website also records students' responses and shares this information with teachers. They started in November, posing two or three AP-like questions at the beginning of each class (students utilized the Socrative app via their iPads to answer and submit their scores). The goal was to use Socrative as a formative assessment of the previous night's assigned textbook reading. Josh offered daily extra credit to students who answered all of the questions correctly. Josh reported during the second interview in December that he viewed Socrative as another way to structure his class. He used it as an "anticipatory set," testing students' textbook reading comprehension and providing students with more AP test preparation practice.

"They Just Wouldn't Get the Content"

As evidenced by his interview responses and corroborated by in-class observations, Josh's own experiences as a student and as a fifteen year veteran teacher influenced the mode of teaching he believed worked best to prepare students for the AP test. During the third interview in March he explained,

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I think I still do things the way I've done them for awhile – lecture based. I still teach

pretty much the same way that I did. I think for some teachers [with the iPad], it's become

more of they flip it [their instruction], they move around, they do less lecturing. I don't

feel comfortable doing less. I don't know which the students would prefer, but again, I'm

still not to the point where I'll let them learn from this thing [the iPad]. So that hasn't

changed. I still think it's better coming from me than them going and finding it.

During the fourth interview in May, he revisited the idea that his students learned best when he

taught them the information they needed to know. He also noted that this philosophy was not an

uncommon one among his AP Psychology colleagues, whom he interacted with via an online via

the College Board's AP discussion forum and at AP trainings and conferences.

You know, shopping the [AP] forums that are out there and listening to other teachers

and going to the AP conference tomorrow – I know it's the same for them, too. Even the

schools that have the one-to-one capability are still lecturing. It's the only way to get

through the amount of material.

Given his concern regarding students' abilities to use their iPads to learn AP Psychology content

on their own, Josh continued to foreground his own content knowledge and experiences, relying

on his perceived previous success of using teacher-centered, lecture-based teaching.

"Left to Their Own Devices"

Josh believed that left to their own devices, literally and figuratively, his students would

not "get" the content on their own as well as they would from his lectures. Only *after* the AP test

was over did he choose to implement an iMovie project using students' iPads. Josh and his

colleague Jon implemented an assignment, "Advanced Psychology iPad iMovie Mission"

(Figure 9), a project they piloted the previous year during the first year of WHS's 1:1 iPad initiative.

Advanced Psychology iPad iMovie Mission

The pace of AP Psychology is one that does not leave time before the AP Exam for group projects. Although we have tried to incorporate the iPad into the AP Psychology class, I would love to see and learn what this technology can do from experts (you). Your iMovie mission is the following:

1. Group-up (3-5), find other people you can work with and individuals that are resistance to "social loafing" (all social loafers group together)
2. Pick a Psychology topic from the list below.
3. Create a (4 min.) iMovie that displays the topic in 4 class periods.
4. The iMovie will be evaluated on the following, rubric on back:
   - Group Work (4 days of work went into the iMovie)
   - Introduction (clear topic, clever plot)
   - Content (accurate information, fully explained)
   - Delivery (script, rehearsed, speech clear)
   - Graphic / Technical (images, music, transitions, time)
5. Have fun displaying what you have learned on the topic.
   - Day one – pick topic, decide on plot and place, characters, costumes and props
   - Day two – write storyline, have a rough script, rehearse lines and acts
   - Day three – start filming,
   - Day four – finish filming and finalize, edit and upload
   - Day five – Present

Figure 9. Josh Tucker's Advanced Placement psychology "iPad iMovie Mission" assignment

The project required students to select peers with whom to work and create a final video, highlighting their understanding of a particular psychology topic. To assess students, Josh and his colleague utilized an iMovie rubric Jon found on the web.

The entire iMovie project took place almost two weeks after the scheduled AP test and was completed during class time. Students chose a topic from the list provided and worked with their group to write and perform a script, capturing their final product with their embedded iPad video cameras. Despite students' freedom of choice and opportunity to complete the entire project during class time as well as Josh's promise to select the "best ones" to show to next year's students, when they showed their videos to their peers during class, the overall quality of the videos and content was relatively poor. In some cases, it was difficult to understand the purpose of the video because students seemed focused on making it "funny" rather than informative. In other instances, the video and/or audio quality made it quite difficult to

understand students' information and/or message. When asked about this project and his students' videos after one classroom observation in May, Josh talked about the fact that the videos were not very good. He elaborated on this during the fourth interview, when he reported

> I think you can pick your places where you give them – just like this [iMovie] project – "Here you go. You choose it. You do what you want with it." But I don't feel like most of them [students' videos] are better than what I could bring them, you know? Sometimes it just seems like on their own they don't get as much.

In this case, he used the poor quality of the students' videos as further support for the idea that AP students in a teacher-centered classroom, such as his, learn better and more than in a student-centered one.

"An Aid to the Lectures"

To some degree, becoming an AP Psychology teacher was not initially one of Josh's goals, considering that psychology was Josh's teaching minor. Although he said he had much more content knowledge now than when he first started teaching psychology, he still talked about how he used technology to address some of his own perceived shortcomings. In the December interview, Josh explained how he used a clip from the television comedy sitcom, "Community" at the beginning of the school year to talk to his students about his content knowledge.

> I tell them from day one, "I'm not a psychology genius." So I think pitching it early on that way lets me off the hook a little bit. I'll just say, "We have to ask Mr. Google." One thing I try to do a very good job of is this – I say [to students], "I can write your question on this yellow pad and I can go search for it." And most of the time I do because a lot of times I'll get that question again the next year.

According to Josh, he used "Mr. Google" and news-based apps to add to his content knowledge as well as research answers to students' questions, posed most often before or after class.

A self-described "poor speller," Josh also used technology to aid his teaching. He shared during the first interview in October, "For one thing, I can't spell a lick so I better not get [writing] on the board. I can't draw, either. That's why my stuff is all PowerPoint." He went on to explain that if his desktop computer or overhead projector did not work it would create problems. "I can fool it a little bit but that's not going to be a good deal if the projector didn't turn on and I had to start writing it all [because I can't spell]." In this way technology, although not necessarily the 1:1 iPads, proved helpful as a way to compensate for Josh's struggle with spelling.

Technology also enabled him to easily update his lecture materials such as PowerPoint presentations and videos, adding or changing from year to year. During the second interview in December, in response to a question regarding the role technology plays in his classroom, Josh explained,

> I think I would say that it [the iPad] is like a supplement, like a textbook. With the idea that it's there for them to review. It's there for them as an aid to the lectures. It's there for them to go back to on their own time, rather than it teaching them. I don't use it a ton, I know.

Following this response, he shared that he did not know of a lot of apps and websites students could readily access on their iPads to learn what they needed to know for his class.

This reinforced Josh's skepticism regarding having students use their iPad to learn course content.

I go down these [online] U Universities and all that stuff, [and] I hit more of a wall than I

hit something where I go, "Now that would be good." Maybe down the road, as more of

that becomes available? You know, the lectures that I've seen before on YouTube, I

wouldn't do that. One, I don't want to try to manage whether they [students] watched it or

not. That's the first thing I don't like because they probably didn't watch it.

Josh felt that requiring students to use their iPads to access and learn course content, in this case

video content, would be an unnecessary add-on that would not add to his students' learning.

Then it's just like, am I just assigning something because it sounds good that no one is

going to watch, or I'm going to have to create some crazy assessment to force [students]

to watch. I'd rather find something that's really good that I could really pitch as, "Hey,

you're going to want to watch this tonight." And then if you do, you do. And if you don't,

your world will probably keep spinning. But I guess for me it's much more of a review.

[The iPad is] another resource for going over what we've done [rather] than a teaching

tool right now.

Josh believed that the iPad was a resource rather than a teaching tool, which meant that when he

used the 1:1 iPads he most often used it to supplement his students' AP test preparation.

"It's Just Streamlined Stuff"

Before the start of almost every class period, Josh used the Internet and his classroom

computer and speakers to play a song connected to the day's topic. For instance, during the unit

on memory, Josh played Sarah McLachlan's song, "I Will Remember You," Natalie Cole's

rendition of "Unforgettable," and Sarah Brightman's performance of "Memory" from the

musical, *Cats*. Many times students listened to the song and either talked to Josh or their peers

about the connection(s) they made between the song and what they were learning. During the

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final interview in late May, Josh explained how and why he liked to use music at beginning of every class and how technology enabled him to do this.

> It used to be a pain in the butt to get music. And then what, are you going to play it on a CD? Now you can YouTube – students will say a song and it's like, "Oh, that relates? Well let's pull it up right now. This second." So I don't know how big a difference educationally music is, but I do have kids that come in and they'll say, "This doesn't have anything to do with it." And I'm like, "It doesn't?"

He continued, talking about how he used technology to build relationships with students and help them understand and remember content.

> So you take something like YouTube, which isn't really one-to-one because our kids don't have access to YouTube…so I try to make a relationship with the kids so that I can do my job. I want to build something where, okay, we're going to cover a lot of stuff but it's going to be pretty low key. I think I've tried to use technology to try to do that with the YouTube songs, [and] with some of the [video] clips that I can now find. I can put my own personality into them and go, "This is what I think is humorous. So let me show you this along with this term." And the kids love that stuff. I wouldn't be able to do that without technology. I probably could do it without one-to-one.

He also acknowledged that his students sometimes used their iPads to find and share information and examples with him related to course content.

> But then they go and find stuff on the one-to-ones [iPads], too and then I end up playing some of that stuff, too. I wouldn't say it's changed what I do a ton. When I try to think back to before we had it [1:1 iPads], it's just streamlined stuff.

So although in some ways using technology and 1:1 iPads helped Josh enhance what he did before it did not change his approach to or enactment of his teaching.

Josh also shared an AP Psychology Google calendar with his students at the beginning of the year and he updated it regularly, which many students checked on their iPads. Having a web-based calendar he could update in real time made it easier to communicate schedule changes and important due dates to his students. During the March interview he reported,

> I'm much better with this thing [the iPad]. I used to print out their calendar and just tell them, "Go and write on your calendar." I wouldn't print them out a new one because I thought it was a waste of paper. Just little things like that. [Now,] I think I'm more organized.

He continued, explaining the benefits of using an electronic calendar to manage and share course due dates and information with students who could easily access it on their iPads.

> And you can write anything on there [the online calendar] and have them see it, too. Like, "Hey, it's a snow day. Read this." So they can look there….We're always staying with the calendar. So if the test moved, you'll see it moved on the calendar. Say, this was a snow day. It was planned as a review day and now we have a test tomorrow because of the snow day today. If they see it moved to Monday, they know.

He also posted his class lecture PowerPoint files and class resources to his school Google site, so that students could have e-copies of the handouts. Although the content of these posted materials did not change, the fact that Josh no longer photocopied most of his class handouts and packets was of significant importance to him, something he shared during the first interview in October.

> It used to be you'd just barrage students with papers – handouts and more handouts. I don't think they feel as overloaded with stuff when they have this [the iPad]. And a lot of

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them, I tell them at the beginning to just set up in iBooks and just keep putting it [e-

course materials] in there because we're going to come back the neuron. With .pdfs, it

sounds like, "Oh, is that all?" But it's so big. And I don't have to run any copies!

No longer having to make copies was a time saver, something Josh also indicated during the

March interview. Instead of making copies, he explained that he could "do other things, like

Socrative or search TED talks. I can do other things on my planning period rather than run a

machine." However, not everything in his class changed from hard copy to e-copy. As was the

case prior to the 1:1 iPad implementation, Josh's students were still required to complete and

submit hard copies of study guides before each test. Josh believed that his students would review

more effectively for the AP exam if they used hard copies rather than iPads.

 "Maybe I Would Want to Use It"

At different times during the study, Josh shared his frustration regarding not always

knowing what the iPad could do or how he could use it more. During the March interview he

discussed the lack of WHS iPad-focused professional development during the school year.

Maybe they [administrators] assume everybody knows everything that it[iPad] can do

and is doing what they want with it. And maybe that's true, too….They've got this thing

in our curriculum that has all the possible 1:1 things that you could incorporate. Well, I

look at all these little icons and I'm like, "I don't even know what half these icons do."

Maybe I would want to use it – probably not, but it would be nice to know what they are.

I guess I could start – I don't know.

This evidence of frustration showed up again when he discussed a conversation about switching

from hard copies of study guides to having students complete study guides online using Google

Docs and Google Forms.

Study guides are a big portion of our curriculum. It's really the only homework grade outside of two papers. Is that something that should move to this Google Form? And here's another thing where I'm not super well versed in that. I'm sure he [the district tech coach] is, like, "They can fill it out in this form. This is how you create the form." Even with my own web page – I'm terrible at trying to – any of those things would be helpful.

Josh's perception regarding minimal WHS 1:1 iPad professional development coupled with his limited technical knowledge and uncertainity regarding the value of using 1:1 iPads to prepare students for the AP test provided rationales for why Josh did not further integrate and use 1:1 iPads in his classroom.

Josh also admitted that he could have done more research on his own but he often felt constrained by the additional time it would require. In March, when asked whether he would teach students in non-AP classes the same way he taught his AP classes, he explained that he would offer more opportunities for student-exploration and student-driven learning if he taught non-AP students. Using the unit on personality as an example, he explained

We would take time in the personality unit to take more personality tests. And for them to search their own [personality and answer the question,] "What do you want to know about yourself?" [Students could then use the iPads to] See if there's an inventory out there. I would let them do those kinds of things and right now they [AP students] don't do any of that stuff.

He continued on, explaining

…without the [AP] test, with more time, [we'd do] more projects, more self [exploration] – go find an inventory that you want to take. Or pick a disorder that you want to go beyond the text and go and see if you can find some other information and display it in

whatever way. Those kinds of things I think I would do more if the nature of the course wasn't the test.

Related to teaching AP students, Josh articulated that his goal, with or without 1:1 iPads, was first and foremost preparation for the AP test.

"It's Probably Not My Strong Suit"

Connected to teaching in a 1:1 iPad classroom, Josh also talked about student management. Although he acknowledged that he did not see or address everything during his classes, he still believed himself to be a relatively effective classroom manager. However, with regard to managing students' iPad use, he knew he could do more. During the first interview he explained, "You know what? I should move around more. I've never like moving around. I'll move down the aisle a little bit. I think I would have less headaches with it if I did walk around more." He continued, explaining that when he turned off the classroom lights and showed short videos during class, which was a routine occurrence, he sat in the back of his classroom to ensure that students were focused on the screen in front, rather than the iPad screen at their table.

> I can see when it's dark if it's [an iPad] lit up. [If I sat at my desk in the front of the room,] I could have a conversation with the kid like, "Hey, who's got the flashlight on back there? What are we doing with a flashlight?" But when I'm back there [when I show videos], nobody is messing around.

Later, he discussed the fact that he monitored his students and dealt with blatant iPad misuse when it occurred. However, he did not actively seek out opportunities to address and correct student misbehavior.

> I'm not on the hunt. It's probably not my strong suit, but I'm not going into the [class]room going, "I wonder if I can find out if [student's name] is misusing his iPad."

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…I told my class, "I actually really don't care what you're doing – I can't make you want something or think that it's valuable."

According to Josh and corroborated by classroom observations, he expected his students to monitor themselves so that only when it was necessary did he choose or need to step in and address iPad misuse.

In part, this was due to his concerns about iPad and student management, particularly when managing students' iPad uses and choices could take away instructional time. As a result, Josh most often chose to incorporate the iPad for unit and AP test review purposes and as a means of giving students access to course content via his website. During the third interview he elaborated on this point.

Don't ask me just how to manage it. Are the kids going to bring it? Is it charged? That's one thing that I like – say I gave a test on it [the iPad] – because one of the things I thought of for the future is I probably will give online tests eventually. Now the kid brings it in and it's not charged – does he fail the test? Can he take it again? If he's not prepared, would he just say that it's not charged? There's the whole game again.

He added that the more he required students to use their 1:1 iPads the more he had to think about and plan ahead of time to use it.

The more "make it or break it I make it," the more that would be another thing that would annoy me – when you don't have it or it's not charged. It would be another thing that I've got to deal with and decide what the outcome is going to be.

Later on in the same interview he explained, "I don't want to try to figure it [iPad management] out." As a result, one of the reasons Josh chose to limit the ways he used 1:1 iPads in his class was to avoid dealing with perceived additional management issues.

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"I'm a Debbie Downer"

During the last interview Josh acknowledged that even though he did not use them a lot, having 1:1 devices made updating and dissemination of course materials much easier. This proved valuable to Josh because now he could share course content with students easily and quickly via the Internet. In reply to a question regarding how he would respond if the iPads went away, Josh said

> First off, I would be upset. Even though I don't feel like I use them a ton, they are the access. They are such an easy device to get things to kids. Right away I would be like, "Oh my goodness, how am I going to give them all this stuff?" And now I've found so much more stuff because of these things [iPads]. It would be a bad deal going back. In fact, I would probably operate like this. "We don't have the iPads anymore but you all have phones or you have a computer at home. I'm still going to act like you have them because I didn't use them very much in the room, anyway." So, I used them more for when they're at home to access things.

So, although he did not use the iPads a lot during class, Josh still valued the fact that if students had wifi available, they could use their iPads to access online course content outside of school.

During this interview, when asked whether 1:1 iPads provided more opportunities for his students to learn Josh replied,

> I'm going to be a Debbie Downer when it comes to 1:1 aren't I? I don't. You know what?....What it seems to be is, for motivated students, it is. For a motivated student without resources, I think it [the iPad] is an equalizer. But for an unmotivated student it might be worse than having nothing. I just think that if they're not motivated to use it as

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an educational tool, I think that it has a lot of distracting ways that it's not going to aid in their learning.

Josh witnessed this distraction in his own classroom. "I mean, our own kids will say that it's [the iPad] a terrible distractor for them. I think, though, again, I don't see a lot of it [the iPad helping students learn], either." Josh went on to explain that next year he planned to change how he used the iPads in his classes, specifically having students put them away during in-class lectures. He reported that his plan for next year was

"Put it [the iPad] away, get it out." I hate that it's come to it because what I'd like to do is convince the kids to use it. And then when I'm not talking – because most of the time I don't go to the bell – rather than the cattle call [i.e., students packing up and standing near the door to leave], go ahead and use it [the iPad].

As a follow-up to this idea, when asked in October 2013 via email about whether or not he ended up having students put their iPads away during the current school year, he shared that he did implement a "put them away" approach. He wrote, "it has been the best thing I've done. I think it has brought about more phone use but I believe it has increased attention and decreased distraction from others on the iPad." According to Josh, 1:1 iPads were not a substitute for an experienced, knowledgeable teacher in the classroom.

"How Are Other People Managing It?"

Josh readily admitted that he did not integrate iPad 1:1 technology into his teaching unless it was geared toward AP test preparation. At the end of the final interview in May he also acknowledged that he still had a lot to learn about using and teaching with 1:1 iPads and he wondered about how other 1:1 iPad teachers were using them in their classrooms.

This is something I would want to know and that's how are other people managing it? Do they have different strategies that are better than what I'm doing? Or are they living in the same world that I am with the same kinds of frustrations and benefits of this thing? Is there a perfect way out there? Is it put them [iPads] away, get them [iPads] out? Is it have them flat? Is it that you don't allow them access to those things?

As a way of summarizing his own experiences and the reasons why he taught the way he did, he explained that in AP classes such as his, despite additional technologies available in the classroom generally, the teacher still remained the main source of information.

For me, and this just comes back to where we started, it wasn't going to change. I wasn't going to go to a student and say, "Go where you want, figure it out." This whole idea of them collaborating and sharing documents and that – I didn't buy into it. It feels terrible to say but I still don't buy into it.

He went on to explain why he did not buy into some of the "promises" of 1:1 digital device classrooms.

