TEACHER PERCEPTIONS OF TECHNOLOGY INTEGRATION PROFESSIONAL DEVELOPMENT IN A 1:1 CHROMEBOOK ENVIRONMENT

by

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This dissertation was prepared under the direction of the candidate's advisor, Dr. Roberta K. Weber, Department of Curriculum, Culture, and Educational Inquiry, and has been approved by the members of her supervisory committee. It was submitted to the faculty of the College of Education and was accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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ABSTRACT

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A variety of computing devices are available in today's classrooms, but they have not guaranteed the effective integration of technology. Nationally, teachers have ample devices, applications, productivity software, and digital audio and video tools. Despite all this, the literature suggests these tools are not employed to enhance student learning according to best practices. The purpose of this qualitative case study was to describe and understand perceptions of a technology integration professional development (TIPD) experience of elementary teachers at a suburban, independent school. The TIPD was an ongoing, 40-minute class led by a technology specialist, taking place in teachers' classrooms, engaging teachers and their students in a 1:1 Chromebook environment.

Data collected were through classroom observations, teacher written reflections, school documents, and face-to-face interviews. The results of multiple cycles of coding wrought findings in regard to teachers' perceptions of effective technology integration,

technology class as professional development (PD), and technology class as enabling effective technology integration. The findings showed teachers perceived technology integration to be effective if it benefited the skills or productivity of themselves or their students and if it directly related to their curriculum. Teachers required the support of their colleagues, technology specialist, IT department, as well as traditional and alternative forms of PD to overcome internal and external barriers to integration. Five of the seven teachers explicitly conveyed the technology class to be effective TIPD and all seven learned about a technology tool or resource, technical knowledge or skills, or ideas for integration during the technology classes. Findings also showed the technology class enabled reflection, which led to ideas for integration; the class enabled integration when the content was related to or the tools were useful for their subject area; the class provided the collaboration necessary for integration to occur.

DEDICATION

This dissertation is dedicated to my parents, Rimma and Mikhail Yankelevich. Every step was taken knowing I had their love, guidance, and encouragement. It is also dedicated to my sister, Maya Garza, who has always and in all things, lit and led the way. To my friends who are like my family: Zarah Ali, Ama Mohan, Nikel Manwah, Maria Rico, Derek Zambrano, and Eric Heyaime, thank you for my sanity.

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CHAPTER 1. INTRODUCTION

The ways in which technology has shaped society in the past two decades is visible in our daily social and professional lives. With the availability and convenience of the Internet, we use our portable handheld devices (smartphones, iPods, tablets, and laptops) to communicate, share, learn, and work with our family, friends, neighbors, and colleagues around the globe. This use is not limited to the adult portion of society. Internet availability and usage for those under the age of 18 is staggering, with 92% of teens going online daily (Lenhart, 2015). Whether they are called the Net-generation or Digital Natives, these learners are known as those growing up in or born into this digital, interactive environment (Karuovic, Glusac, Radosav, & Grahovac, 2016; Neumann, 2016). They are marked by the fact that "Digital technology has pervaded every aspect of their lives: how they play, how they socialize, how they communicate, and how they learn" (Weisberg, 2011, p. 189). They are also already using phones, tablets, and computers to assist in their schooling (Christensen & Knezek, 2017; Sahin, Top, & Delen, 2016). Cell phone alarms are set to remind them of papers due, video chats are used to help with homework, and YouTube videos are referenced for complex material.

Considering this, are educational institutions capitalizing on Internet capable devices in the classroom? Schwartzbeck & Wolf (2012) argued that: "There is a moral and economic imperative to change the way teachers teach and students learn in the United States" (p. 2) to ensure that all students graduate from high school and succeed in college or the workplace and this change is possible through digital learning. Digital

learning is defined in part as, "any instructional practice that is effectively using technology to strengthen the student learning experience" (Schwartzbeck & Wolf, 2012, p. 1). The National Educational Technology Plan makes a similar argument for importance of digital learning, "Technology can be a powerful tool for transforming learning" by developing student teacher relationships, reinventing learning and collaboration, addressing accessibility and equity, and working to meet the needs of all learners (Office of Educational Technology, 2010, p. 3). The value of technology integration in the classroom seems inarguable, but how about its success? Christensen and Knezek (2017) argued that a paradigm shift in the way teachers instruct and students learn with mobile technologies is required to successfully integrate technology into the classroom.

Teachers—their knowledge, attitudes, beliefs—are the key to successful integration (Chiu & Churchill, 2016). Technology integration is supposed to "transform education, thereby promoting 21st century skills," but the quality and scope of the teacher professional development (PD) is lacking (Tondeur, Forkosh-Baruch, Prestridge, Albion, & Edirisinghe, 2016, p. 111). So while schools may offer PD, it has not been sufficient in affecting change in the classroom (Gray, Thomas, & Lewis, 2010; Murthy, Iyer, & Warriem, 2015). The disconnect may be in the *type* of PD being provided. One of the International Society for Technology in Education's 14 Essential Elements "to effectively leverage technology for learning" is "Ongoing Professional Learning" (International Society for Technology in Education, 2017, para. 10). Ertmer and Ottenbreit-Leftwich (2013) argued that, "to achieve the kinds of technology uses required for 21st century

teaching and learning we need to help teachers understand how to use technology to facilitate meaningful learning" (p. 1).

Background

As such, the research site's department of educational technology, was tasked to provide teacher training, student essential skills, and overall technology integration support into curriculum and instruction, seamlessly blended with best-practices of the classroom. The rationale was that there was a disconnect between having the devices versus having the skills and knowledge, and thus the *willingness*, to use them with one's students. From this, a technology class was born. Teachers in pre-kindergarten through grade five would no longer drop their students off at a computer lab and be able to utilize said time for planning. Now, the educational technologist would come to the teachers' classrooms and engage both the teacher and students in the technology-essential skills in a manner that modeled best practices of technology integration. This being the case, the problem became gauging teacher perceptions of this technology class acting as PD and its influence on their ability and/or willingness to effectively integrate technology into the classroom.

Statement of the Problem

Numerous technology tools and Internet-ready mobile devices are available in classrooms all across the country, but they have not guaranteed the effective integration of technology. The ratio of instructional computers with Internet access to students in elementary classrooms was already under 3:1 in 2008 (Gray et al., 2010). Nationally, many teachers have ample devices, applications, productivity software, and digital audio and video tools (Dawson, 2012). Despite all this, the literature suggests these tools are

not employed to enhance student learning according to best practices (Brantley-Dias & Ertmer, 2013; Murthy et al., 2015; Schnellert & Keengwe, 2012). Simply depositing technology into the classroom and/or providing traditional forms of teacher PD (large group trainings/"one-shot" workshops) do not ensure effective technology integration in the classroom.

Based on a peer-reviewed literature search, there has yet to be a study that investigated a technology class designed as a co-learning experience for both students and teachers that places the teacher in such an authentic PD environment as their own classroom. Previous research has mainly focused on traditional forms of PD and has suggested the need for studying alternative forms. In addition, little research is available on PD and technology integration in a 1:1 mobile or cloud-based device environment, tools that are overwhelming the educational device market (Sahin et al., 2016; Karsenti & Fievez, 2013). As a result, this study presents an opportunity to both fill the gap and add to existing literature by studying teacher perceptions of a unique PD experience in a 1:1 Chromebook environment—previously a 1:1 iPad environment—devices quickly gaining popularity in the classroom.

Purpose of the Study

The purpose of this qualitative case study was to first describe and understand perceptions of seven fourth and fifth grade teachers regarding effective technology integration; and second, to describe and understand their perceptions of a technology integration professional development (TIPD). The TIPD was an ongoing, 40-minute class led by an educational technologist, taking place in teachers' classrooms, engaging teachers and their students in a 1:1 Chromebook environment.

Research Questions

1. How do elementary teachers perceive effective technology integration in a 1:1 Chromebook environment?
2. How do elementary teachers perceive an ongoing technology class as a professional development experience in a 1:1 Chromebook environment?
3. How do teachers perceive an ongoing technology class as supporting "effective technology integration" in a 1:1 Chromebook environment?