For me, it was never going to change the nuts and bolts of what I was doing. I always felt that I could get the most material to them lecturing. And trying to explain the stuff in a way that makes sense to me – so from [the year] 2000 whatever until now, that hasn't changed a whole lot. The Power Points, what I say, how much time I spend teaching, that hasn't changed. [The iPad has] given them [students] more access to some of that stuff but that's it.

As an AP teacher in a 1:1 iPad classroom Josh committed himself to teaching students how to pass the AP test. As a result, he used this commitment to vet what and how he taught, including the ways in which he chose to utilize 1:1 technology.

Josh Tucker: Concluding Thoughts

Throughout the study it was evident Josh took pride in the success of his students. He was pleased with their in-class performances as well as their AP test results. He also viewed himself as a successful teacher who continued to add to his content knowledge and teaching repertoire as a means of increasing his students' opportunities to earn college credit. He stated in the first interview, "The stuff we've got and how we're going, it is good. I like what I'm doing." Many WHS students also appeared to like what he did, evidenced in part by the fact that he was often invited by WHS senior classes to speak at their graduation ceremonies.

As noted earlier, in an effort to face his fear of speaking to a large group Josh accepted this year's graduating class's invitation and delivered a graduation speech. Toward the end of his speech, Josh encouraged graduates and audience members alike to take risks and be willing, when necessary, to fail. He also reminded them that when they failed, they should not "listen to the critics [but] instead find your own arena of high achievement." For Josh, one of his "arenas of high achievement" was, and continued to be, his perceived success in helping many of his students prepare for and pass the AP test.

During the last interview, Josh wondered aloud about other teachers in 1:1 classrooms. "Are there teachers that are able to have those things [iPads] out all the time and have the greater majority of the time on them spent about that class? I don't think it happens in my room." He went on to suggest that this was the type of teacher that researchers needed to study.

I think if you found that person who is pulling that off, that's what the next generation of

educators has to look to – how can you help the kids manage them? And I guess the last

thing I would say about it is I don't think they're going away. As our district tries to figure

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out how to maintain it, other districts are buying them. The movement is this way [to 1:1 devices].

In this statement, Josh acknowledged that he was not a 1:1 iPad teacher who was "pulling that off," compared to other 1:1 teachers who successfully and regularly employed the devices, in which they centered students' 1:1 uses on learning and applying course content. Unlike these teachers, Josh still viewed the iPad as limited in its ability to directly contribute to his students' learning and AP test preparation. Instead, as was the case prior to moving to the 1:1 iPad model, Josh's best teaching resources continued to be himself and his ability to learn, identify, and share information with his students.

CHAPTER SEVEN

"The Colon is the iPad: This is the Thing That Draws Us Together"

Brian Avery

It's really important for teachers to think about the collaborative nature of one-to-one. It's got collaboration in the name – one-to-one. So it's not just about each kid having a device. It's about each teacher having the opportunity to work one-to-one. And that's the transformation. That's what makes it worthwhile.
Brian Avery (Interview Three, February)

Brian Avery: Teacher and Teaching

Brian Avery is a tall, witty, and energetic second career high school English teacher. Prior to returning to college to obtain a teaching certificate and earn a Master's degree in education, Brian had been an independent music store owner and a professional magician for more than ten years. During this study, he was in his 9th year of teaching at WHS and taught five sections of sophomore English, including two English 10 "Foundations" courses and three English 10 classes. Beyond his role as a teacher, he also functioned as a WHS peer "technology coach," an extra-duty, paid position created to support teachers during the first two years of the WHS 1:1 iPad integration. He reported that he enjoyed being a technology coach because it enabled him to learn alongside of and work with his peers as they figured out ways to integrate 1:1 technology in their classrooms. It also kept him busy trouble-shooting and learning about new iPad applications and uses.

As was the case in other participants' classrooms, Brian's room contained a pull down projection screen and overhead projector as well as a teacher station with a desktop computer and document camera. His classroom contained three rows of student tables and chairs, which sat up to thirty students and faced the front of his room. It was also a classroom which had a "lived in" feel to it, in large part because Brian's classroom was full of current and former students'

projects. These items hung from the ceiling, were affixed on walls, and rested on counters and tables in various locations throughout the room. These projects included a life-size stove and coffin both made of cardboard, paintings, mixed-medium artwork, mobiles, and other theme-oriented projects. In Brian's classes, students focused on themes and topics in conjunction with the literature they read and the writing they produced. Sometimes Brian created themes, such as "Faith, Hope and Love Help Us to Survive" and "Man's Inhumanity to Man Reveals Itself in Any Culture" and at other times he required students to generate their own. The topics covered in Brian's class also varied, often depending on student interest. For example, during a persuasion and research unit, students studied and presented on self-selected topics such as, "The True Ways of the Farm: Organic Food" and "Use of Technology in America".

Located in the back corner of his classroom, Brian's desk and work area contained an additional desktop computer as well as former students' gifts, such as Jones soda bottles filled with tiny handmade paper stars, students' pictures and thank you notes, a prize box filled with a sundry of items, and multiple class t-shirts from his days as the school journalism teacher and advisor. These artifacts served as tangible evidence of Brian's positive connections with many of his students. Based on feedback he shared during the year, it was also clear that he appreciated these visible reminders of his students and the time they spent with him learning about English Language Arts, themselves, and the world in which they lived.

Brian's story of 1:1 iPad learning, integration, and teaching reveals a teacher's desire to use 1:1 technology to know and serve his students better as well as connect them to the world beyond their classroom walls. As a teacher, Brian committed himself to building relationships with students, being a positive role model, and providing students opportunities to use language and literature to learn about themselves, others, and the world in which they lived. Of the four

participants, he was the mostly likely to model, promote, and integrate the use of the iPad as well as specific iPad apps such as Corkulous, TED Talks, Flipboard, and Zite in his teaching and students' learning. Brian's story highlights the ways in which one teacher used 1:1 iPad technology to create a "one to one" model of instruction. In this model, during the classes he taught Brian shared course content via the iPad, expected students to use iPads to complete their work, and engaged with students as he walked around his classroom and provided individual and small group instruction.

"You Gotta Care"

Brian's care for his students was evidenced in the expectations he held for his students' academic and social behavior within his classes. According to Brian, for 1:1 iPads to promote students' learning, students had to know how and when to use the iPads as well and make choices that promoted their learning and demonstrated respect for themselves and others. Of the four study participants, Brian was the only teacher to remove a student from his classroom for iPad mismanagement during a classroom observation. His iPad misuse policy, as explained during the second interview in December was, "You swing. You miss. My idea with that is, 'Look, we're going over the syllabus. This is your warning. You know the policy. We're talking about it right now and it applies to all of you.'" At the end of his syllabi for both courses, Brian included the statement, "respect yourself, your peers, and your teacher through everything you do and say."

He took this statement seriously, particularly with regard to his students' uses of iPads. To illustrate, in his English 10 Foundations classes he provided more in-class scaffolding, engaged in additional classroom management, and moved at a slower pace than in his three English 10 classes. During an observation in December when his English 10 Foundations

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students were supposed to come to class with a completed speech script they were going to practice "delivering" during class, only a handful of students had completed the assignment and/or showed up to class on time with a hardcopy in hand. Shortly after class started, Brian addressed those students who, for whatever reason, had chosen to come to class unprepared. He explained that completing work on time was important and a way to show respect for oneself, their peers, and himself, their teacher. Moments after giving this reminder to respect themselves and put forth their best efforts, Brian stopped to deal with a student's misuse of his iPad. Standing in the back of the room, looking at his students – one in particular who was hunched over his iPad and typing – Brian announced, "Right now Aaron [student's name] will stop messaging. Tell me if I'm right?"

Aaron looked up from his iPad and responded, "You're right."

"Head off to the SRC [student responsibility center]. You know my policy. No exceptions." After Brian said this, Aaron packed up his stuff and left the room. Moments later Brian told the rest of the class, "You gotta care. Apathy gets you nowhere." Although 1:1 iPads created additional classroom management issues for Brian, because he committed himself to connecting with students he believed that it was even more important in 1:1 classrooms to hold students accountable for their behavior and actions, so as to more readily ensure their ability to focus and succeed.

"My Comfort Level With Technology"

Because he had taught for nine years already, Brian said that he felt more confident in his knowledge of content and teaching. During the first interview in October when asked about his pedagogical knowledge, Brian explained that "at this point in my career, the well has gotten

fairly deep for pulling up a bucketful of ways to teach." In December, he talked about his confidence regarding his content knowledge.

> I think as the years go by, [my] repertoire gets bigger and bigger just from experience. And by no means am I trying to convey the notion that I know it all because that would be the farthest thing from the truth. But there are just basic things that, as an English teacher, eventually you get those down and they become second nature.

He reiterated this confidence regarding his expanding technical knowledge. During the February interview he said, "obviously it [knowledge of technology] empowers me to use it [technology] confidently because of my comfort level with technology". Brian's confidence coupled with his view of teaching helped him purposefully integrate 1:1 iPads in his teaching and classroom which resulted in many changes, one being his implementation of online course management systems such as Edmodo and iTunes U.

According to Brian, prior to teaching in a 1:1 classroom he spent the majority of the class time providing whole class instruction. However, this school year he employed the online classroom management site, Edmodo for all five classes as a means of sharing course content as well as sending out regular course-related reminders to his students. In his three English 10 classes, using Edmodo was a positive change because it enabled him opportunities to share information and directions with students ahead of time, so that he had more time to work with and provide feedback to individual students during class. For example, during an observation in October, Brian started out one English 10 class by saying, "Ya on Edmodo? It's show time." He then went over the e-handouts he had uploaded to Edmodo, holding up hard copies of each and explaining what students needed to do during the hour. After giving them directions, he put them

in small groups and told them to "keep it business-y." Once they began working, Brian circulated around the classroom and talked with students for the remainder of the class period.

Brian also used Edmodo with his English 10 Foundations students to share content and push out reminders to students. However, because of his Foundations students' various needs and challenges as well as some iPad issues such as damaged iPad hardware and revoked iPad privileges, Brian used Edmodo differently than with his other English 10 classes. As he did with his English 10 classes, he used it to share electronic resources connected to the course as well as reminders regarding due dates and changes. However, because these classes moved slower and students needed more scaffolding, he did not provide calendars or long-term assignment expectations with his Foundations students. He explained during the December interview,

> What I've been doing is taking the English 10 curriculum and gutting it and using what I
> think they [Foundations students] can handle and I see how it goes. That's why there's
> never a calendar in Edmodo. You'll never find a calendar for foundations. English 10 I
> usually have a week outlook.

For both classes, Edmodo functioned as a tool to share course content and reminders. For Brian, using an online course management system that all students accessed during school and at home, if they had wifi, enabled him to electronically share content with students so as to provide additional in-class time in which he could circulate and check in with students, providing individual instruction when warranted.

"It's a Paradigm Shift for Students"

At the beginning of the second semester Brian switched his three English 10 sections from Edmodo to iTunes U. Brian liked using an online course management system but wanted to use it more to promote individual and independent student work and focus. According to Brian,

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using iTunes U enabled him to create a "project-based learning" environment in his classroom. During the third interview in February, he explained that although the first few weeks using iTunes U were difficult, he could envision all sorts of possibilities for how he could use it to share content and promote students' learning. In comparison with Edmodo, he preferred iTunes U because

> it generates that to-do list in the assignment section, [and] you can just load it up with the whole unit so that they [students] can be just working at their own pace. They can be reading ahead; they don't have to wait for the kid in the back who still doesn't get it.

He also expressed his excitement regarding the switch to iTunes U. "It's really exciting to me. This semester is incredibly exciting for me to see." He then went on to talk about the differences between Edmodo and iTunes U.

> Edmodo's great from a social standpoint [because] its graphic user interface mimics Facebook and that's where iTunes U is lacking – [with Edmodo] you can have that social discourse. But that's why I'm using Kidblog as a solution [to maintain online student discourse]. So there's always a solution. You know, it's a paradigm shift for students and parents that, as teachers in lower grade levels utilize things like iTunes U and work more toward project based learning and inquiry based learning, it will become second nature. It will become the new normal for students.

At the same time, using iTunes U required Brian to front-load a lot of his work prior to seeing his students face-to-face. He reported during the last interview in April,

> [iTunes U] forces me to be really structured in my thinking, to be able to carve it out and help them to pace themselves. I didn't have that in the past so it was much more of that organic approach – which is a euphemism for, "Hey, is this working? Okay, let's keep

going with it. What just moved me on the way to work today? I should do that." Now,

it's a lot of sitting down and looking at the calendar and the standards and the anchors and

exploring formative opportunities.

Using iTunes U forced Brian to think ahead and be more intentional in his conceptual *and* day-

to-day planning. During the February interview, Brian talked about how the iTunes U platform

provided him with an electronic venue with which to easily share more "tertiary materials" and

content with students, going beyond the .pdf versions of handouts he used prior to teaching in a

1:1 classroom.

For example, Brian required students to create a digital product as part of the informative

research project (Figure 10) he assigned to his English 10 students, which they submitted and

presented mid-April.

English 10 ANCHOR ASSIGNMENT

100 Points Possible ~ Due Date:_____

Informative Research Project: Digital Product

The Background

You will research an issue that is open-ended enough to enable you to create a thorough, *informative* speech and digital product/visual aide, but narrow enough that you will then be able to turn it into a persuasive essay and speech for a later challenge. After you do your topic research, you will organize your findings into something you can electronically publish, thus creating a digital graphic organizer of sorts; this will be the digital visual aide you will use to give an informative speech to the class. The format you choose will be up to you, so feel free to go beyond the content requirements. This project will form the building blocks needed to prepare for your Informative Speech and eventually for a Persuasive Essay and Speech.

Steps to Follow

__1) Compile information from at least 10 *credible, valid* sources.
__2) Find a minimum of 10 images that connect to your topic. Save these images on your iPad and be sure to document each image source. (Google is *not* the source to list.)
__3) Find a minimum of 1 brief video or Podcast that illuminates your topic.
__4) Conduct at least one interview with an expert (not your best friend) on your topic.
__5) Construct a Works Consulted page in MLA format.
__6) Organize information into 5 Subtopics.
__7) Get the format for your project approved by your teacher. A few iPad app possibilities include: Bamboo Paper, Book Creator for iPad, Corkulous, Creative Book Builder, Inkflow, Lino, My Sketch Paper, Paper by 53, Penultimate, Scribble Press, Skitch, Sticky Notes for iPad, Wordpress, and Zapd. Some of these cost money; some don't. Download a bunch of them and find one that you feel will give you a creative way to share with us the new information you've discovered from your research!
      *NO iMovies, Keynotes or Powerpoints for this project, please.
__8) Begin organizing your research findings in a creative, organized way using your app to assemble the information listed in the rubric below.

The Rubric

___/50 Your product creatively and effectively synthesizes your research in a way that is user friendly and worthy of publication. Your text only *informs* your readers without attempting to persuade them; you avoid giving your opinions on the subject. Your product is clearly organized and is grammatically and mechanically correct.
___/5   Works Consulted page (MLA format) is included with a minimum of 22 sources (10 for images, 10 for information you researched, 1 for a video or podcast, and 1 for an interview you conducted).
___/5   All textual evidence uses in-text/parenthetical citations, using the MLA format.
___/1   A minimum of 10 appropriate images are included.
___/2   A minimum of 1 personal interview is included.
___/2   A minimum of 1 video or podcast is included
___/7   First subtopic is thoroughly developed with research-based information.
___/7   Second subtopic is thoroughly developed with research-based information.
___/7   Third subtopic is thoroughly developed with research-based information.
___/7   Fourth subtopic is thoroughly developed with research-based information.
___/7   Fifth subtopic is thoroughly developed with research-based information.

____/100 Points Possible

Core Standards Covered by Project: RIT – 1, 2, 3, 7, 8, 10. W – 1, 2, 4, 5, 7, 8, 9, 10. L – 1, 2, 3, 6

Figure 10. Brian Avery's English 10 Informative Research Project: Digital Product assignment

In the last interview, Brian talked about how he used iTunes U to provide students with additional ideas, examples, and models of exemplary speakers who used effective visual aids (i.e., digital products) during their speeches. Doing so, according to Brian, scaffolded students' understanding and improved many of their final products and in-class speeches.

Frequently, [I ask myself] "what's the next major thing they're doing within these couple

of weeks that perhaps I need to develop more? What else could I offer them that would

help deepen their understanding of this thing? For example, when they were about to

start working on their digital visual aid [for the in-class presentation], I started looking

for more TED talks so that I could show them different presenters and their visual aids to

get a conversation going with the kids about what works and what doesn't work. And

interestingly, happily, I've gotten a real payoff on that. Looking at the majority of the

visual aids thus far, there's been a real economy of text and a real heavy dose of images

and relying much more on just understanding their topic and their research and being able

to actually talk about it, rather than stand up there and read to us.

Seeing his students use the content he shared and assigned via iTunes U in their in-class

presentations and final products deepened his belief that in his class using 1:1 iPads, and iTunes

U specifically, improved his ability to share content and impacted his students' learning and

development.

"I Talk Way More, That's the Irony"

Since the implementation of 1:1 iPads Brian explained that he moved around his

classroom all the time, also corroborated by classroom observations. Rarely did Brian instruct

from the front of his classroom for more than the first five minutes of his classes. Most of the

time in his three English 10 classes during the second semester, students accessed Brian's iTunes

U class on their iPads and worked independently. While they worked, Brian moved around the

classroom and checked in with and talked to students. In his English 10 Foundations classes,

although his students had different needs and required more scaffolding, he still tried to create a

project-based work environment, in which he used Edmodo to post and share daily checklists to

remind students' of the on and offline work they needed to complete during each class period. In both classes, he spent the majority of his time working one-on-one or in small groups with his students.

During the third interview in February, Brian explained that when teachers used tools such as Edmodo or iTunes U to do more than "house" course content, it had the potential to change how they thought about and enacted their teaching.

Things like iTunes U or Edmodo have to be paired with vigilance from the teachers. Otherwise, it's just online learning, but trapped in the classroom. But if the teacher is working with every single kid and seeing where they're at and what they're struggling with – and I've got plenty of kids who never need any clarification on any of the iTunes U posts. [They] never need to talk to me about any of it. They never have a question and always do top notch work.

He elaborated further, explaining that using iTunes U in his three English 10 classes fostered independence and promoted project based learning. As a result, Brian felt more successful as a teacher; however, this move toward students spending the majority of their class time working independently and at their own pace still met with some student resistance.

And then there are other kids who do top notch work but will not read it [information on iTunes U]. They prefer to hear it. Those are the kids who I will say, "Did you read the post?" And they'll say, "No," and I'll say, "Why don't you read the post. If you're still confused, call me back over and I'll clarify whatever you're unsure of." That then frees me up to sit with the kid who is actually, legitimately struggling with the thing they're supposed to be doing in the first place.

A few sentences later, he talked about working with students who, even in 1:1 iPad classrooms, still preferred to have the teacher tell them what to do and what and how to learn, rather than using their iPads to work on and accomplish assigned tasks and projects.

> If I sense there's push back, I'll explain why. Most kids are just like, "Oh, where is that?" It's right there. And they'll read it and things are good. But there will be the occasional kid who will push back and act like I'm being a jerk. And I suppose regardless of what I do they're going to cop that attitude [that I'm not teaching them because I'm not standing up front talking] so I try not to take it personally.

Even with more autonomy, in large part due to Brian's use of Edmodo and iTunes U, some of his students still wanted him to stand up front and talk, whereas Brian preferred to give students what they needed to know and do and then spend his time circulating around the room, working and talking with individual students who needed help.

The increase in teacher movement in his classroom during his classes also impacted how much Brian talked, something he found somewhat ironic. In February, he explained,

> I don't talk as much up front. I talk more, way more. That's the irony. So [a student] can go shoot their mouth off that I'm being lazy because I'm not up front teaching, but anyone who spends an hour in here will discover that that's so not true! I've never talked as much as I do now. It's just that I'm actually able to work with my patients individually rather than roll them all in on a gigantic gurney and say, "What's your malady? Okay, we're just going to drop a whole bunch of prescription drugs out of the ceiling. If one drops in your mouth, grab some water! Let me know if it works!" Right?

He then reported that because he put all instructions and content for his English 10 students' daily and weekly work on iTunes U, they had access to everything they needed to know and do,

freeing Brian to work individually with his "patients" (i.e., students) in order to more effectively and efficiently meet their needs. For Brian, this represented a profound change for how he instructed and interacted with his students.

"Is It a New Car?"

Although Brian reported that he experienced "profound change" when he used 1:1 iPads in his classroom, he recognized that this change was not just the switch to a 1:1 digital device model, nor was it the result of access to and use of a particular app which produced this change. Having the opportunity to teach in a 1:1 iPad classroom also provided Brian with opportunities to change some of his own thinking and understanding about how he could better meet his students' needs and create an environment that supported project-based learning. During the second interview in December Brian stated,

> I think in some ways people limit themselves with the one-to-one technology. Oh, we need to find an app to do this? I would say if that app is going to help generate more interest in the activity, then great. If you're just seeking out apps for the sake of doing the same thing but just with pretty colors, then why bother?

When asked about whether or not some teachers might consider "pretty colors" an enhancement to students' learning Brian asked,

> But is that transformative to education? I think it's got to constantly come back to how is this transforming education? Are we just doing the same stuff in a different way? Is it a new car? And does that car get me from here to there, just with a new smell and different color? And if that's the case, do I really need that new car?

In this case, the "new car" was the iPad. For Brian, the iPad became

a transformer. More than meets the eye....because what we do should be transformative. It should be in a way that's not just repeating the same old thing. For example, if I have the kids write and they swap papers for a peer review, I can transform that classic writing workshop technique by having them blog on the iPad and having some other class peer review their work. That's transformative because now suddenly the audience got bigger and the audience isn't their pals that they're stuck in here with every day.

He further discussed how he transformed his students' ideas about writing.

The way I have my blog set up is it's just first initials. Depending on the group, first initial and last name, maybe just initials. So they won't necessarily know who they're dealing with....I know who they are and they know I know, so that's in place to hopefully keep them honest. So now suddenly they're writing for a bigger audience. It's more authentic. So you're transforming their writing – you're moving it beyond just saying to the class, "Here's your audience for doing a [type of] writing." [The student rhetorically says back] Okay, so you just told us this fake audience we're writing for but we all know that you're [the teacher is] going to grade it.

Brian used kidblog.org, a free, online blogging site for teachers to use with their students. At various times using Kidblog students corresponding with their in-class peers; at other times, they conversed with Brian's students in a different section of English 10. According to Brian, Kidblog is "almost like the Edmodo of blogging. It's a secure site. It's designed for educators. It's not nearly as restrictive as Edgyblogs, which I tried a few years ago." Using Kidblog enabled Brian access to all students' writing, as well as their peers' comments and, as Brian noted, students' writing could also be shared across classes instead of just desks and aisles.

 "Are We Creating Our Own Demise Right Now?"

Brian acknowledged that even with the changes he made and experienced, he also had to be careful not to push himself too far "into the shadows," an issue he addressed during the second interview in February when he responded to a question regarding the next steps he wanted to take as a teacher in a 1:1 iPad classroom.

Well, I've actually been thinking about that lately. I think in some sense, the next step has already begun, in that I'm actually returning to more interaction with students. Because there was a period this year when I think I sort of shifted into this, "Well it's all there so that's all you need." So I went through a brief period in which I made it almost like an online course. I was here [in my classroom] but I don't know if it was where I was at in the curriculum that wasn't conducive for the level of individual engagement, or if it was an issue of it being [too] early in their tenth grade year, in which they're still really immature and not capable of just carrying on a conversation with me.

Brian's reflective stance regarding his teaching and what happened with his English 10 students during the first semester was consistent during observations and across all four interviews.

During the third interview, he offered some concerns he still had about how to best use 1:1 iPads to teach and promote student learning.

I found myself feeling like, "I don't feel like I'm doing anything other than evaluating what they're submitting. I don't feel like I'm teaching. I don't feel like I'm seeing them working independently and at their own pace."

As he reflected on why he felt this way he explained,

I think my biggest misstep first semester was simply trying to have it be so inquiry-based that I was really pushing myself into the shadows – despite the fact that I was going to each team [of students] and making attempts to work with each team….But I think that's

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what I come back to, that you also can't take on this thinking that the device [1:1 iPad], to

a certain extent, replaces you. And that was something I said to [WPS district tech coach]

very early last year. I said, "Are we creating our own demise right now?" And I think he

thought I was joking but I was serious.

He then brought it back to his own beliefs that even in 1:1 classrooms it was still important to

use human-to-human contact and teaching to foster students' development of knowledge,

themselves, and the world in which they lived.

Some of the initial research that I've seen says to most effectively use one-to-one

technology, it has to be a mix of the technology and human interaction. There's still that

deep need for human interaction and [students] hearing it explained to them and having

the opportunity to look confused even after the explanation and for the teacher to then go,

"You're not quite getting this, are you? Well, how about this?" And then reframing it.

As evidence of this, Brian talked about how his students in his English 10 Foundations courses,

in particular, benefited from using their iPads *and* having Brian available in class to explain

things and further scaffold and support their learning.

And so that's probably one of the most important things – telling people who are heading

into it [teaching in 1:1 classrooms] that you can't expect it to – you shouldn't expect it

[the iPad] or want it to – replace you. If anything, it heightens the need for you because

there are a lot of kids who need the verbal aspect. And it's not enough to just shoot video

of yourself and load that in. [As a result,] it's really more back to basics for me. And this

[second] semester has been much more intentional with returning to interactions that I

always valued in the job. And I'm able to better do that with the one-to-one.

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For Brian, 1:1 technology was beneficial to his teaching and for his students' learning but the teacher in the classroom also mattered and he worked to make his classroom presence and contributions a valuable part of his students' learning.

"I Don't See the Sense in Going Completely Digital"

According to Brian, 1:1 iPads were not always the best tool for teaching or students' learning. As a result, technology was not part of every aspect of Brian's instruction. For example, one thing he did not use technology for was assessment of his students' formal writing. During the October interview he reported,

> I often have students submit their work to me via email, if it is something that doesn't require being marked up—such as a worksheet or something. Anything, such as an essay that requires written feedback has remained in the analog. Grading has remained faster for me sticking with the old way.

He reiterated this idea in February, when he responded to a question about his own knowledge of technology and how that influenced when and why he used it, connected to assessing his students' work.

> Generally speaking, I don't grade any kind of essays or writing pieces digitally. I still don't find that a productive use of the technology. I certainly know people who do that and more power to them, but I don't see the sense in going completely digital.

He explained,

> You still have to function with paper and I just think it comes down to balance. It's like being able to work with the Windows operating system and also being able to work with [Apple's] IOS. The more you know and the more parameters in which you can work, the more flexible you are and the more adaptable you are.

For Brian, it was important to learn about how and when to use (and not use) 1:1 technology and he worked to ensure that when he chose to use and teach with 1:1 iPads it advanced his teaching and his students' learning and development.

"It's Got Collaboration in Its Name"

According to Brian, connecting with and caring about his students mattered deeply to him and he actively sought to build and maintain positive, mentor-like relationships with students. At the beginning of almost every hour, Brian stood in the hallway outside his classroom and greeted students, giving out high fives or fist bumps, something he often did at the end of his classes as well. Brian also worked one-on-one with individual students, helping them with their personal and academic challenges, and he regularly complimented his students' work and affirmed their successes. Brian shared that one of the things he found most satisfying and what he enjoyed most about teaching was "the relationships with students and being surprised by their academic breakthroughs."

Brian's focus on connecting and building relationships with his students and his commitment to helping them succeed was evident throughout this study. During the first interview he explained that because his students had iPads and ready email access (if they had wifi available to them outside school), he committed to checking and responding to students' emails, doing so from 8:00pm – 9:00pm each weeknight. He did this for two reasons. First, students now used their iPads to send him emails regarding course-related questions during non-school hours. Second, he believed that being virtually available to students outside of school further enabled him to connect with and provide students with additional instruction and guidance. Using 1:1 technology, he opted to make himself accessible to his students beyond the school days and walls.

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At the same time, Brian also believed that 1:1 technology had the potential to isolate humans from one another. During the second interview in December, he shared

I'm offended by people walking the halls looking at a rectangle [their iPad or phone]…. I'm offended when I see [WHS] colleagues doing that. I'm particularly offended because that's terrible modeling for students.

He continued, explaining that people who spend so much time looking at electronic rectangles end up

floating through the world not noticing people. Not being part of the very people who are right around you. Living this vacuous existence. So we can say that, through social websites, etc. that we're more connected than ever. We're more connected than ever with people who aren't within our proximity. We're more disconnected than ever from the very people who are breathing the same oxygen. That makes me incredibly sad….we've gotten really good at being social animals but not with people in the same space. That's very disturbing to me.

As a result, Brian spent time trying to figure out how to use 1:1 technology to create a "one human to one human" learning environment. He stated in February,

it's really important for teachers to think about the collaborative nature of one-to-one. It's got collaboration in the name: one-to-one. So it's not just about each kid having a device, it's about each teacher having the opportunity to work one-to-one. And that's the transformation. That's what makes it worthwhile.

Throughout the school year, Brian continued to work on "transforming" teaching and learning using 1:1 iPads in his classroom.

He also pushed collaboration between students in his classroom and between students and the world in which they lived. During the study, he required students to tweet or email questions to experts in various fields and he expected them to regularly contribute to a classroom blog. He also modeled how to use the iPad to connect to the outside world. For example, during the winter he introduced and required his students to use a relatively new school-friendly, research-centered website called "Instagrok" (www.instagrok.com) to conduct research for a class project. Seeing the large number of users from one location, namely the city of Watertown, the Instagrok creators reached out to Brian via email. As a result, Brian ended up Skyping with these individuals and he talked to his students about this conversation. He also provided the Instagrok developers with feedback he and his students generated as a result of using their site. This collaboration netted Brian and his students an "Instagrok Award" and a tweet on Instagrok's Twitter site for having the most concentrated number of users during the month of February.

As was the case with the real-world application interactions with the Instagrok developers, 1:1 iPads offered Brian additional ways of expanding students' abilities to collaborate and connect between his classroom and the school day. During the final interview in April he reported that he used 1:1 iPad technology to move toward a "space" with more "interaction,"

> where it becomes – now that you've created this space, you've got the interaction via email with the students. You've got interaction via Edmodo – kids posting questions on the Edmodo page and other kids answering them. Them helping each other – very much the social networking approach. And…the classroom continues beyond the classroom….it's very much going beyond the class walls and the class time.

As a teacher in a 1:1 classroom, Brian actively sought to use the iPad technology and Internet to foster communication and collaboration, in and out of school.

"Look, Just Begin with Some Basics"

While important to use 1:1 technology when available, Brian refuted the idea that teachers' motivation to use 1:1 technology should come from taxpayers, namely parents and community members, because they had paid money and expected them to be used. They should be used Brian explained, but not because they were expensive. Rather, they should be used because it improved teaching and learning. During the third interview in February, Brian elaborated on this point.

> [The iPad] shouldn't be viewed as a device for doing the same stuff they've been doing but just on a screen. It needs to be transformative. If all the kids are just doing the same old, same old that they could have just run off photocopies, then there's nothing significant. You might as well not use it. And it's not about how many apps can I get on this thing for my kids to use. That was, I think, a huge part of all of our mentality at the beginning. I've got to find apps that work for my curriculum. And trying to just sort of force it – there's a lot of that and I was guilty of it, too. [There was] this mandate from the [WHS] admin that we have to make good use of the taxpayers' dollars.

For Brian, the "pressure" to make good use of taxpayers' dollars was not a good reason for using the iPads. He stated, "yeah, you need to honor that investment, but you don't do it just for the sake of using it and saying that you're using it. It needs to be meaningful". Brian then talked about what he was now doing that was "meaningful" as well as what he saw his peers doing.

> I think [WHS] people have abandoned stuff that was sort of surfacing and gimmicky. Last year I'd have them [students] do an iMovie, just for the sake of [using] it. Yes, it was

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a different way for them to demonstrate their understanding but I don't know that it actually deepened their understanding.

He elaborated further and talked about the second year of WHS's 1:1 iPad integration. He explained that now he asked himself whether or not what he had students doing with their iPads was worthwhile. He explained,

[I ask myself] Is it [the iPad use/app] a good use of time? Because that can be quite a time investment. So is the thing that [I'm using] to check for understanding – could it be done in a much more efficient fashion, yet engaging? Because the argument can be made that it's [the iPad] more engaging. Well, yeah, okay but is it worth all that extra time? Could [the teacher] have discovered whether they get that or not in a quicker fashion?

At the same time, given the availability of the 1:1 iPads in his classroom and at Watertown High School Brian believed that it was important for teachers to learn how and when to use them so as to use them well, rather than just to say they were being used.

Now in his second year of the 1:1 iPad initiative, Brian talked about the fact that with anything new, such as 1:1 iPads, teachers have to have time to learn and adjust. During this last interview, he explained that teachers who use and teach with 1:1 technology need to "start somewhere".

When I talk with people from other districts who haven't gone one-to-one [yet] I say to them, "Look, just begin with some basics. Get your assignments digital, get yourself into a classroom management system like Edmodo or iTunes U and there you have just made incredible strides because that requires such a rewiring of your thought processes, just getting that stuff moved around and into place and finding your routine for posting that stuff and getting that down."

Although he exhorted teachers to "start somewhere" he also explained that they needed to focus on improving their teaching and students' learning, something he was doing himself. In doing so, "starting somewhere" enabled teachers to move toward a model of teaching and learning with 1:1 technology that enhanced instruction and transformed student learning. As Brian explained when he concluded this earlier response, for "it [1:1 technology] to be transformative, it has to go beyond just doing the same stuff with a different look".

Brian Avery: Concluding Thoughts

At the bottom of the last page of Brian's English 10 and English 10 Foundations course syllabi, there was a sectioned titled, "A Few Important Thoughts," which in some ways represented his experiences teaching in a 1:1 iPad classroom. This section read,

> Ready for an amazing year? By coming prepared to share, it's yours for the taking! I'm excited to begin this adventure with you. This year truly will be a journey toward deeper understanding of yourself and the world that seems to exert so much force on you. You are on the edge of an experience unmatched by any other class you will take in high school. That's my promise to you.

Brian worked to ensure that he fostered positive relationships with his students and that he helped them use English Language Arts and technology to explore and learn about the world in which they lived. He also viewed the iPad as "the colon" in the 1:1 technology model. During the last interview he explained

> you can't have one without the other. It's not one-to-one technology, it's one-to-one….It's not one-to-one technology, it's just simply one-to-one. The iPad is actually the colon. [In a 1:1 model,] the first one is the student, the colon is the iPad, and the other one is the teacher. And this is the thing [the iPad] that draws us together.

Using the iPad as "the colon," Brian promoted student success through actively exploring new ways to use and integrate 1:1 iPads to help his students learn, collaborate, and connect. His goal was to use 1:1 technology to generate meaningful and purposeful learning opportunities. As a result, he expected his students to actively participate in their learning, using their minds, hearts, *and* 1:1 iPads to propel their thinking and growth.

CHAPTER EIGHT

Discussion

Willing is not enough; we must do.

Johann Wolfgang von Goethe

The purpose of this study was to (a) understand how teaching in 1:1 iPad classrooms changed, in any ways, how secondary teachers thought about or enacted their teaching and (b) to identify the funds of knowledge upon which they drew when they planned and taught in their 1:1 iPad classrooms. Looking across four cases provided multiple examples of the ways in which different content area teachers enacted change and the funds of knowledge they used to plan and teach. Specifically, cross-case analyses results indicate that focal teachers enacted one of three different types of change, namely "Adding On," "Combining," or "Remaking". Results also point to the important role these teachers' Knowledge of Educational Ends (KEE) played in relation to the type of change they enacted.

Case Participants

Ralph Peterson. Ralph's overarching goal was to prepare his students to pass first year college chemistry courses. As a result, this goal directly impacted how much he and his students used 1:1 iPads in his class. According to Ralph, neither the content nor his teaching changed much as a result of teaching in a 1:1 iPad classroom. Although he and his students used their 1:1 iPads during the study for various purposes, Ralph often foregrounded particular funds of knowledge which resulted in the perpetuation of a lecture-based, teacher-centered classroom environment.

Tim Donaldson. As a world languages teacher, Tim was willing to change and try new things with the 1:1 iPads, as long as he perceived it to be beneficial to his students' second

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language acquisition and learning. For Tim, change made sense when he perceived the iPads fitting into his teaching. Change did not make sense when/if he felt that he had to force the iPad into his teaching. When Tim planned and taught with the iPad, he drew upon various funds of knowledge all the while maintaining an emphasis on supporting students' second language skills, cultural awareness, and appreciation.

Josh Tucker. Citing previous students' passing AP test scores as a reason for continuing to facilitate lecture-based, test-preparation teaching, Josh saw no reason to change how he delivered in-class content, although he did utilize the 1:1 iPads for test preparation and review. At the end of the study, Josh still viewed the iPad as limited in its ability to directly contribute to his students' learning and AP test preparation. Instead, as was the case prior to moving to the 1:1 iPad model, Josh's best teaching resources continued to be his content knowledge and his ability to learn, identify, and share information with his students.

Brian Avery. Brian valued relationships with students and he worked to ensure that he fostered positive relationships with his students with and without technology. Using the idea that the iPad is "the colon," in the 1:1 model, Brian explained how his teaching changed. Prior to the 1:1 iPad initiative, he often stood in the front of his classroom and delivered whole class instruction. During the school year in which this study took place, Brian chose to use the iPad to house course content so that he could work directly with students. He also required students to regularly use their iPads to interact with others as well as demonstrate their learning and thinking.

Three Types of Change

According to Cuban (2013), 1:1 classroom technology integration results in change. Although it is most often policymakers who initiate and promote changes, such as 1:1

technology integration, it is still left to classroom teachers to enact these changes (Cohen, 1990).

In 1:1 classrooms, teachers' understanding of technology influences how they plan and teach

(Zhao, Pugh, Sheldon, & Byers, 2002). This understanding also impacts the type of change they

make. The type of change a teacher experiences and enacts also determines whether the changes

they make align with best practices and/or expand students' learning opportunities.

Findings suggest that the secondary teachers in this study enacted change in various

ways. Three categories serve as a means of broadly identifying and understanding the ways these

secondary teachers enacted change when they planned and taught in their 1:1 iPad classrooms.

These three types of change, "Adding On," "Combining," and "Remaking," are extensions of

Cohen's (1990) weaving metaphor, regarding what teachers do to their teaching fabric when

required to implement a change. These change types were identified and generated during this

study's data analysis. To distinguish between the three types, definitions and indicators are

included as well as examples from this study's data (Table 3).

Table 3.

Types of Teacher Change in 1:1 iPad Classrooms

Type	Indicators	Examples
Adding On: *Supplement old with new*	Teachers employ 1:1 technology to support pre-existing pedagogy, practices, and course content.	• Convert hardcopy worksheets and handouts to electronic versions • Provide in-class lecture materials electronically
Combining: *Blend old with new*	Teachers use 1:1 technology to accompany and extend established pedagogy, teaching practices, and course content.	• Adjust previous assignments to include multi-media elements • Utilize apps and websites to further students' exploration and understanding of course content
Remaking: *Remove old and replace with new*	Teachers utilize 1:1 technology to generate and implement new ways of teaching, communicating, and assessing students.	• Use apps and websites to broaden students' audience and increase the ways they may demonstrate knowledge and understanding • Employ social media and electronic resources to expand access to and connection with "out-of-school" peers and experts

These categories, definitions, indicators, and examples were generated during the process of cross-case analysis. The examples included for each change type are by no means exhaustive. Rather, they are meant to illustrate some of the ways in which teachers enact each type.