Role of the Researcher

The researcher is a computer science and technology specialist for grades pre-kindergarten through first at the research site. Previously, the researcher was responsible for providing technology PD for faculty grades pre-kindergarten through fourth. In addition, the researcher was responsible for designing and teaching an earlier iteration of the technology class. However, the researcher is neither currently working with the study sample nor responsible for the current technology class development or instruction. As the researcher has been both a classroom teacher and an educational technologist at this site for six years, this may have influenced teachers' desire to be involved in the study.

Significance of Study

The use of devices (computers, tablets, interactive whiteboards, document cameras, etc.) in the classroom has been heavily encouraged and funded in the last two decades; however, the placement of devices in the classroom does not translate to a ready adoption and proper integration of the devices by teachers. The argument has been made that teacher professional development (TPD) is needed to establish the habits of mind (attitude), knowledge, and skills necessary to implement devices in an authentic and

possibly transformative way. Studying the perceptions of a group of teachers with regard to a unique method of TPD may lead to the adoption of a specific instructional method or even a technology integration model in schools where technology integration is new, has not been successful, or where resources are limited. On a smaller scale, this study may influence administrative decisions regarding the continuation or development of the technology class at the case site as well as at local schools with which the site consults. The outcomes for successful technology integration are "[assessing student learning, differentiating instruction, and providing rigorous, relevant and engaging learning experiences for all students]" (International Society for Technology in Education, 2011, p. 1).

Chapter Summary

In summary, Chapter 1 introduces the transformative qualities of modern computing devices on today's society. Device use is pervasive and students are already utilizing them to assist in their schooling. As such, it must be asked whether schools are capitalizing on the transformative possibilities of technology integration. The teacher is at the center of the issue, being the primary driver of change. PD is integral to a teacher's ability to effectively integrate technology into the classroom to meet the needs of 21st century learners. A review of the literature was conducted to explore the many facets of achieving effective technology integration in the classroom.

CHAPTER 2. REVIEW OF THE LITERATURE

Recent qualitative and quantitative (case and phenomenological) studies have demonstrated that technology is currently utilized in elementary education for word processing, drill-and-practices, memorization tasks, presenting lectures, communicating amongst faculty, parents, etcetera (Dawson, 2012; Inan & Lowther, 2010; Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010). In direct opposition to the aforementioned uses, the literature suggests that technology should be used to support student-centered, constructivist practices (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Liu, 2011; Ottenbreit-Leftwich et al., 2010; Wang, Ke, Wu, & Hsu, 2012). The constructivist approach is defined as learning that is "complex, interactive, changing, active, and situated, and which allows learners to individually construct their knowledge in a unique and meaningful way" (Levin & Wadmany, 2008, p. 257).

The goal of this review was to consider the significant factors influencing teachers' understanding, willingness, and ability to effectively integrate technology in a 1:1 Chromebook environment. This included defining effective technology integration, exploring barriers, examining the teacher as the critical factor, reviewing current PD frameworks and methods for promoting integration, exploring the role project-based learning (PBL) can play in integration and PD, and 1:1 device programs.

Toward a Definition of Effective Technology Integration

Research couches effective integration in terms of valuable, meaningful, or transformative (Dawson, 2012; Ertmer et al., 2012; Inan & Lowther, 2010; Ramorola, 2013; Wang et al., 2012). What does this type of integration look like according to the research? We must develop a thorough understanding of what is meant by technology integration to successfully assist practitioners in translating it into the classroom. Ramorola's (2013) view of "transformative'" is "bringing together or combining technology with teaching and learning strategies in order to meet the curriculum standards and learning outcomes of each lesson, unit, or activity," (p. 656) which seems a more traditional approach. Comparatively, Dawson (2012) used the term "transformational" to describe using technology, "in innovative ways that are authentic, purposeful, and supportive of higher-level thinking" (p. 117). Ertmer et al. (2012) used the term "meaningful" to describe integration that is student-directed and involves using technology for critical thinking, problem solving, collaboration, and communication. Wang et al. (2012) argued that technology is "valuable" when it creates a learning environment that meets the "different needs of students" (p. 126). Inan and Lowther (2010) defined technology integration as computer use that simply, "supports classroom instruction" (p. 138).