　　"Adding On". In terms of change, "Adding On" is when a teacher supplements something old with something new. Regarding the teachers in this study, when enacting "Adding On," what teachers did before remains central to their teaching and planning and when they add on, they supplement their pedagogy and practice with whatever is new. As indicated in Table 3, when teachers enact "Adding On" relative to 1:1 iPads, they use 1:1 technology to further support their existing pedagogy and practice. Results indicate that Ralph Peterson and Josh Tucker most often enacted "Adding On" when they made changes in their planning and teaching. In other words, both teachers understood and viewed 1:1 iPads as an "add-on" to their content

and how they taught, reporting that even with 1:1 iPads they continued to teach in similar ways as before the 1:1 iPad implementation.

Enacting "Adding On" in their planning and teaching meant that Ralph and Josh allowed students to use their iPads to access the PowerPoint presentations that corresponded to their in-class lectures. Ralph also encouraged his students to use graphing calculator apps on their iPads when they worked to solve equations. Josh expected his students to use the iPad app, Socrative at the beginning of class to answer AP-style questions regarding the previous night's textbook reading assignment. Moreover, Ralph and Josh found ways to incorporate technology into their teaching that did not require them to significantly change how they taught. For example, Ralph and Josh talked about the ways they added content to their class websites and shared digitized materials electronically with students. This change increased student traffic on their class websites and resulted in their ability to utilize these sites more effectively to share course information, study guides, and resources with students. They also digitized many of their students' worksheets and study packets and they utilized different iPad apps to help their students complete assigned review work.

These examples highlight the ways in which Ralph and Josh viewed the iPad as a means of supporting their pre-existing pedagogy, practice, and course content. The connection between their understanding and their enactment of "Adding On" also aligns with Ertmer and Ottenbreit-Lefwich's (2010) review of literature focused on the characteristics and types of understanding that teachers need to for effective technology implementation/integration in their practice. Teachers like Ralph and Josh, who maintained a teacher-centered view of teaching and learning even when they integrated 1:1 technology into their teaching, demonstrate how closely teachers'

technology integration practices align with their instructional beliefs and philosophies (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012).

Ralph and Josh seemed to recognize, although not by name, the type of change they experienced and enacted, namely "Adding On. " For example, they both talked about the fact that the iPad was not necessary for their students to learn or succeed in their classes. For them, the 1:1 iPads did not initiate revolutions nor did they seek to generate revolutionary changes, something about which they were quite clear. They both reported that they used the 1:1 iPads to support what they already did. As a result of "Adding On" 1:1 iPads to their pedagogy, practice and content, they continued to do what they had previously done, what Tchudi (2000) called putting "old content in new media bottles" (p. 32). It is also possible that their additional years of teaching experience further influenced why Ralph and Josh enacted "Adding On". In fact, this was quite likely the case. Relying on their previous years of experience and expressing confidence regarding their own knowledge, Ralph and Josh shared that they liked and felt good about what and how they taught. They talked about the fact that they did not see or feel a need to make important changes with regard to the ways they planned or taught in their 1:1 iPad classrooms. The choice to "add on" 1:1 iPads to their existing pedagogy and practice aligns with Christensen's (2008) finding that schools and teachers implement technology and place it into existing classroom and teaching models, sustaining their existing pedagogies and practices instead of displacing or changing displacing them.

Another reason why these two teachers most often experienced and enacted "Adding On" connects to Wenglisky's (2005) concept of "goodness of fit. " This term refers to the connection teachers make between their specific curriculum and the technology available to them. Neither Ralph nor Josh saw a clear "goodness of fit" (Wenglisky, 2005) between the 1:1 iPads and their

curriculum or end goals. In Ralph's case, for example, the iPad's lack of Flash compatibility as well as his belief that most of his students would not be allowed to use 1:1 digital devices in their entry level college chemistry classes provided rationales for limiting the ways he planned and taught with 1:1 iPads. Josh did not believe that his students would or could effectively independently learn the AP course material using their 1:1 iPads. Josh's stated goal was to prepare students to take and pass the AP Psychology test and Josh did not view the 1:1 iPads as fundamental or even directly connected to achieving that goal. As a result of their perceived lack of a "goodness of fit," Ralph and Josh opted to enact "Adding On" when it came to integrating 1:1 iPads and in doing so, when they used iPads it was to supplement old with new.

"Combining". When teachers enact "Combining," they blend old with new. In a 1:1 iPad classroom, they use technology to accompany and extend established pedagogy, teaching practices, and course content. Results suggest that Tim Donaldson enacted "Combining" when he planned and taught in his 1:1 iPad classroom. For example, Tim's pedagogy and practice appeared to shift in some ways when he was introduced to and explored online tools such as Padlet and Kidblog. For example, when Tim understood how to use these sites to provide virtual opportunities for students to practice and share their writing (in Spanish) he integrated these tools into his teaching and students' learning. In this instance, he adjusted a previous text-based, offline writing assignment to include online blogging and posting to a web-based, private classroom bulletin board.

According to Tim, his use of these tools changed some of the ways he required students to share their knowledge and learning. For example, instead of students providing written responses during a unit on Spanish dances, as he had previously done, Tim implemented the use of Kidblog. Doing so allowed Tim to share multi-media content with his students and provided

an additional way for students to access content and demonstrate their learning. To illustrate, using this blogging site, he posted links to online Spanish dance videos and required students to post blog responses to the videos as well as comment on their peers' posts. Tim's increased understanding of the iPad and related tools influenced the type of change he enacted. As a result of "Combining" old with new, he often utilized his additional understanding and willingness to integrate 1:1 iPad technology to extend his teaching and students' learning. This example also highlights Inserra and Short's (2012) finding that in order for incremental changes to occur when teachers use technology in their classrooms, teachers must first understand the relationships between technology, teaching, and learning. In Tim's case, when he understood the affordances of particular tools available via the iPad (i.e., Padlet and Kidblog) he was better equipped to enact "Combining," in which he blended what he did previously with the new options presented by having 1:1 iPads .

As evidenced by the four teachers in this study, teachers do not all experience, think about, or use 1:1 technology in the same ways (Bebell & Kay, 2012; Garthwait & Weller, 2005; Kozma, 2003). Like Ralph and Josh, Tim Donaldson experienced and made changes within the 1:1 iPad classroom in which he taught. Unlike Ralph and Josh, Tim's classes and teaching did not focus on preparing students for an end-of-the-year AP test or passing a first year college class. As a result, this may have impacted the ways in which Tim viewed the 1:1 iPad's "goodness of fit" (Wenglinsky, 2005) in connection with his high school Spanish language curriculum. For instance, the more Tim learned about various iPad apps and websites he could use in his Spanish classes, the more willing he became to incorporate 1:1 technology and combine it directly with what he already did. As he enacted "Combining," he was careful to align these sites, apps, and tools with his existing curriculum, rather than using the iPad for the sake of

using it. For Tim, it seemed that he used iPads more when he connected his understanding regarding ways in which he could combine 1:1 technology with his already established pedagogy, practice and content (Wenglinsky, 2005).

As Tim enacted "Combining," he went through an "adaptive process" of negotiating, reworking, rethinking, and integrating of 1:1 iPads within his teaching and classroom (Lei, Conway, & Zhao, 2008). For example, during the first year of the 1:1 iPad integration Tim had his students use a presentation app to complete a unit assessment focused on Spanish legends. During this study, Tim chose to incorporate additional multi-media elements within the legends unit final assessment. As a result, Tim extended the previous presentation assignment and incorporated the iMovie app, adding multi-media elements to the previous assignment. In doing so, the focus of the assignment remained the same but the final product and the ways in which students created and shared their work changed. In other words, he combined an old assignment with a new technology. As a result of "Combining," Tim's students' multi-media iMovie presentations enabled him to assess his students' ability to create and integrate content alongside their written and oral language skills.

Another reason Tim was able to enact "Combining" was because he saw connections between the technology and his curriculum, which motivated him to continue to negotiate, rework, rethink, and integrate the 1:1 iPads within his teaching and classroom in ways that accompanied and extended his pedagogy and practice. Tim's choices to enact "Combining" were also informed by the pedagogical beliefs he articulated about what was "best for students" when it came to teaching and learning a new language. When Tim chose to "blend old with new," his understanding of and practices with the 1:1 iPads evolved in ways that resulted in additional uses and changes in his planning and practice (Hicks, Young, Kajder, & Hunt, 2012). Like Tim, when

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teachers enact "Combining," they see connections between their curriculum and technology and when they gain knowledge and experience with technology, they are more likely to find additional ways to incorporate it in their planning and teaching (Morsink, et. al, 2010/2011).

"Remaking". When teachers like Brian Avery enact "Remaking," they "remove old and replace with new." Lehmann and Livingston (2011) claimed that 1:1 technology creates classrooms where "teachers are facilitators and mentors, guiding students through learning and creation…[and] it stops being about the technology and becomes about the work" (p. 77). In choosing to enact "Remaking," Brian was "not be afraid to build learning experiences that don't always go exactly according to plan, but instead involve[d] some element of flexibility while striving for innovation" (Hicks, Young, Kajder, & Hunt, p. 73). Brian's understanding of the ways in which he could use 1:1 iPads to more effectively connect with his students changed how he planned and taught. As a result, he often enacted "Remaking" and used 1:1 technology to "generate and implement new ways of teaching, communicating, and assessing students."

One example of "Remaking" connected to Brian's belief that 1:1 technology should function as the "colon" between the teacher and the student. For example, Brian utilized Edmodo and iTunes U as course management systems through which he provided directions and shared course content with his students. Using these course management systems enabled Brian to "Remake" how he delivered content and attended to his students' questions and needs. As a result, Brian perceived great benefits from enacting "Remaking" using iTunes U and Edmodo because it allowed him to spend the majority of his in-class time working with students individually and in small groups.

Using iTunes U and Edmodo to "Remake" how he delivered course content also changed how Brian planned for his students' learning. The act of "Remaking" necessitated more work for

Brian prior to the start of every unit because now he needed to organize his ideas and align his goals early on, before students ever started the unit. He also had to plan further ahead, which included identifying and organizing content, assignments, and various multi-media resources in order to scaffold and support students' learning as they worked through each unit. As a result of this additional planning, particularly planning ahead of time, Brian "remade" how he planned for student learning. The result was a new way of facilitating learning, in which he was able to provide his students with new multimedia content (e.g., TED talks, access to websites, etc.) as well as opportunities to work at their own pace.

As an ELA teacher in a 1:1 iPad classroom who enacted "Remaking," Brian responded to the call from Hicks, Young, Kajder, and Hunt (2012) for English teachers, in particular, to "fully embrace the playground of words and texts and ideas and the tools available to create and share them" (p. 73). "Playing" is an important part of learning (Koehler & Mishra, 2009; Koehler, Mishra, Bouch, DeSchryver, Kereluik, Shin, et al., 2011), particularly as humans function in physical and virtual worlds (Lei, Conway, & Zhao, 2008). For Brian, "Remaking" included learning about, playing with, and implementing a new research-based website Instagrok and news apps such as Zite and Flipboard, as well as requiring students to use various presentation apps such as Corkulous, Bamboo Paper, Skitch, and Scribble Pad to represent their learning. In his quest to "Remake" some of the ways he planned and taught, Brian willingly tried new things and invited students in the inquiry and learning processes.

Similar to Tim Donaldson, Brian also saw direct connections between the 1:1 iPads and his English Language Arts (ELA) curriculum. However, the connections Brian made extended beyond "Combining" because when he taught and planned, Brian often used 1:1 iPads to "remove old and replace with new". As a result of enacting "Remaking," Brian demonstrated

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that he understood the possibilities 1:1 iPads presented and the connections between his curriculum and 1:1 technology which enabled him to embrace new ways of planning, instructing, and interacting with his students.

Specifically, the ways in which Brian understood and used 1:1 iPads provided new opportunities for his students to be challenged, actively engaged, and part of the learning process. For example, he used the 1:1 iPads to expand his students' audiences, requiring them to find and reach out to experts during a research-based writing unit. Some of his students used Skype, FaceTime and email to communicate with the experts they found. Brian also utilized the online blogging site Kidblog, pairing students across classes to participate in writing peer-evaluations. Brian employed and shared online videos to provide students with access to skilled presenters and their presentations, in the hopes that his students would utilize these skills during their own in-class presentations. For Brian, "Remaking" also included extending communication opportunities beyond the school day, as Brian also made himself available every weeknight, hosting a nightly office hour in which students could connect with him via email.

In some cases, "Remaking" also means doing something new, something that was not previously necessary or, perhaps, not even possible. For example, during this study when Ralph, Josh, and Tim taught in their 1:1 iPad classrooms, they did not include references to or instructions regarding digital citizenship, how students could most effectively showcase and share their learning using various iPad apps, or how to use the iPad to examine and assess tools and websites, including the efficacy of information and resources. In contrast, because Brian enacted "Remaking," he also generated new ways of teaching, which included teaching his students *how to use* the 1:1 technology, which extended beyond trouble-shooting technical difficulties. For example, during class and via self-made or web-based videos, he often modeled

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how and why to use particular apps, websites, and iPad functions. He was also explicit with students about how and why to practice responsible digital citizenship, including citation of sources and considerations regarding social media and interacting with others online. Although one may argue that the ELA content area may lend itself more readily to teaching students about digital citizenship and responsibility, this cannot be not the responsibility of one content-area teacher or one department. It may also be possible that the nature of his content as well as the fact that Brian did not teach any Advanced Placement or upper-level, college bound courses "freed" him to engage with technology in more meaningful ways. In any case, Brian often engaged in "Remaking," which included adding new teaching practices, such as those centered on understanding and teaching students how and why to use technology responsibly (Ribble & Bailey, 2007).

Moving from "Adding On" to "Combining" to "Remaking"

When examining and looking across the three types of change, it is likely that most, if not all teachers will enact "Adding On" at various points when they teach in 1:1 iPad classrooms. To illustrate, there were instances when Tim Donaldson and Brian Avery enacted "Adding On." For example, like Ralph and Josh, Tim and Brian also converted many of their course worksheets and handouts to electronic versions, which they shared with their students. Tim also enacted "Adding On" when he used his iPad's digital camera feature to take pictures of his students' Spanish textbook pages, which he then shared electronically with his students. He captured these images so that students would not need to transport their books home and, instead, could refer to the digital images via their iPads to complete assigned work. Given that all four participants engaged in "Adding On" at various points, it stands to reason that there are times and places in which it makes the most sense for teachers to enact "Adding On," such as when

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teachers digitize and electronically share course content with students or when they allow students to access course grades via a school-based grading website.

However, given the two additional types of change that are possible within 1:1 iPad classrooms, the goal, it seems, should be to help teachers move beyond "Adding On" so that in addition to sometimes using 1:1 technology to supplement their teaching, they may also use 1:1 iPads to extend their pedagogy and practice (i. e. , "Combining") and even more so, work toward using 1:1 technology to generate and implement new ways of teaching, communicating, and assessing their students ("Remaking"). For instance, when teachers like Brian Avery engage in "Remaking" they are also likely to enact "Combining" at various times as well. For example, early on in the school year Brian adjusted one of his students' assignments to include a digital artifact and he often shared informational websites with students that aligned to the content he and his students explored.

One reason Brian moved beyond "Adding On" and "Combining" was, in part, his commitment to integrating 1:1 technology as a means of helping him achieve his own vision of one-to-one, human-to-human teaching (Wenglinsky, 2005). As a result, Brian used and implemented the iPad so that it became "an integral component of the context" of his classroom (Lei, Conway, & Zhao, 2008, p. 10). Unlike other participants, Brian was also more likely to enact "Remaking" because he reported that his instructional beliefs and philosophies readily aligned with his understanding of how to use 1:1 iPads to promote student learning (Boling & Beatty, 2012; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012).

Teacher Integrated Knowledge: What Makes a Teacher "TIK"?

Knowing is not enough; we must apply.

Johann Wolfgang von Goethe

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In addition to identifying and understanding the type of change a teacher enacts within a 1:1 iPad classroom, it is also important to identify and understand the funds of knowledge a teacher uses when making these changes. Understanding these funds enables us to better identify the types (and combinations of types) of knowledge a teacher uses and applies when making decisions about planning and teaching. The second question framing this study centered on teacher knowledge, specifically the funds (and combinations of funds) of knowledge these teachers used when planning for and enacting their instruction within the 1:1 iPad classrooms in which they taught. The Teacher Integrated Knowledge (TIK) framework offered a descriptive framing for identifying and examining the various knowledge types these teachers used when planning and teaching in their 1:1 iPad classrooms (Figure 11).

CK = Content Knowledge
PK = Pedagogical Knowledge
TK = Technological Knowledge
PCK = Pedagogical Content Knowledge

KL = Knowledge of Learners
SCK = Standards/Curriculum Knowledge
KEC = Knowledge of Educational Contexts
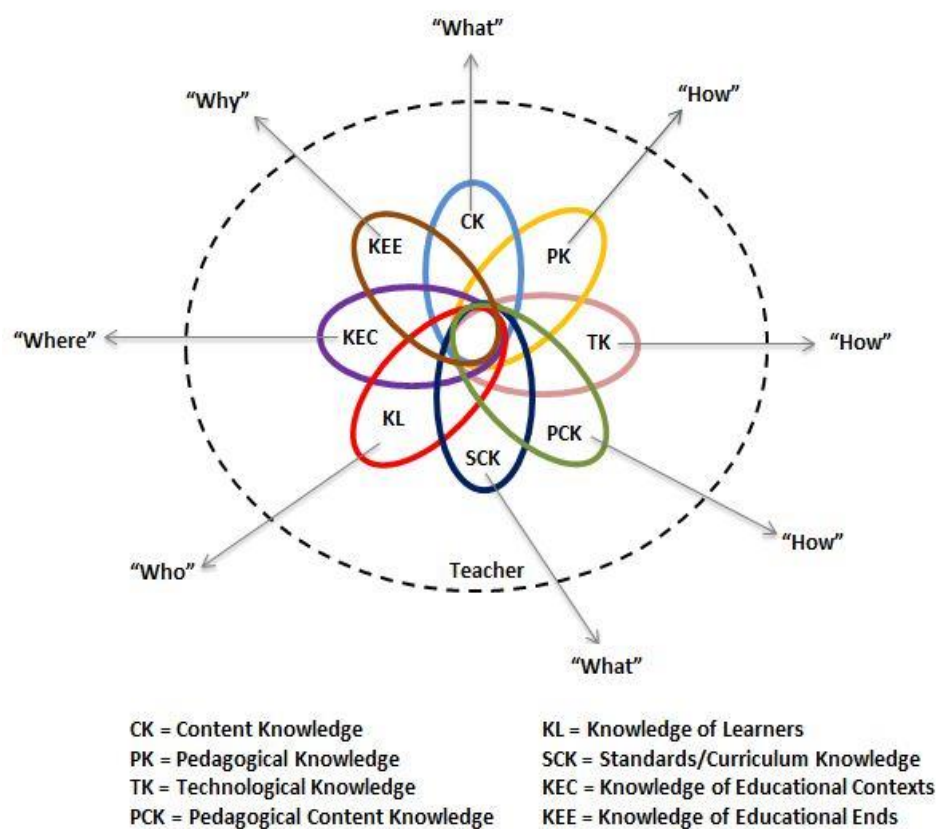KEE = Knowledge of Educational Ends

Figure 11. Teacher Integrated Knowledge (TIK) framework

When these teachers drew upon one or more knowledge fund within the TIK framework, doing so required knowledge and action because "knowledge is information that changes something or somebody – either by becoming grounds for action, or by making an individual (or institution) capable of different or more effective action" (Drucker, 1990, p. 242). Therefore, utilizing the TIK framework offered a way of identifying, understanding, and representing the relative influence of various knowledge funds and knowledge fund combinations these teachers used and acted upon when they planned and taught.

Although I wondered if teachers would draw upon various funds of knowledge outlined in the TIK framework (Figure 11), prior to the start of this study and during the early stages of data collection, I anticipated that these teachers' Knowledge Learners (KL) would be a primary knowledge source for planning and enacting instruction in 1:1 iPad classrooms. Different students have different needs and teachers attend to students' needs in a variety of ways. I based this assumption on three things: 1.) my previous education experiences teaching students with diverse needs from various backgrounds; 2.) the socio-cultural perspective that knowledge is constructed and contextualized for each participating individual (Ben-Peretz, 2011; González, Andrade, Civil, Moll, 2005; Lave & Wenger, 1991) and, 3.) the idea that teachers appear to adjust their teaching based on the students they teach (Connelly, Clandinin, & He, 1997). However, as data collection and analysis occurred, the changes teachers made and the connections between these changes and participants' Knowledge of Learners (KL) were different than I anticipated. When planning and teaching in their 1:1 iPad classrooms, these four teachers did not appear to forefront their KL as often as I originally expected.

Connected to their 1:1 technological implementation and integration, results suggest that the type of change these teachers enacted appeared to be directly influenced by their Knowledge

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of Educational Ends (KEE). Within the TIK framework, Knowledge of Educational Ends (KEE) is defined as "knowledge of educational purposes and values, including using education to promote democratic citizenship, improve students' standardized test scores, preserve economic stability, generate student awareness and understanding of self and/or world, and prepare students for college and work." Furthermore, this knowledge fund aligns with Hammerness' (2005) focus on the centrality and influence of teachers' visions. These "visions" are teachers' "hopes, cares, and dreams – [aligned] with their understandings – their knowledge about how and what children should be learning" (p. 5). Moreover, teachers cannot separate themselves from what they do or who they are (Rodgers & Scott, 2008). As a result, the ways these teachers perceived the higher (or limited) purpose for their work, as reflected in their KEE, appeared to directly inform *what*, *how*, *who* and *where* they taught. Teachers' Knowledge of Learners (KL) (including other funds) was still important but not to the degree I originally theorized or assumed.

In each case, participants' KEE appeared to motivate their pedagogical choices as well as their 1:1 technology integration choices. These choices also influenced the types of change they enacted. Although there were instances in which teachers did not change, when they did change their KEE appeared to connect with the change(s) they enacted. For Ralph and Josh, even though their KEEs were somewhat different, their KEE appeared to support their rationales for only "Adding On," whereas Tim's KEE seemed to buttress his reasons for "Adding On" in some instances as well as "Combining" at other points. Additionally, at various points in the study, Brian's KEE appeared to lend support for engaging in "Adding On," "Combining," and "Remaking" (Table 4).

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Table 4.

Participants' Knowledge of Educational Ends (KEE) and Type of Change

Participant	Knowledge of Educational Ends (KEE)	Connection Between KEE and Change Type	Type(s) of Change
Ralph Peterson	Prepare and equip students to take and pass entry level college chemistry courses	Use 1:1 iPads to **supplement** existing curriculum and practices	"Adding On"
Josh Tucker	Prepare and equip students to take and pass the Advanced Placement (AP) psychology test	Use 1:1 iPads to supplement existing curriculum and practices	"Adding On"
Tim Donaldson	Promote students' understanding of and appreciation for world languages and cultures, specifically Spanish and the countries/cultures in which Spanish is the primary language	Use 1:1 iPads to **supplement** existing curriculum and practices, as well as **blend** existing curriculum and practices with new ideas and tools.	"Adding On" and "Combining"
Brian Avery	Use literature and writing to create and expand students' awareness of themselves and their world	Use 1:1 iPads to **supplement** existing curriculum and practices, **blend** existing curriculum and practices with new ideas and tools, **remove old** content and practices, **replacing it with new** ideas, tools, pedagogy, and assessments.	"Adding On," "Combining," and "Remaking"

As evidenced in Table 4, KEE was a driver of choice for these four participants. For example, Josh's and Ralph's KEE were very task-focused and, perhaps, instrumental in their orientation toward teaching and learning. Tim and Brian, on the other hand, were driven by KEE that appeared to be more idealistic and aligned with the broader social/civic benefits of second language learning and English Language Arts.

In addition to enacting particular types of change, the ways in which Ralph, Josh, Tim, and Brian drew upon various TIK knowledge funds also differed. The various knowledge funds (and combination of funds) upon which they drew made sense given that they taught different subjects, had varying years of experience, and worked with different student populations. However, despite these differences they consistently drew upon, integrated, and acted upon one particular fund of knowledge, specifically knowledge centered on *why* they taught, as reflected in their KEE. Even as they used and relied upon various funds (and combinations of funds) contained in the TIK framework, these teachers' Knowledge of Educational Ends (KEE) still remained a central part of their planning and enactment of teaching. The following sections are organized by the three change types these teachers enacted and representative activities and examples are included to highlight the various knowledge funds upon which they drew, and more importantly, the ways in which their particular KEE appeared to motivate their 1:1 technological implementation and integration.

Knowledge of Educational Ends and "Adding On"

Ralph Peterson's primary goal, namely the educational end toward which he taught, was to prepare his students for college chemistry. According to Ralph, he perceived himself successful in aligning his teaching with this educational end. Therefore, he most often enacted "Adding On" when he integrated 1:1 iPads in his classroom because his KEE motivated him to

use the iPads to support and supplement his pre-existing pedagogy, practices, and course content. For example, when he decided to have students download and use graphing calculator and periodic table iPad apps for the courses he taught, he did so because he knew students would need to understand and utilize these tools in his class and the entry level college chemistry courses they would take, as reflected in his KEE. In this instance, Ralph combined his Knowledge of Educational Ends (KEE) with his Content Knowledge (CK) and Technological Knowledge (TK) to enact "Adding On" (Figure 12).

CK = Content Knowledge
PK = Pedagogical Knowledge
TK = Technological Knowledge
PCK = Pedagogical Content Knowledge

KL = Knowledge of Learners
SCK = Standards/Curriculum Knowledge
KEC = Knowledge of Educational Contexts
KEE = Knowledge of Educational Ends
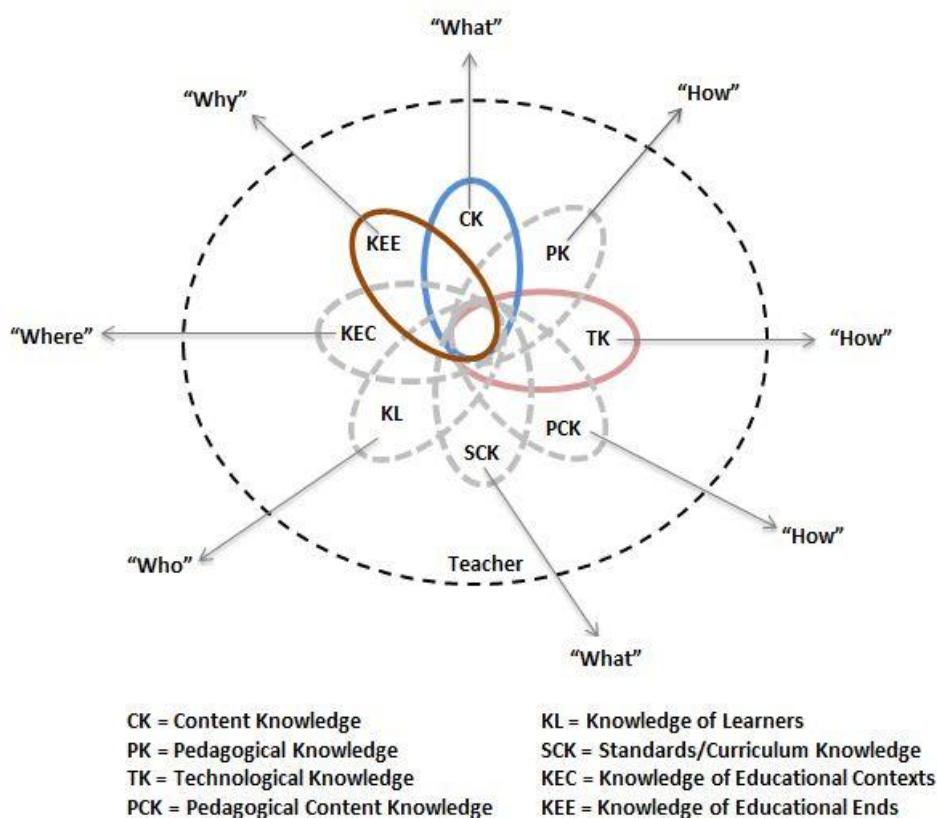
Figure 12. Ralph Peterson's TIK (representing his integration of KEE, CK, and TK)

In doing so, Ralph provided information to students regarding the graphing calculator and periodic table apps he believed would be most beneficial for his students. Using these iPad apps in his classes would also, he hoped, prepare them for future college chemistry courses.

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Another example of how Ralph's Knowledge of Educational Ends (KEE) motivated the type of change he enacted connects to his decision to utilize his class website more as a result of his students' consistent iPad and Internet access. Keeping his goal of preparing students for college chemistry at the forefront, he required students to complete assigned textbook readings, unit-based homework packets, and lab reports. Most of these assignments were similar if not the same ones Ralph reported successfully using to prepare previous students for college chemistry courses. Once again Ralph's KEE provided motivation for giving students additional access to pre-existing content. As a result, Ralph enacted "Adding On" when he digitized these assignments and uploaded them to his class website. In this instance, in addition to drawing upon his KEE, Ralph also employed his Content Knowledge (CK) and Standards/Curriculum Knowledge (SCK) to determine the specific content and materials he shared via his website. He also employed his Technological Knowledge (TK) to create and upload digital versions of these previously print-based assignments and resources to his class website. (Figure 13).
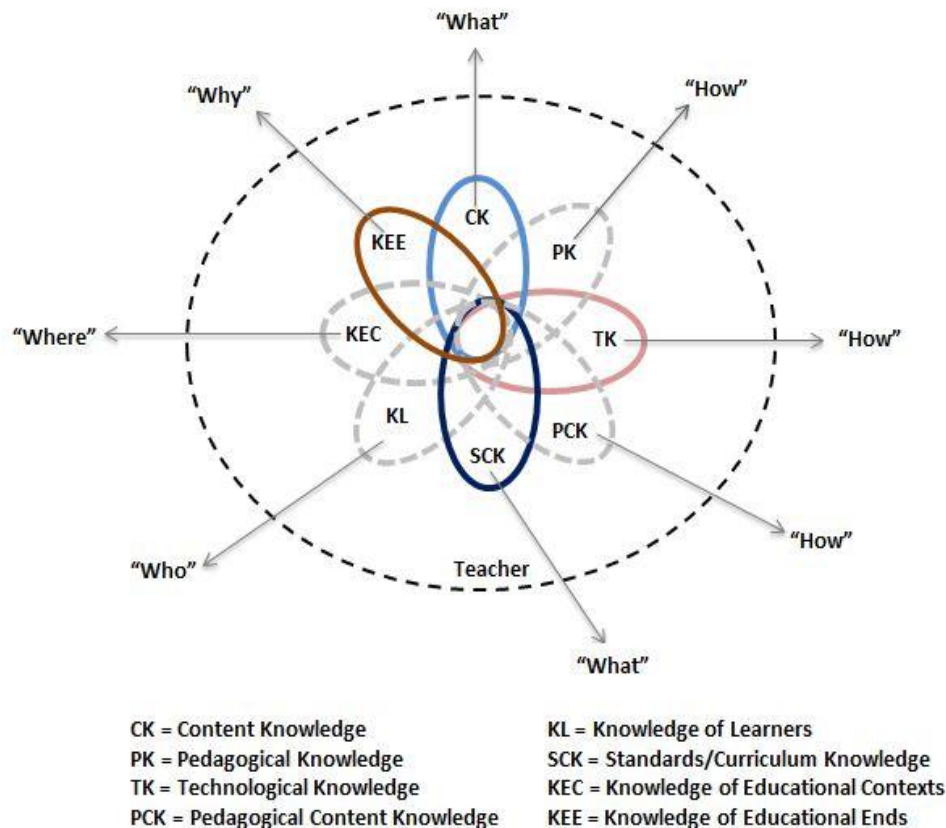
Figure 13. Ralph Peterson's TIK (representing his integration of KEE, TK, CK, and SCK)

The combination of Ralph's KEE as well as his own perceptions of his continued success in achieving this end offer a possible reason why the type of change Ralph enacted was "Adding On". It may be that because Ralph did not see a direct connection between his KEE and 1:1 technology Ralph continued to prioritize and use his pre-existing pedagogy, practice, and course content to support. As a result, Ralph foregrounded his KEE and in doing so enacted "Adding On," using 1:1 iPads to supplement what he already knew and did.

Similarly, Josh Tucker's Knowledge of Educational Ends (KEE) also influenced how he taught and, in doing so, it impacted the type of change Josh enacted. The educational end Josh continually aimed to achieve was helping his students prepare for and pass the College Board's Advanced Placement Psychology test. Like Ralph, Josh did not see an explicit connection

between 1:1 iPads and his KEE. In fact, Josh often offered skepticism when talking about whether students could use their iPads to effectively prepare to take and pass the AP test. As a result, Josh's KEE provided motivation and support for maintaining his pre-existing pedagogy, practices, and course content. As a result, Josh also enacted "Adding On". For example, Josh started using the online website and app, Socrative because he realized he could use it to check his students' AP textbook reading comprehension and provide them with opportunities to practice answering AP-like questions. Josh enacted "Adding On" in this instance and in addition to drawing upon his KEE, he also relied upon his Standards/Curriculum Knowledge (SCK) to identify and select previously released AP test questions. Additionally, he drew upon his Technological Knowledge (TK) to create a password protected virtual classroom within Socrative's site as well as upload questions and create the daily, short quizzes he required students to take at the beginning of each class period (Figure 14).

CK = Content Knowledge
PK = Pedagogical Knowledge
TK = Technological Knowledge
PCK = Pedagogical Content Knowledge

KL = Knowledge of Learners
SCK = Standards/Curriculum Knowledge
KEC = Knowledge of Educational Contexts
KEE = Knowledge of Educational Ends
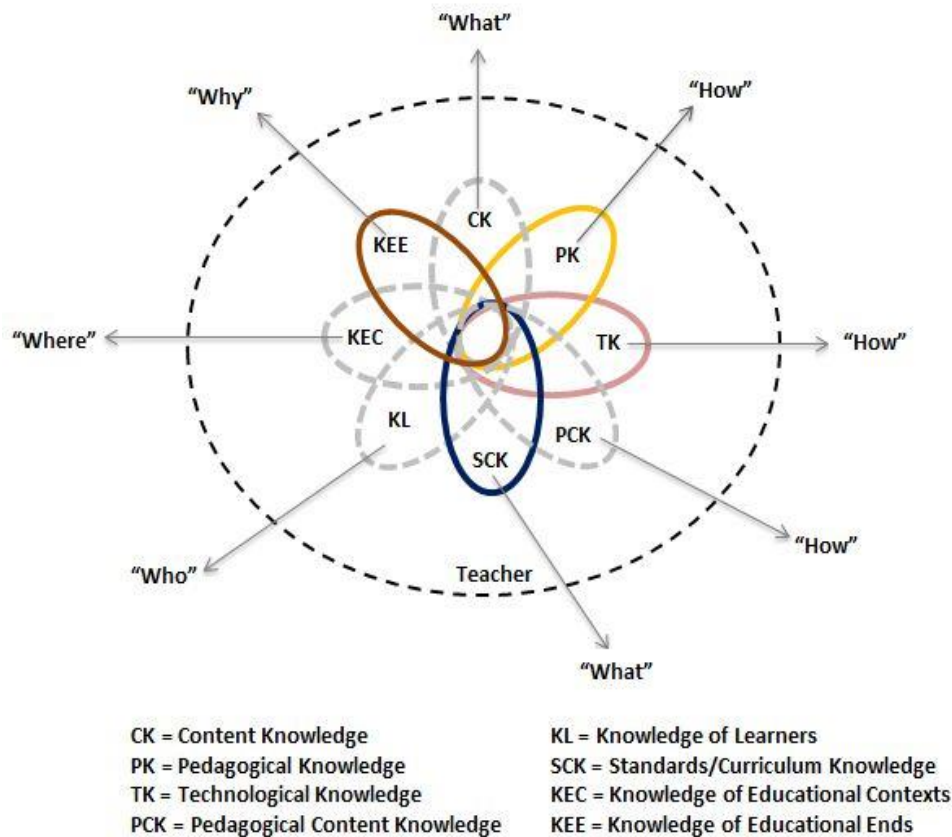
Figure 14. Josh Tucker's TIK (representing his integration of KEE, PK, TK, and SCK)

In doing so, Josh maintained a commitment to his KEE and enacted "Adding On" in which he integrated the use of Socrative as a means of further supporting his students' AP test preparation.

Furthermore, Josh also relied on his KEE when he implemented the "Advanced Psychology iPad iMovie Mission" assignment. Given Josh's stated KEE connected to preparing students to take and pass the AP test, which included a vision of a teacher-centered and directed classroom as being most effective to meet this end, Josh again utilized his KEE to determine the timing of this assignment which resulted in another example of "Adding On". So that it would not interfere with students' AP test preparation, the iMovie Mission assignment was introduced and completed *after* his students took the College Board's AP Psychology exam. In this instance,

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although the assignment required students to integrate multi-media elements to demonstrate their knowledge, it took place after the AP test and it did not count for a significant part of their grade.

Related to this iMovie assignment and in addition to relying on his KEE, Josh also employed his Content Knowledge (CK) to generate a list of possible psychology topics and to field students' questions during the in-class preparation and video-recording. Josh also utilized his Technological Knowledge (TK) connected to the iPad app, iMovie and Google Drive (he required students to upload their project videos to a shared Google folder). He relied on his Knowledge of Students (KL) stating that his students needed a "break" and something "fun" to do after the AP test. As a result of utilizing his Knowledge of Educational Contexts (KEC) Josh knew this assignment would allow students to use their iPads which would meet his administrators' stated expectation that WHS teachers and students should employ their iPads for teaching and learning purposes (Figure 15).