This is what the literature says effective technology integration *should be*, but Ertmer, Addison, Lane, Ross, and Woods (1999) and Ertmer, Gopalakrishnan, and Ross' (2001) qualitative studies explored *what was* with regard to current constructivist technology integration practices. Ertmer et al. (1999) found that technology was being used as a supplement (i.e., rewarding students when they were done with an assignment)

or a support (i.e., using a software program to reinforce certain skills), but was rarely used to go beyond the curriculum. Even with self-professed exemplary technology users, integration fell into the categories of skill-based use, content-based use, or process-based used, with only process-based use qualifying as "best practice" according to the literature (Ertmer et al., 2001). They concluded that, "exemplary technology use, as perceived and practiced by teachers, does not readily align with current descriptions of best practice; rather, it illustrates what happens when visions meet reality in today's K-12 classrooms" (Ertmer et al., 2001, p. 19). Correspondingly, almost a decade later, Dawson's (2012) macro-level, action research project found that most teachers integrated technology to support student learning of specific content, but did not necessarily embrace all the tenets of constructivism.

Taking the various terms and accompanying definitions into consideration, the term *effective technology integration* was defined for the purpose of this study as purposefully using technology tools to support, enhance, or transform current curriculum and/or instructional practices. This recognizes that teachers are on a continuum of integration practices, which may or may not coincide with the literature on best practice. The vision of constructivist-based integration practices may still be the ideal, but barriers persist.

In summary, the abundance of technology tools available in elementary classrooms does not immediately transfer to technology integration that is constructivist and student-centered as the literature suggests it should be. Technology integration has been defined in terms of meaningful, valuable, and transformative all of which create a

lack of clarity to its purpose. Purposeful, or effective, technology integration works to support, enhance, or transform the curriculum, ideally in a constructivist manner.

Barriers to Effective Technology Integration

In Levin and Wadmany's (2008) review of the literature, they compiled over 30 possible barriers to technology integration that fall into various categories, but primarily those outside of a teacher's control and those within it. Ertmer and Hruskocy's (1999) concept of first-order and second-order barriers reflect this type of categorization. First-order barriers include computer access, software, planning time, technical, and administrative support; second-order barriers include teacher beliefs and practices (Ertmer & Hruskocy, 1999).

However, Levin and Wadmany (2008) posited that trying to isolate and study any one or combination of factors is purposeless because "factors affecting the adoption of technology reflect both individual and organizational variables as well as pedagogical and technology-related variables" (p. 237). Similarly, Inan and Lowther (2010) argued the complexity of the issue in that an "advanced statistical technique for examination of dependent and independent variables to reveal the relative effects of each variable on the other variables" was needed (p. 139). Their path analysis found teacher demographic characteristics (years teaching and age), computer proficiency, teachers' beliefs, and availability of resources and support to be important factors affecting technology integration.

Contextual factors. In accordance, Groff and Mouza's (2008) review of the literature derived a framework with six categories affecting technology integration efforts, five fall within the purview of this study: factors associated with the school (The

School), factors associated with the teacher (The Teacher), factors associated with the technology-enhanced project (The Project), factors associated with the students (The Students), and factors associated with the technology (Technology). For the purpose of this study, Groff and Mouza's (2008) derivation will be utilized as it includes both second and first order barriers and conceptualizes/situates technology integration in a PBL model.

The first factor defines a school administration that develops a school culture which supports technology integration efforts with planning time, PD, and collaboration among colleagues, resources, technical support for said resources, and a physical environment that does not isolate technology/computers in a separate lab (Groff & Mouza, 2008). The teacher "is the decision maker/director who has the greatest influence on classroom events" (Groff & Mouza, 2008, p. 29). As such, his or her technology skills and proficiency, attitudes and beliefs, and knowledge of support resources are a vital factor in successful technology integration and at the heart of this study. The technology-based project being attempted may also be a barrier in itself if it deviates too far from teachers' current practices and beliefs, requires teaching new content, puts a strain on available resources, or demands substantial outside support. With regard to students, "The background, attitudes, beliefs, and skills that students bring to a proposed project can significantly influence its direction and success" (Groff & Mouza, 2008, p. 33). Finally, the technology tools themselves pose a barrier as they can malfunction and require a strong, technical and human, infrastructure to support their affective use (Groff & Mouza, 2008).