CK = Content Knowledge
PK = Pedagogical Knowledge
TK = Technological Knowledge
PCK = Pedagogical Content Knowledge

KL = Knowledge of Learners
SCK = Standards/Curriculum Knowledge
KEC = Knowledge of Educational Contexts
KEE = Knowledge of Educational Ends
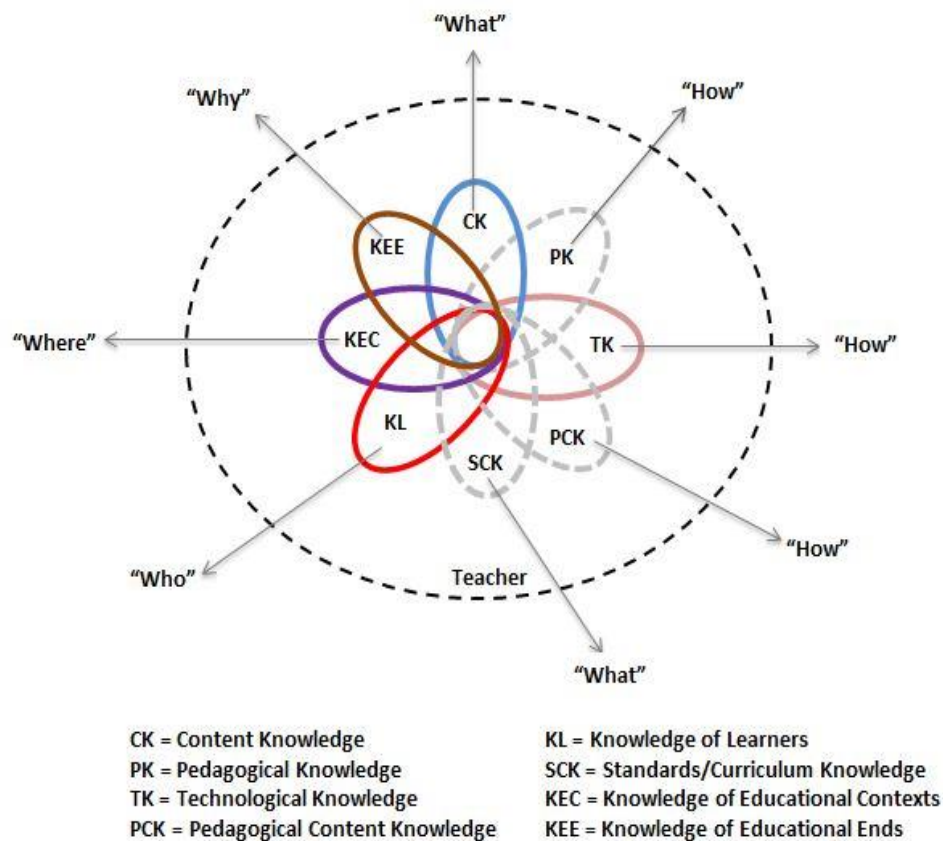
Figure 15. Josh Tucker's TIK (representing his integration of KEE, CK, TK, KL, and KEC)

According to Josh, and in keeping with his KEE related to preparing students for the AP test, the iMovie assignment existed, in part, to fill some of the time between the AP test and the end of the school year. As a result, in this case Josh's KEE provided further motivation for enacting "Adding On". Josh's KEE also appeared to influenced the timing of the assignment (i.e., after the AP test) and impacted its overall value (relatively low, comparatively) with regard to fostering students' digital literacy skills and/or representing their knowledge and understanding.

Knowledge of Educational Ends and "Combining"

Tim Donaldson's KEE centered on his commitment to promoting students' understanding of and appreciation for world languages and cultures, specifically the Spanish language and the countries and cultures in which Spanish is the primary language. Tim's KEE also impacted the

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types of change he enacted in his 1:1 iPad classroom. For example, when Tim implemented the "leyenda" project in his Spanish Two classes, he explained that the overarching goal of the assignment connected to his KEE because he intended for this assignment and its accompanying unit to provide his students with opportunities to further add to their understanding of Spanish culture, specifically some Spanish legends, as well as apply their written and oral Spanish language skills. As noted previously, in addition to "Adding On" at various times, Tim also often viewed the 1:1 iPads as accompanying and extending his establishing pedagogy, teaching practices, and course content. Moreover, because he saw direct connections between using 1:1 iPad technology and his KEE, Tim frequently enacted "Combining" when he planned and taught in his 1:1 iPad classroom.

An example of the way in which Tim's KEE led to his enactment of "Combining" connects to final project for the multi-week "leyenda" (i.e., "legend") unit he planned and taught. The final assignment for this unit required students to write (in Spanish) their own legend as well as create and present an individual, in-class multi-media presentation that accompanied and illustrated their story. Tim chose to revise this final assignment to include the iPad, in which he blended old with new, because he viewed the iPad as a means of augmenting the assignment so as to provide students with additional ways of extending and representing their cultural knowledge and language skills. Keeping his KEE in mind, Tim re-designed the final leyenda project his Spanish Two students completed and presented. To do so, he utilized his Content Knowledge (CK) to ensure that he framed the assignment in conjunction with the legends students already read. Tim also employed his Standards/Curriculum Knowledge (SCK) to make sure that the assignment continued to align with his department's required unit on Spanish stories and legends as well as their requirement that students regularly apply their Spanish language

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skills by engaging in multiple formal writing opportunities. Given Tim's understanding of his administrators' expectations regarding regular 1:1 iPad integration in WHS classrooms, he employed his Knowledge of Educational Contexts (KEC). To enact "Combining" Tim also drew upon his Technological Knowledge (TK) to identify, choose, and integrate various iPad apps and tools students could use to complete and share their leyenda final projects (Figure 16).

CK = Content Knowledge
PK = Pedagogical Knowledge
TK = Technological Knowledge
PCK = Pedagogical Content Knowledge

KL = Knowledge of Learners
SCK = Standards/Curriculum Knowledge
KEC = Knowledge of Educational Contexts
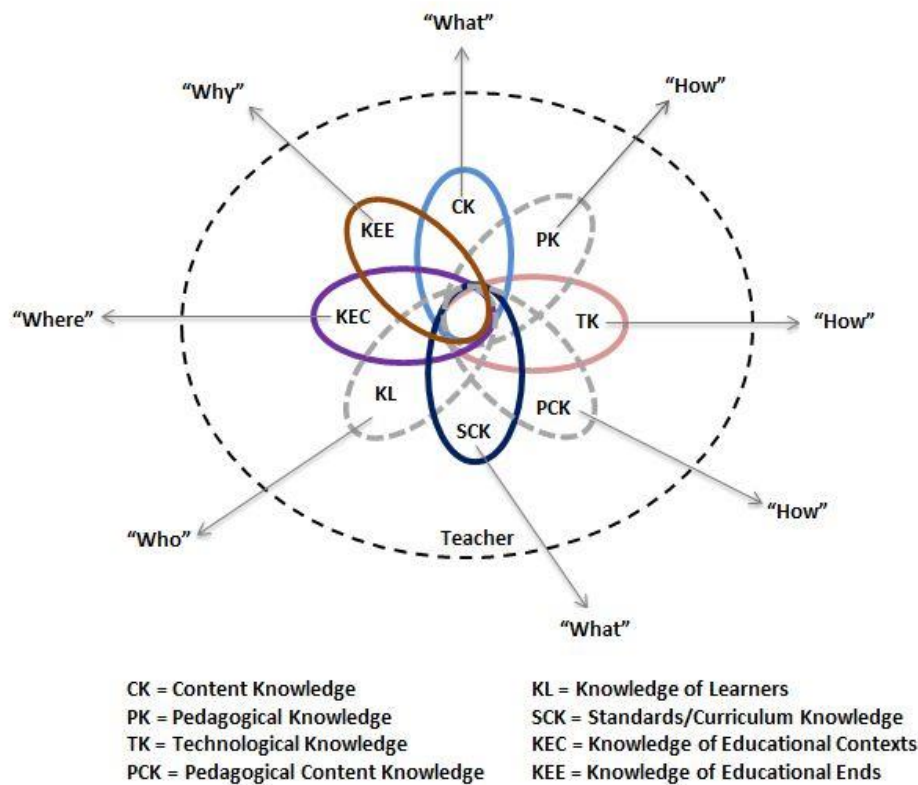KEE = Knowledge of Educational Ends

Figure 16. Tim Donaldson's TIK (representing his integration of KEE, CK, SCK, KEC, and TK)

Throughout this unit, even as Tim drew upon and utilized various combinations of knowledge funds, his KEE remained constant. It directly informed and impacted his teaching and students' learning.

Tim's enactment of "Combining" also connected to his implementation of Kidblog in his Spanish Three class, which offers further support regarding the ways in which Tim's KEE influenced the type of change he enacted. Drawing upon his KEE, which centered on his desire to promote students' understanding of Spanish culture (in this case various Spanish dances and musical styles) as well as provide students additional opportunities to practice their Spanish language skills, Tim decided to use Kidblog. He used this site to extend students' conversations connected to the selected Spanish music and dance videos he shared. He also drew upon his Technological Knowledge (TK) to learn more about Kidblog and set up a private class site. To select the specific online Spanish dance videos and music files, Tim relied upon his Technological Knowledge (TK) again as well as his Content Knowledge (CK). Employing his Standards/Curriculum Knowledge (SCK), Tim made sure to include specific dances and music previously agreed upon by his department. Acknowledging that this activity would be best completed in small groups, Tim employed his Pedagogical Content Knowledge (PCK) and when he assigned students to a specific group, he drew upon his Knowledge of Learners (KL) (Figure 17).

CK = Content Knowledge   KL = Knowledge of Learners
PK = Pedagogical Knowledge   SCK = Standards/Curriculum Knowledge
TK = Technological Knowledge   KEC = Knowledge of Educational Contexts
PCK = Pedagogical Content Knowledge   KEE = Knowledge of Educational Ends
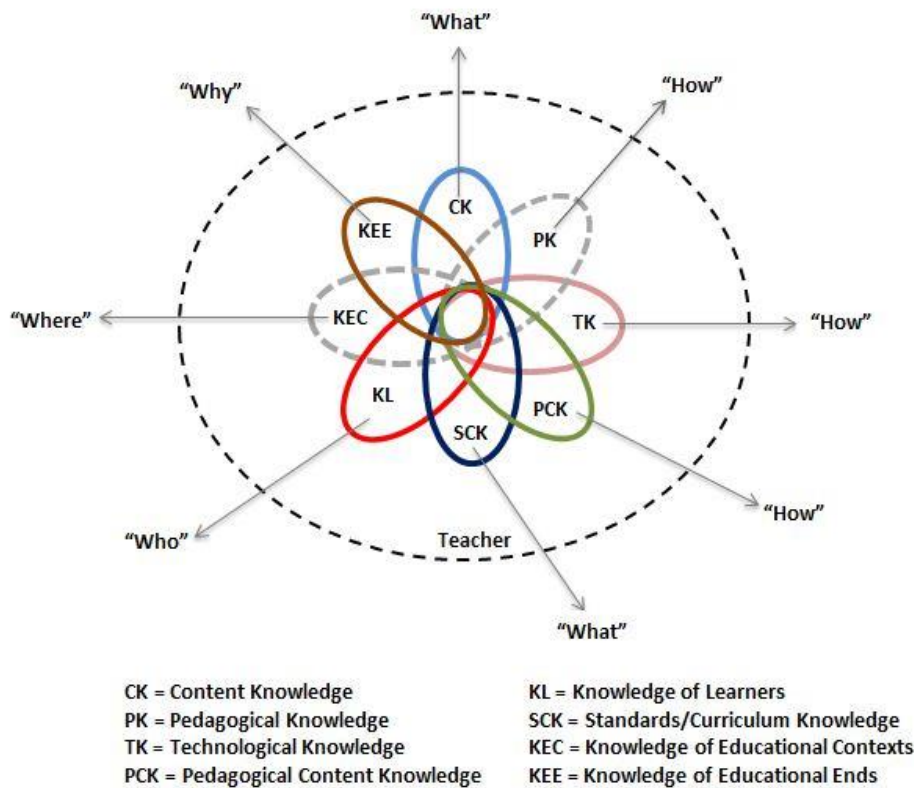
Figure 17. Tim Donaldson's TIK (representing his integration of KEE, CK, TK, PCK, SCK, and KL)

As a result, it stands to reason that because Tim viewed the 1:1 iPads as further enabling him to realize his KEE, he often enacted "Combining" as a means of accompanying and extending his pedagogy, practice, and content.

Knowledge of Educational Ends and "Remaking"

Similar to his colleagues, and even when he drew upon various knowledge funds, Brian Avery's KEE remained central to his planning and teaching. As an English Language Arts (ELA) teacher Brian maintained a firm commitment to his KEE, namely to use literature and writing to create and expand his students' awareness of themselves and their world. He also understood how to use 1:1 iPads to further achieve this end. In addition to enacting "Adding On" and "Combining" at various times, in some instances he also reported that because he understood

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and regularly sought to make direct connections between 1:1 technology and his KEE, he was able to realize and achieve his KEE in new ways, which often led him to enact "Remaking".

Aligned with his KEE, Brian reported that he purposely planned and taught so as to maximize his ability to connect with his students because, as he noted, connections with teachers encouraged student engagement and learning and, in some cases, improved the likeliness of students' academic and personal success. As a result, Brian frequently shared the various ways he sought to use this regular connection to positively impact his students' academic and personal lives. He also utilized connections with his students to promote a deeper understanding of themselves and how they fit into their community, society, and world. For example, Brian's choice to enact "Remaking" to facilitate his English 10 students' online learning using iTunes U reveals ways in which Brian's KEE connected to and provided motivation for his end goal of supporting students' self-awareness and development. To illustrate, when using iTunes U to "remake" the way he planned and taught in his 1:1 iPad classroom, he generated a new way of teaching, communicating, and assessing his students. In addition to his KEE, Brian also drew upon and added to his Technological Knowledge (TK) as he explored and learned more about iTunes U. He reported that as he vetted iTunes U he drew upon his Pedagogical Knowledge (PK) and Knowledge of Learners (KL) in order to figure out whether iTunes U would work well to support adolescent learning (PK) and, more specifically, his students' learning and development (KL) (Figure 18).

CK = Content Knowledge
PK = Pedagogical Knowledge
TK = Technological Knowledge
PCK = Pedagogical Content Knowledge

KL = Knowledge of Learners
SCK = Standards/Curriculum Knowledge
KEC = Knowledge of Educational Contexts
KEE = Knowledge of Educational Ends
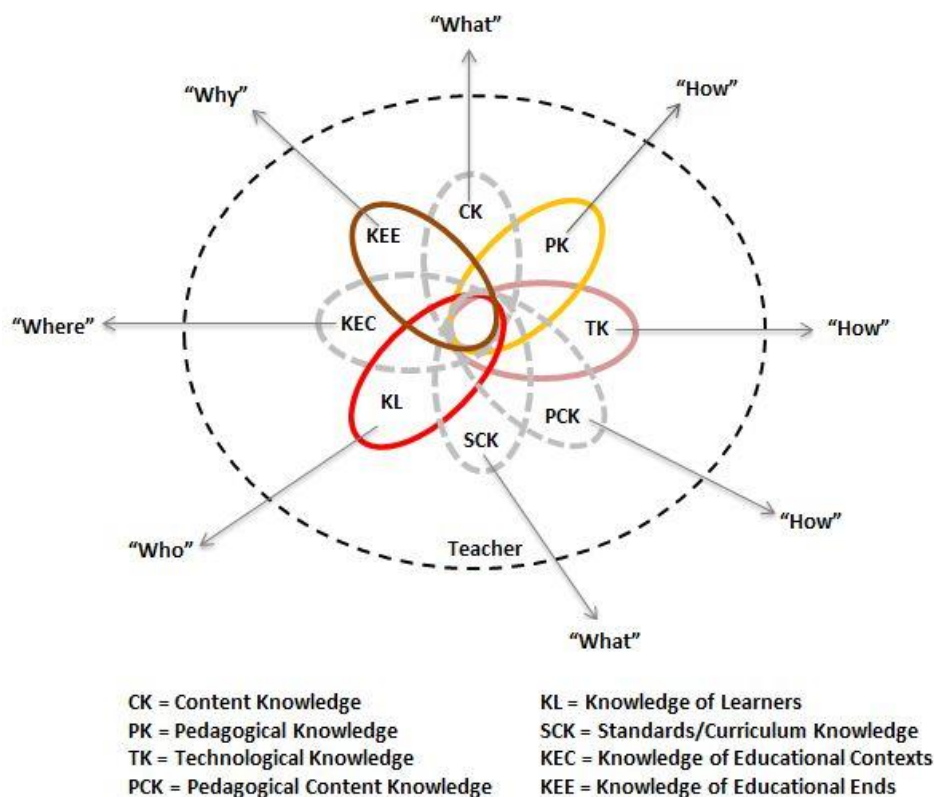
Figure 18. Brian Avery's TIK (representing his integration of KEE, TK, PK and KL)

As Brian engaged in "Remaking" through his learning, implementation, and usage of iTunes U, he became more excited about the ways in which this change further enabled him to integrate his KEE in his planning and teaching. In other words, the multiple connections Brian made between his KEE and how he could use 1:1 technology to more readily achieve this end often resulted in "Remaking" when Brian planned and taught in his 1:1 iPad classroom.

Another example connected to Brian's KEE and his enactment of "Remaking" is found in the second semester research project he created and implemented. Aligned with his KEE, Brian sought to involve students in their own learning, including ideas and topics connected to their community and world. As a result of this stated educational end, instead of assigning individual student research topics during the spring semester for an "Informative Research Project" assignment, Brian allowed students to self-select their topics. Connected to this assignment, his

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enactment of "Remaking" had to do with the new ways he employed 1:1 iPads to promote students' understanding of their topic as well as the ways in which they organized, represented, and shared their knowledge.

To facilitate students' research, understanding, and learning, Brian required his students to use the website Instagrok. Brian used and added to his Technological Knowledge (TK) when he learned about and explored this website. In conjunction with his TK, Brian also learned that Instagrok filtered students' searches and allowed for its users to select a "level" of difficulty connected to their search results. Brian favorably viewed this aspect of Instagrok because it allowed his students to tailor their searches based on their individual topics, interest, and abilities. Drawing upon his Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK) and Knowledge of Learners (KL), Brian showed students how to use various aspects of the site and he modeled and explained to students how these features could help them organize their search results, learning, and ideas (Figure 19).
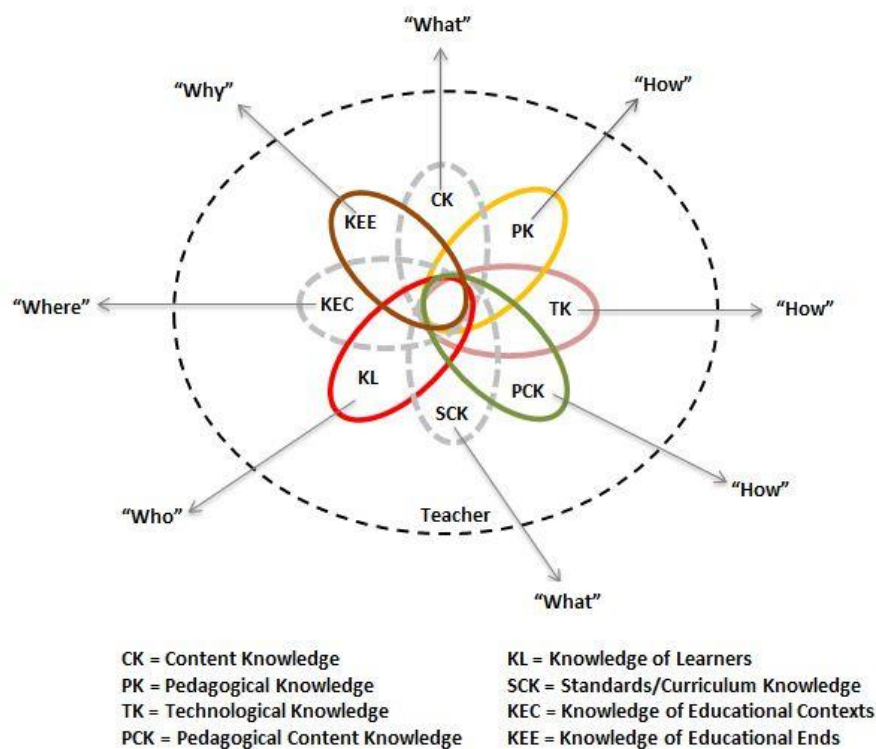
Figure 19. Brian Avery's TIK (representing his integration of KEE, TK, PK, PCK and KL)

As a result, Brian continued to identify ways in which he could implement and integrate 1:1 technology so as to generate new ways of teaching, communicating, and assessing students. Brian's enactment of "Remaking" emerged from his KEE which meant he often taught in new ways which provided students with additional ways of learning about themselves and their world.

Knowledge of Educational Ends Matters

In conjunction with Ertmer and Ottenbreit-Lefwich's (2010) review of literature focused on the characteristics and types of understanding teachers need to effectively implement technology into their teaching, results of this study suggest that the type of change these teachers enacted appeared to be influenced by their Knowledge of Educational Ends. All four teachers reported that they enjoyed teaching, liked to "play" with technology when they had the time, and

they cared about their students. At the same time, they had very different Knowledge of Educational Ends. These teachers utilized various goals and ideas about what "ends" they sought to achieve. Specifically, they reported how they utilized their KEE to identify, prioritize, and act upon what they "knew" was most important for their students' learning and success. At the same time, the ways in which these teachers viewed and understood how 1:1 technology connected to or, in some cases, further supported or advanced their KEE influenced to the type of change they enacted. Messing (2005) notes that teachers have multiple ways of knowing and although KEE was originally represented in the TIK model as a separate fund of knowledge, based on the results, it may be that KEE is not best represented as a separate fund of knowledge. Perhaps a teacher's KEE, which may be more clearly understood as the "end" or the goal(s) and purpose(s) toward which they strive, could actually be a filter they use to make decisions about teaching and learning in their classrooms (Figure 10). If this is the case, then whatever goal(s) or end(s) teachers seek to achieve, depending on what, how, who and where they teach, will determine the funds of knowledge upon which they draw. Therefore, I revised the TIK framework to show how the dashed line, which was originally used to represent the "Teacher" and illustrate the fact that educators take in information all the time, is more likely representative of a teacher's "educational ends". When teachers enact changes in their 1:1 iPad classrooms they must consider the goals and purposes they seek to achieve. In doing so, they will draw upon various funds and combinations of funds to meet these "ends".
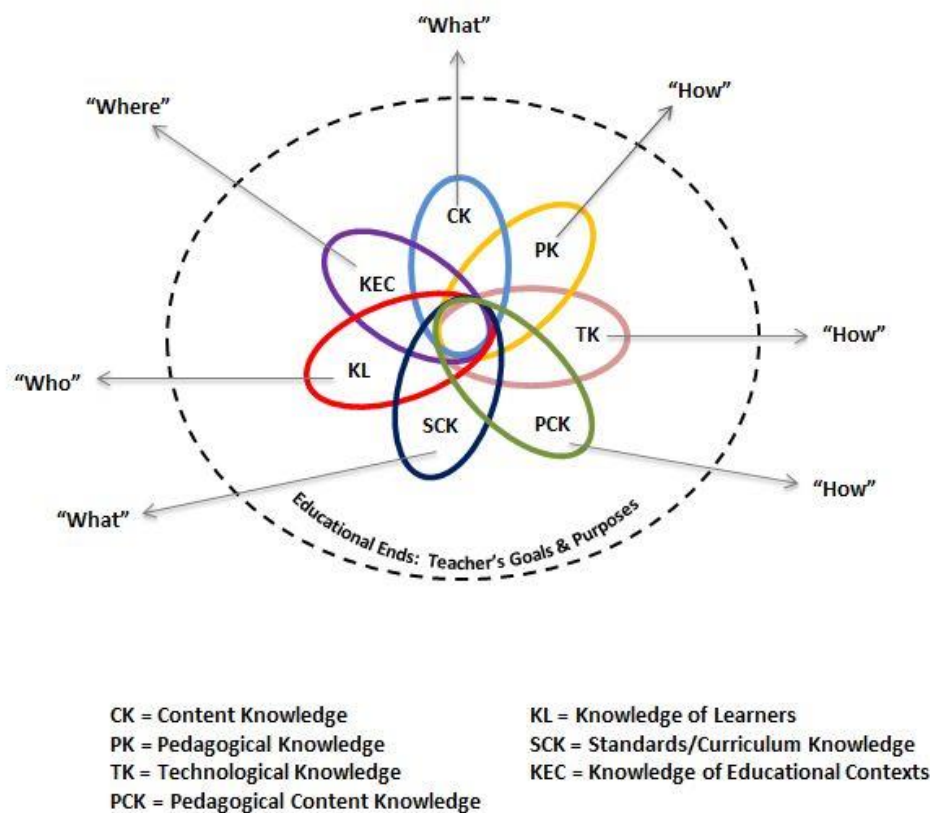
Figure 20. Revised TIK theoretical framework in which KEE is a filter and captured in "Educational Ends: Teacher's Goal and Purposes"

No matter what, how, who, where, or why they teach, it stands to reason that teachers should strive to continuously learn (Shulman, 2004a), engage in cognitive flexibility (Spiro, Feltovich, Jacobson, & Coulson, 1995), and utilize knowledge based on the specific situations and circumstances in which they teach (Feiman-Nemser, 2012). These attributes are particularly important in twenty-first century classrooms where technology is regularly accessible and utilized. For instance, in 1:1 tablet and laptop classrooms adding 1:1 technology introduces an additional element of complexity because 1:1 technology becomes one more thing teachers need to understand, think about, and use when planning for and enacting their teaching (Ifenthaler & Schweinbenz, 2013). At the same time, it is not enough to know, as philosopher Johann

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Wolfgang von Goethe stated long ago. Humans must also apply their knowledge within the situations and circumstances in which they find themselves such as teachers who teach in 1:1 iPad classrooms.

As a result, teachers' educational ends and the goals and purposes they seek to achieve matters more than we might think it does for technology integration and, more specifically, 1:1 technology integration in classrooms. Whatever teachers seem to hold most dear or most important, in terms of their KEE, seems to act as a filter for the decisions they make and drive the choices they make about "Adding On," "Combining," and "Remaking" their pedagogical practice. This is an important finding because this variable can easily fly "under the radar". Thus far, the theoretical framing that has driven inquiry into teacher practice has focused almost wholly on PCK (Shulman, 2004a) and TPACK (Koehler & Mishra, 2009). Based on these data, however, what teachers know and believe about the whole enterprise of schooling, its purpose, and its ends seems to be a critical driver of change and an important filter regarding teachers' technological implementation and integration, and by extension, their students' experiences with 1:1 technologies in classrooms.

CHAPTER NINE

Implications, Limitations, and Future Research

Implications

This study provides new insights into the ways that teachers' Knowledge of Educational Ends (KEE) influence the type of change they are likely to enact in their professional practice when, as mandated by school policy, they are expected to integrate 1:1 tablet computers in their classrooms. In this study, teachers' KEE span a continuum from strictly instrumental purposes (e.g., to pass an AP exam) to higher-order societal benefits that come from advanced study across disciplines. These differences seem to frame the choices teachers made about the technology so that the two teachers with more discrete or instrumental KEE (i.e., Ralph and Josh) opted to enact "Adding On" and teachers with a broader view of KEE (i.e., Tim and Brian) were more likely to enact "Combining" or "Remaking". This finding has important implications for in-service teacher professional development.

In-service teacher professional development. Findings from this study lend further support for the fact that the ways teacher adopt and use different types of technology, including 1:1 technology, differs (Aldunate & Nussbaum, 2013). Despite these differences, technology is part of most humans' daily lives, including the lives of many K-12 classroom teachers and students. Given that learning is on-going and part of a teacher's job (Feiman-Nemser, 2012), it is important for in-service teachers to understand and utilize technology in ways that provide relevant and important learning experiences for their students (U.S. Department of Education's Technology Plan, 2010). When teaching with 1:1 classroom tablet technology, in-service teachers have opportunities to utilize and teach with these devices all the time (Lei, Conway, & Zhao, 2008). One way to provide opportunities to facilitate teacher learning and professional

development connected to 1:1 tablet technology is through on-going professional development learning opportunities. However, even with the ubiquity of 1:1 devices in these classrooms, teachers may only enact "Adding On" and in doing so limit the ways they and their students utilize 1:1 technology.

According to Darling-Hammond and McLaughlin (2011), meaningful professional development should be sustained, on-going, and include multiple opportunities for participant-driven inquiry, reflection, and experimentation. Moreover, teachers need multiple opportunities to share and apply their learning with peers as well as in their own classrooms (Casey, 2011; Wilson, Rozelle, & Mikeska, 2011). Therefore, providing teachers with professional development opportunities in which they identify and articulate their particular Knowledge of Educational Ends (KEE) may further assist in-service professionals in recognizing the end(s) toward which they teach. This recognition may also offer opportunities to contextualize and situate their teaching and learning in relationship to their knowledge and pedagogy (Desimone, 2011). In other words, when teachers become more aware of and explicit about their KEE, they may be better equipped to identify specific ways they can move beyond "Adding On" to enact "Combining" and "Remaking".

Spires, Wiebe, Young, Hollebrands, and Lee (2009) proposed that for successful 1:1 technology implementation, teachers needed theoretical as well as practical understanding of technological integration. In doing so, they will be further equipped to use their professional development experiences to expand their pedagogy and practice (Darling-Hammond & Richardson, 2009; Joyce & Calhoun, 2010) and use 1:1 tablet technology to enact changes that more readily support best practices and facilitate student learning. These professional development experiences should also challenge teachers to expand and embrace a larger "vision"

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(Hammerness, 2006) for their KEE. It is true that passing an AP test is important for many students and teachers. However, if teachers knew that using technology, including 1:1 technology, would enabled deeper thought, additional creative engagement, and the further construction of meaning in a range of ways that would help students be better thinkers on the AP test, for example, it may be possible that these teachers would be more able and willing to enact "Combining" or, hopefully, "Remaking".

Therefore, teachers moving toward or already teaching in 1:1 tablet classrooms need numerous opportunities to learn about 1:1 technology as well as how to use it (Ifenthaler & Schweinbenz, 2013; Levin & Schrum, 2012). Additionally, if teachers are to move from "Adding On" to "Combining" and, hopefully, "Remaking," they may first need their KEE challenged through on-going professional development. In many cases, getting teachers interested in "Combining" and "Remaking" their practice with technology will require making it clear that a common vision for the larger purposes of education is expected, such as "preparing young people to enter into the full involvement in a complex society" (Labaree, 1997, p. 73). This vision moves well beyond getting students to earn a passing AP test score or performing well enough to pass an entry level college course. Teachers will also need a clear understanding of these three change types.

Therefore, when designing and implementing professional development focused on 1:1 tablet technology integration, providers and participants should consider including information centered on the three change types teachers enact when teaching in 1:1 classrooms. In-service professionals also need multiple models of these change types, in particular "Combining" and "Remaking". Providing a variety of K-12 examples and models of these two change types, rather than just the secondary examples generated through this study, may prove beneficial for K-12

teacher learning and development. Using these change type examples and models, teachers will also need opportunities to regularly reflect and connect these change types to their own individual pedagogy and practice (Opfer & Peddler, 2011). Making these connections to their individual pedagogy and practice may further encourage and enable teachers to move from "Adding On" to "Combining" and "Remaking".

Creating awareness and understanding of the various knowledge funds contained in the TIK framework may also support teachers' on-going professional development. In particular, providing teachers with an understanding of these eight knowledge funds potentially offers specific language and explicit ways for teachers to talk about what they know, what they still need to know, and the funds and combinations of funds upon which they rely when they plan and teach in their 1:1 tablet classrooms. These discussions are an essential component of growth in a learning community (Shulman, 2004b). According to Lave and Wenger (1991), "indeed, as Jordan (1989) argues, learning to become a legitimate participant in a community involves learning how to talk (and be silent) in the manner of full participants" (p. 105). Therefore, learning about and engaging in discussions of theory and practice guided by the types of change framework (i.e., "Adding On," "Combining," and "Remaking") may be an important addition to the community of teachers who use and make choices about how to integrate 1:1 technology appropriately and effectively in their work with students.

Limitations

This study centered on four secondary teachers in one school district and although much may be learned from these teachers, this study's sample size and scope are limited. By design, a comparative case study aims to provide thick description (Yin, 2009; Geertz, 1973) of the variables and individuals in question. As such, the intent of this design was never to generalize.

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It is important to recognize, however, that a more diverse sampling frame may have provided a broader range of perspectives to inform the research questions. For example, this study does not include any elementary or middle school educators. It also does not include teachers from other content areas such as math, English as a Second Language (ESL), Special Education, or other electives such as building trades, computer science, business, music, art, dance, or life sciences. Future case studies should include participants from this broader frame so that we might begin to construct more generalizable insights about the ways teachers' KEE influences their enactment of change in 1:1 tablet classrooms.

Likewise, although I sought to remain neutral during classroom observations and throughout the data analysis process, my background as a former employee of WPS may have inadvertently influenced my interpretation of the data. At the same time, my previous relationship with the district and many of its employees afforded some opportunities to build upon my "insider knowledge" of the school district and school site. Furthermore, because Watertown High School is located in a particular context and serves certain students, it cannot necessarily be considered representative of other high schools, particularly those operating in urban or rural contexts.

Future Research

This study provides support for the three types of change teachers may enact when teaching in 1:1 iPad classrooms. Further research will be necessary to further confirm or potentially expand these change types. For example, applying these change types to additional teachers from a range of grade levels and multiple school sites would allow for additional understanding of the ways teachers enact change in 1:1 iPad classrooms. Studying teachers across grade levels and content areas as well as in multiple sites could provide more models and

examples of these three change types which could, in turn, be integrated into and contribute to in-service teacher professional development. For in-service teachers, an area of future research connected to the three change types could involve developing an intervention where the researcher shares the TIK model with teachers and asks teachers to articulate their Knowledge of Educational Ends (KEE) as well as ways in which they seek to align their specific KEE with their pedagogy and practice. Combined with helping teachers make their KEE explicit, researchers could also share the three change types as a means of building or developing future participants' understanding. After that time, researchers could study the ways in which teachers' awareness and understanding of their KEE and the three types of change, influences, if at all, their ability to move beyond "Adding On" when planning and teaching in 1:1 tablet classrooms.

The TIK model also offers additional possibilities regarding the study of teacher knowledge in conjunction to technology implementation and integration. Future research may include applying the TIK model to more teachers in technology-focused schools and classrooms to identify whether or not teachers' Knowledge of Educational Ends (KEE) exerts an important influence in conjunction with the type of change they enact. Future research could also include working directly with in-service teachers to identify and "map out" the funds of knowledge they use when teaching with technology. In this case, teachers would be responsible for identifying and understanding the type(s) of knowledge upon which they draw and for what reason(s), which may offer additional insights into the type(s) of knowledge they need and use when teaching in 1:1 technology classrooms.

Conducting research focused on the three change types and the TIK theory in pre-service education programs could also prove beneficial. Preservice teachers often enter teacher preparation programs with their own "apprenticeships of observation" (Lortie, 1975) which

inform their understanding of teachers and what it means to teach in and learn. Many preservice teachers will end up teaching in contexts different from their previous experiences, often working with diverse students (Howard & Aleman, 2008). In addition to their experience-based perceptions about types of students, classroom management, assessment, and content delivery, their apprenticeship of observations may also include experiences connected to the ways in which previous teachers used and taught with technology, perhaps even 1:1 technology. As a result of these prior experiences, they have "learned how to do school" (Lave & Wenger, 1991, p. 107) and will need ample opportunities to engage in communities of practice in which they move from thinking and talking about teaching with technology "from the outside" (p. 107) to thinking about and using the language and practices of technology integration and implementation.

According to Darling-Hammond (2010), one element of successful teacher preparation programs is that they provide preservice teachers with a variety of classroom and field-based learning experiences. Within these experiences, teacher candidates should have multiple opportunities to learn about and apply specific practices and tools, including those connected to technology. At the same time, teaching preservice teachers about technology as well as ways to integrate it into their content areas and teaching is challenging (Borko, Whitcomb, & Liston, 2009). In many cases, preservice teachers are considered "digital natives," (Prensky, 2006) which means they often grew up using various technologies. This compelling and popular label might promulgate assumptions about their preparedness to integrate technologies in instructional contexts. However, Lei's (2009) study of "digital native preservice teachers" revealed that despite their experiences with technology, preservice teachers still needed specific learning and application experiences centered on technology and technological integration. Lei found that the

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majority of preservice teachers' experiences with technology had been with social media and communication. As a result, "they lack[ed] the knowledge, skills, and experiences to integrate technology into classrooms" (p. 92). Lei concluded that for preservice teachers to use technology in meaningful ways, teacher educators needed to pay attention to and more readily integrate five aspects focused on supporting preservice teachers' learning to teach with technology (Table 5).

Table 5

Lei's (2009) Five Aspects of Preservice Teachers' Learning to Teach with Technology

1. Expose preservice teachers to a variety of technologies that can be used to support different teaching and learning activities.
2. Emphasize subject-specific technology.
3. Include assistive technology as an important component of teacher technology preparation programs.
4. Help preservice teachers understand the enabling conditions for technology use.
5. Help preservice teachers make meaningful connections between technology and teaching.

Therefore, similar to in-service teachers, preservice teachers also need opportunities to learn about and implement various technologies, in their case, throughout their teacher preparation program experiences.

Connected to implementing Lei's (2009) five aspects of learning to teach with technology, it may also benefit preservice teachers to learn about and have opportunities to apply one or more of the eight funds of knowledge contained in the TIK framework when they participate in one or more of Lei's five aspects. For example, secondary social studies preservice teachers could be encouraged to "emphasize subject-specific technology" (number two on Lei's list) and in doing so, connect and apply their developing Content Knowledge (CK) and Pedagogical Content Knowledge (PCK) when considering the relatively new iPad app, "Ken Burns" which allows users to access "mixtapes" connected to one of six themes, all of which are

related to Ken Burns' documentaries about United States History. Emphasizing this subject-specific technology and drawing upon their CK and PCK, these pre-service teachers may be better equipped to consider the ways in which this app may or may not be useful in teaching or assessing students.

Additionally, acknowledging and applying the TIK funds of knowledge may generate additional understanding of teaching and learning in technology-rich classrooms, including 1:1 technology settings. Specifically drawing attention to and being explicit about Knowledge of Educational Ends (KEE) may provide teacher educators and preservice teachers with specific language with which to frame and articulate "apprenticeships of observation". Addressing and unpacking preservice teachers' KEE may also offer language for identifying and expressing the specific educational ends upon which preservice teachers can and should focus. With additional awareness and understanding of the eight TIK knowledge bases, preservice teachers may be more able to engage in one or more of Lei's (2009) five aspects when they learn about and apply their learning with regard to technology integration in K-12 classrooms.

Furthermore, learning to teach requires providing preservice teachers multiple models and a clear understanding of effective teaching and learning. When preservice teachers have opportunities to consider multiple examples and learn from a variety of individuals and contexts, their vision and understanding of teaching will often increase and they will be open to additional ways of knowing (Feiman-Nemser, 2012). As a result, providing preservice teachers with information and specific, content-area and grade-level models regarding the three types of change in-service teachers enact when teaching in 1:1 tablet classrooms could contribute to preservice teachers' learning. When preservice teachers can understand and see multiple models of effective technology integration and teaching, such as those in "Combining" and even more so

in "Remaking," preservice teachers may be more likely and equipped to enact "Combining" and "Remaking" in their own field and future teaching experiences (Gronseth, et al., 2010; Ottenbreit-Leftwich, Brush, Strycker, Gronseth, Roman, & Abaci, 2012). With additional understanding and awareness of these three change types, including multiple models and explicit conversations focused on preservice teachers' KEE, preservice teachers may be better equipped to move from enacting "Adding On" to "Combining" and "Remaking."

Conclusion

When teachers' Knowledge of Educational Ends (KEE) is driven by their hopes and dreams for students, such educating students to fully involve themselves within the society and world in which they live (Labaree, 1997), teachers' technological integration choices differ significantly from those who are more squarely focused on helping students pass standardized tests or perform at a certain level so as to improve their success in first year college courses. Therefore, teachers' KEE appears to influences teachers' technological implementation and integration, including the type of change they enact when planning for and teaching within 1:1 iPad classrooms. What teachers know and hold to be true about the "educational ends" of school matters, not only regarding the types of knowledge they utilize but also the ways in which they use what they know to direct and facilitate student learning. As 1:1 technology models continue to be implemented and integrated in K-12 classrooms throughout the United States, recognizing the importance of teachers' KEE as well as challenging teachers' KEE, when and where appropriate, may lead to a deeper, more robust understanding of the purposes of education which, in turn, may positively impact the type of change teachers enact within 1:1 tablet classrooms.

APPENDICES

Appendix A

Semi-Structured Interview Protocols

1:1 Technology Case Study Participant Interview One Protocol

Researcher: Thank you for participating in this study as well as for completing the online survey I sent earlier. I plan to audio record this interview; is this all right with you? [press record, after participant's consent]. Please state your name and today's date. In order for me to learn a bit more about you, I'd like to first review the content of the online survey you completed. I will also take some notes as we talk, if you don't mind.

[briefly review participant's survey responses]

Researcher: I'd like to follow up with questions related to your thoughts about teaching and learning, both generally as well as in your content area(s). I'd also like to ask you some questions regarding your experiences with the iPad and how, when and why you use it in your classroom.

Teaching and Learning in a Teacher's Content Area(s):
1. How do you discuss and/or represent the use of technology in your course syllabus/syllabi?
    a. Possible follow up: What is the expectation, as stated in the syllabus, for teacher and/or student use(s) of the 1:1 technology in this course?
    b. Possible follow up: Is the content in your syllabus reflective of what actually happens in your classroom, particularly connected to technology and how you and your students use the 1:1 devices? Why/why not?
2. How do students learn best in your content area(s)?
3. What teaching strategies do you use to promote student learning in your content area(s)?
4. What resources do you use to learn about your content area(s)?
    a. Possible follow-up: What digital resources do you use, if any, to learn about your content area(s)?
5. What resources do you use to learn about teaching your content area(s)?
    a. Possible follow-up: What digital resources do you use, if any, to learn about teaching your content area(s)?
6. What resources do you use to plan and teach lessons?
    a. Possible follow-up: What digital resources do you use, if any, to plan and teach lessons?
    b. What resources do you use to assess students and students' learning?
    c. Possible follow-up: What digital resources do you use, if any, to assess students and students' learning?

Teacher Perceptions of and Experiences Teaching in a 1:1 Technology Model:
Researcher: I will use the phrase "1:1 technology model" throughout this study and by this I mean a model in which every teacher and student in a classroom have a hand-held technological device, such as a tablet, laptop, smart phone, etc. In your case, the 1:1 model is the iPad.

7. When do you and your students use 1:1 technology in your classroom and for what purposes?
8. How does 1:1 technology fit (or not fit) within your content area(s)?
9. What changed, if anything, when you started teaching with 1:1 technology, namely the iPad?
    a. Why did this change? What were the results of this change?
10. What stayed the same, if anything, when you started teaching with 1:1 technology, namely the iPad?
    a. Why did this stay the same?

Researcher: Are there any additional thoughts and/or ideas you'd like to share? Thank you for your time and responses; if, after I review my notes may I ask any follow up questions I may have via email?

1:1 Technology Case Study Participant Interview Two Protocol

Researcher: Thank you, again, for participating in this study. I plan to audio record this interview; is this alright with you? [press record, after participant's consent]. Before we look at this set of questions, I'd like to first review some of the information we discussed in the first interview [if necessary]. I'd also like to ask you some questions, based on the observations I did when I was in your classroom [insert dates here].

[Ask questions related to the first interview and/or 1st set of classroom observations, if applicable.]

Researcher: During this interview, I'd like to ask you some more questions regarding your experiences with the iPad and how, when and why you use it in your classroom. I'd also like to learn more about your personal and professional experiences with technology. I also want to talk about the two items that you brought today, namely something that, for you, represents technology as well as something that represents how you use technology in your content area(s).

Researcher: Now, I'd like to ask you some questions about technology, including your own history as well as what types of technology you've used in the past, if any, as well as the types of technology you currently use, if any.

Teacher's Perceptions of and Experiences with Technology in the Classroom:
1. What role(s) does technology play, if any, in your classroom?
    a. Possible follow-up: what role(s) does 1:1 technology (in your case the iPad) play, if any, in your classroom?
2. What types of technology do you and/or your students use when you teach?
    a. How often do you use these types of technology in your content area? (e.g., every day, every other day, once a week, once every couple of weeks, etc.)
        i. Possible follow up: What's the rationale for the uses and the frequencies you use these technologies?
3. What types of iPad applications do you use in your teaching and why?

4. Describe your thought process – what are the types of questions and/or ideas that go through your head when you plan for students' learning in your content area(s)?
    a. Has this changed (if so, in what ways) since you've used the iPad?

Teacher's Technology History
5. Where do you get information about technology and/or how to use technology, either personally or professionally (i.e., Wired, Forum, etc.)?
    a. If so, what types of sources do you access, to get this information (i.e., print or online or both)?

Teacher's Prior Experiences with Technology:
6. In your personal life, what types of technology tools do you use and for what purposes?
    a. Possible follow-up: What specific devices/tools do you use and why?
    b. Possible follow-up: How often do you use these types of technology?
7. Can you think of a specific story and/or example that you'd be willing to share that illustrates how you use technology in your personal life?

8. In your estimation, how much of your experience with technology *outside school* is driven by the following:
    a. Your own interest in technology (e.g., it's interesting; you like to "play" with new devices; you like to be up on the "latest and greatest")?
    b. Necessity to learn/use it for a specific purpose (e.g., online banking; communication with others; you have to learn how to operate a device, etc.)?

9. How much of your experience with technology *inside school* is driven by:
    a. Your own interest in technology (e.g., it's interesting; you like to "play" with new devices; you like to be up on the "latest and greatest"; you like to come up with new ways to teach using technology)?
    b. Necessity to learn/use it for a specific purpose (e.g., you are expected to use it for specific purposes, such as online grading, attendance, communication, teaching, etc.; there's a specific device or program your department uses, etc.)

Researcher: Are there any additional thoughts and/or ideas you'd like to share? Thank you for your time and responses; if, after I review my notes may I ask any follow up questions I may have via email? In addition, for the third interview, which will be our last one, I'd like to ask you to bring in two new items. The first should be a specific iPad application you use to plan lessons and/or teach lessons. The second should be either an assignment you've created and have already assigned or will assign to your students this year that requires them to use at least one aspect of the 1:1 technology, namely the iPad.

Post-Observation Interview: Possible questions to ask.
- In your own opinion, what is your own assessment of the effectiveness of this use of technology in the classroom today?
- What worked well and why?
- What could be different (and why)?

- What's the evidence that says this worked or didn't – what's the evidence that you use to inform your use (and students' uses) of the iPad?
- How do you decide when and how often to use the iPad in your classes and does this use vary between classes/hours and/or sets of students?

1:1 Technology Case Study Participant Interview Three Protocol

Researcher: Thank you, again, for participating in this study. I plan to audio record this interview; is this alright with you? [press record, after participant's consent]. Before we look at this set of questions, I'd like to first review some of the information we discussed in the second interview [if necessary]. I'd also like to ask you some questions, based on the observations I conducted when I was in your classroom [insert dates here].

[Ask questions related to the second interview and/or 2nd set of classroom observations, if applicable.]

Researcher: During this interview, I'd like to ask you some more questions regarding your experiences with the iPad and how, when and why you use it in your classroom. I'd also like to learn some more about your personal and professional experiences with technology as well as your perceptions of how your colleagues use the iPad in their content area(s). I also want to talk about the three items that you brought today, namely a course syllabi, for one of the classes you are teaching this year; a specific iPad application you use to plan and/or teach lessons; and, an assignment that you've created and have already assigned or will assign to your students this year that requires them to use at least one aspect of the 1:1 technology, namely the iPad.

Researcher: First, I'd like for us to talk about the items you brought with you today. Let's start with the course syllabus.

Item #1: iPad application Used for Planning and/or Teaching Lessons
1. What is the iPad application you chose to bring in, related to facilitating student learning?
    a. How and why did you choose this particular application?
    b. Possible follow up: How did you learn about this application?
    c. Possible follow up: How often do you use this application and how long have you been using it? What did you use before you started using this application; why did you switch to this application?
    d. Possible follow up: What other applications do you use for planning and/or teaching lessons? What do you like about these applications?
2. What's different and/or similar about using iPad applications in your content area, compared to what you used before you engaged in the 1:1 technology model?

Researcher: Next, I'd like for us to talk about the assignment you brought that you've created and have already assigned or will assign to your students this year that requires them to use at least one aspect of the 1:1 technology, namely the iPad.

<u>*Item #2: Teacher Created Assignment that Requires Students to Use Some Form of*</u>
<u>*Technology*</u>

3. What is the assignment you brought (should be, in their opinion, an exemplar)?
   a. Is this a new assignment or one you've modified?
   b. What does this assignment require students to know and be able to do?
   c. What aspect(s) of the 1:1 technology (i.e., iPad) are included in this assignment and why?
   d. How did you go about designing/creating this assignment?
      i. Possible follow up: is this a new assignment or a new version of a previous assignment that you've used in the past?
      ii. Possible follow ups:
         1. How many of your assignments from before the 1:1 initiative do you still use (and why)? How many of them required students to use some form of technology?
         2. How many of your assignments, if any, changed because of the 1:1 initiative?
            a. Possible follow up: If there were changes to assignments, what were they and why did they change?
   e. Is this assignment similar or different from other assignments you've given to your students? How/why?
   f. Has the ways in which you think about creating assignments and/or assessing students changed because of the 1:1 model? If so, in what ways? If not, why do you think there haven't been any change?

Researcher: For this last part, I'd like to focus on your ideas and thoughts about the 1:1 model, not only as you view your own teaching but also as you think about how your colleagues talk about and use 1:1 technology in their content area(s).

<u>*Teacher Perceptions of Themselves and their Use(s) of and Teaching with 1:1 Technology:*</u>
4. In your opinion, do you think your teaching has changed since you started teaching with a 1:1 technology model? If so, in what ways?
   a. Possible follow up: How is teaching in a 1:1 model different from teaching in a non 1:1 technology model?
5. What's the "sweet spot" for you, using the 1:1 device? What's most promising with your use(s) of the iPad?
6. What's important for teachers to think about and be able to know and do when they begin teaching in a 1:1 technology model?
   a. Possible follow up: what's important, in terms of the implementation process of a school-wide and/or classroom pilot of a 1:1 technology model?

7. Now that you're at least a year and a half in, in terms of using and teaching with a 1:1 technology model, what do you see as possible next steps, if any, for your own teaching and/or your students' learning, using a 1:1 device?
   a. Possible follow up: how do you see the 1:1 model working both now and in the future of K-12 education models and schools?

Researcher: Are there any additional thoughts and/or ideas you'd like to share? Thank you for your time and responses; if, after I review my notes may I ask any follow up questions I may have via email? I will also plan to follow up with you again either via email and/or in person, once I've had a chance to review my notes and conduct further analysis, if you don't mind?

1:1 Technology Case Study Participant Interview Four Protocol

Researcher: During this interview, I'd like to ask you some questions regarding your experiences with the iPad and how, when and why you use it in your classroom. I'd also like to learn some more about your thoughts and ideas connected to teaching with 1:1 technology and what teachers need to teach in a 1:1 environment.

Part 1: Teacher Perception of Classroom "Model" –
1. Some people in education talk about **teacher-centered classrooms** and **student-centered classrooms**.
    a. Are you familiar with these terms and how they are used?
    b. If so, please define both terms in your own words.
    c. Then, using these two ideas (one or both), how would you describe the classroom in which you teach and why?

Part 2: Motivations for 1:1 Models –
2. According to research by Lei, Conway and Zhao (2008), teachers and institutions are often motivated by different factors when they consider moving to and teaching in a 1:1 teaching model. Using the motivators below *for YOU* *what motivates you to use (or not use) the iPad in your classroom?*
    a. **Fear**
    b. **Hope**
    c. **Simple Access**
    d. **Sophistication**
    e. **Equity**

Researcher: For this next part, I'd like to focus on your ideas and thoughts about the 1:1 model and the types of knowledge teachers need when they teach in a 1:1 environment.

Part 3: Change, Difference and Teaching –
3. When you began teaching in a 1:1 classroom, what (if anything) did you expect to change? Why?
    a. Were your expectations accurate? If not, what was different?
4. When you began teaching in a 1:1 classroom, what (if anything) did you expect to stay the same? Why?
    a. Were your expectations accurate? If not, what was different?
5. For some, teaching in a 1:1 environment means "change without difference" and for others it means "change with difference" (still, for others it means both).
    a. For you, in what way(s) has 1:1 technology resulted in "**change *without* difference**"?
    b. For you, in what way(s) has 1:1 technology resulted in "**change *with* difference**"?

Researcher: Are there any additional thoughts and/or ideas you'd like to share? Thank you for your time and responses; if, after I review my notes may I ask any follow up questions I may have via email? I will also plan to follow up with you again either via email and/or in person, once I've had a chance to review my notes and conduct further analysis, if you don't mind? ***Thank you, again, for participating in this project!***

Appendix B

Online Case Study Participant Survey Questions

Online survey questions distributed and collected via Survey Monkey.

1. Please type your first and last name in the box below.
2. For the purposes of this study, pseudonyms will be used to identify all case study participants (i.e., you!). Therefore, if you would like to, please create one for yourself (first and last name). This is the name I will use to identify you in any/all publications/discussions of this study. NOTE: If you don't want to select your own pseudonym, I will generate one for you.
3. What are some things you find MOST satisfying and/or most enjoy about teaching (and why)?
4. What are some things you LEAST enjoy about teaching (and why)?
5. If you could only use ONE WORD to describe yourself as a teacher, what work would you use and why?
6. How long have you been a teacher (including this one)?
7. What content area(s) are you certified to teach?
8. What classes are you teaching this year?
9. Prior to using the iPad in your classroom and with your students, what experiences did you have connected to using technology in your classroom and/or content area(s)? Select all that apply.
   a. Undergraduate coursework related to technology and/or technology use
   b. Graduate coursework related to technology and/or technology use
   c. School-level technology teacher training
   d. District and/or ISD technology teacher training
   e. Professional conference sessions connected to educational technology
   f. Personal use and/or experiences with technology
   g. Other (please describe)

10. Respond to the following statement: "My prior experiences with technology positively affect my experiences with and uses of 1:1 technology (i.e., the iPad) in my content area(s)." Please select the answer that best reflects you.
    a. Strongly agree
    b. Agree
    c. Disagree
    d. Strongly Disagree
11. In your content area(s), how often do you use the following **classroom/school technology devices** for *student instruction*? For each item listed, select one category. N/A = not applicable

	Daily	Weekly	Monthly	Yearly	N/A
iPad					
Smart Phone					
Desktop computer					
Laptop computer					

Clickers					
Online web-based resources					
Overhead Projector					
Document camera					
Television					
Smart Board					
School computer lab					
VHS/DVD Player					
Other (please specify)					

12. In your content area(s), how often do you use the following school/classroom technology devices for *student assessment (formal and informal)*? For each item listed, please select one category. N/A = not applicable

	Daily	Weekly	Monthly	Yearly	N/A
iPad					
Smart Phone					
Desktop computer					
Laptop computer					
Clickers					
Online web-based resources					
Overhead Projector					
Document camera					
Television					
DVD/VHS player					
Other (please specify)					

13. In your classroom, how often do you use the following **aspects of the iPad** for *student instruction*? For each item listed, please select one category. N/A = not applicable

	Daily	Weekly	Monthly	Yearly	N/A
FREE content –related iPad/iPhone applications					
SCHOOL PURCHASED content –related iPad/iPhone applications					
PERSONAL PURCHASED content –related iPad/iPhone applications					
Word processing					
Video-recording application					
Digital Camera application					
Email					
Internet Research					
Watching videos and/or					

video clips					
Online chat forums and/or discussion boards					
Desktop sharing software					
Online assessment(s)					
Presentations (web or app-based)					
Websites					
Other (please specify)					

14. What **challenges** have you encountered, in terms of using 1:1 technology (i.e., the iPad) in your classroom? Select all that apply.
    a. Finding/getting immediate technical help/support
    b. Finding/getting immediate administrative help/support
    c. Time to learn about how to use the iPad in my content area
    d. Time to implement the iPad in my content area
    e. Internet connectivity
    f. Hardware problems
    g. iPad Application problems
    h. Lack of training/technological expertise
    i. Individual Student management issues
    j. Classroom management issues
    k. Pressure to use technology from school/district level administrators
    l. Lack of money/funding
    m. Other – please specify

15. What **benefits** have you encountered, in terms of using 1:1 technology (i.e., the iPad) in your classroom/content area? Select all that apply.
    a. Increased student engagement
    b. Decrease of classroom management issues
    c. Access to additional online content-specific resources
    d. Increased student access to the Internet
    e. Ease of planning and executing my daily and/or unit plans
    f. Access to and use of specific iPad/iPhone applications related to my content area
    g. Increased e/communication opportunities with students
    h. Increased e/communication opportunities with parents
    i. Increased e/communication opportunities with high school staff/colleagues
    j. Other – please specify

16. What factors influence *__positively__* your use(s) of 1:1 technology (i.e., the iPad) in your content area? Select all that apply.
    a. Administrative expectation/pressure
    b. Parental expectation/pressure
    c. Department expectation/pressure
    d. Fellow faculty expectation/pressure
    e. Student expectation/pressure
    f. Personal expectations/pressure
    g. It uses connects well to my content area(s)

     h. There are many online resources and/or apps that apply to my content area
     i. It prepares students for future school and/or career applications
     j. I like technology and think it's important to use
     k. It's easy to use

17. What factors influence **_negatively_** your use(s) of 1:1 technology (i.e., the iPad) in your content area? Select all that apply.
     a. Administrative expectation/pressure
     b. Parental expectation/pressure
     c. Department expectation/pressure
     d. Fellow faculty expectation/pressure
     e. Student expectation/pressure
     f. Personal expectations/pressure
     g. It uses do not connect well to my content area
     h. There are not many online resources and/or apps that apply to my content area
     i. I don't like technology and don't think it's important to use
     j. It's hard to use and requires too much time to learn what I'd need to know to implement it in my content area(s)

18. **_For planning lessons_** in your content area(s), how valuable is 1:1 technology for the ways in which you think about and plan your lessons? Choose only one.
     a. Valuable
     b. Somewhat valuable
     c. Not very valuable
     d. Not at all valuable

19. **_For facilitating student learning_** in your content area(s), how valuable is the use of 1:1 technology? Choose only one.
     a. Valuable
     b. Somewhat valuable
     c. Not very valuable
     d. Not at all valuable

20. **_For assessing students_** in your content area(s), how valuable is the use of 1:1 technology? Choose only one.
     a. Valuable
     b. Somewhat valuable
     c. Not very valuable
     d. Not at all valuable

21. When using 1:1 technology (e.g., laptops and/or tablets) for the first time, some teachers have said, *"I felt like a first year teacher all over again!"* In your own experiences with integrating the iPad in your classroom and content area(s), to what degree did (and/or do) you feel like a "first year teacher all over again"? Choose only one.
     a. Almost all the time
     b. Most of the time
     c. Some of the time
     d. Little of time, if at all

22. In your experience, what are the **_most beneficial aspects of using 1:1 technology_** in your content area(s)/classroom? Discuss below.

23. In your experience, what are the *least beneficial aspects of using 1:1 technology* in your content area(s)/classroom? Discuss below.
24. Overall, for you, how valuable is 1:1 technology for teaching students in your content area(s)? Choose only one.
    a. Very important
    b. Important
    c. Not very important
    d. Not important
25. Is there anything else you'd like to share regarding your uses of 1:1 technology, your prior experiences with technology and/or anything else related to this study? If so, please comment below.

By submitting the "OK" button, you agree to participate in this study. Your responses and all school identifiers will remain confidential and pseudonyms will be used for all publications/presentations. **Thank you for participating!**

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