In summary, over 30 barriers to effective technology integration have been identified via smaller qualitative case studies or larger quantitative survey studies (see Table 1). They may be external to the teacher such as policy or internal such as pedagogical practices. For the purpose of this review, three factors from Groff and Mouza's (2008) framework will be explored (The Teacher, The Project, and Technology).

Table 1

Barriers to Effective Technology Integration

Literature Source	Barriers Outside Teacher Control	Barriers Inside Teacher Control
Ertmer & Hruskocy (1999) *First Order and Second Order Barriers*	Computer Access Software Planning Time Technical Support Administrative Support	Teacher Beliefs Teacher Practices
Inan & Lowther (2010) *Factors Influencing Technology Integration*	Availability of Resources Overall Support (admin, peers, parents, community) Technical Support (resources, troubleshooting) Computer Availability	Years Teaching Teacher Age Computer Proficiency Teacher Beliefs Teacher Readiness
Groff & Mouza (2008) *Challenges/ Obstacles/ Limitations*	School Culture Planning Time Professional Development Collaboration Among colleagues Resources Technical Support Physical Environment	Teacher Technology Skills Teacher Proficiency Teacher Beliefs Teacher Attitudes Knowledge of Support Resources

(continued)

Table 1

Barriers to Effective Technology Integration

Literature Source	Barriers Outside Teacher Control	Barriers Inside Teacher Control
Levin & Wadmany (2008) *Individual, Organizational, Pedagogical, Technological Barriers*	Convenient Access to Computers Funding and Equipment Issues Inadequate Infrastructure Limited or Inadequate Staff Development Lack of time to experiment and develop lessons, units, rubrics, and for preparing resources for lessons Poor Leadership Availability of guidance from specialist mentors and online resources - Lack of ongoing support School Philosophy Changing Technology	Teachers' inexperience for using technology as a productivity tool Information and Innovation Overload and Burnout Fragmented Knowledge Teacher Confidence Teacher Positivity Toward Technology Teacher Beliefs and Views on IT Teacher Resistance to Change Willingness to change long-standing pedagogical practices and classroom role Prior negative experiences with technology Feeling intimidated that students know more Motivation and need to improve technology knowledge and skills

The Teacher as the Critical Factor

Adult experiential learning. In-service teachers are a unique type of learner. They are adults, as well as practitioners, with a rich history of experiences. Recent articles cite adult learning theory as a framework for the design of TIPD experiences. Malcolm Knowles, largely responsible for bringing andragogy, or adult learning theory, to the United States in the 1960s, developed

six assumptions of the adult learner, which "…has implications for program design and instruction" (Merriam & Bierema, 2014, p. 47). These assumptions lead to a learning facilitator who "sets a climate for learning that physically and psychologically respects adult learners and then involves learners in the planning, delivery, and evaluation of their own learning" (Merriam & Bierema, 2014, p. 47). These assumptions include the learner's need to know, the self-concept of the learner, the prior experiences of the learner, the learner's readiness to learn, the learner's orientation to learning, and, the learner's motivation to learn (Knowles, Holton, & Swanson, 2015). These principles are all wrapped within the context and goals of the learner and necessitate a learning facilitator who "sets a climate for learning that physically and psychologically respects adult learners and then involves learners in the planning, delivery, and evaluation of their own learning" (Merriam & Bierema, 2014, p. 47).

A crucial assumption is learner experiences, in which experience is both, "a resource and stimulus for learning" (Merriam & Bierema, 2014, p. 106). As such, TPD must capitalize on the learner-centered, experiential approach that promotes reflective-practice, as advanced by those such as Dewey, Kolb, and Schön (as cited in Merriam & Bierema, 2014). This is discussed further in the section on PBL. In addition, teacher perceptions in regard to attitude or willingness to integrate technology into the curriculum may be colored by their own experiences or frustrations with technology.

Beliefs and attitudes. A common thread in the research, both qualitative and quantitative, is the critical role that teachers play in the successful integration of technology into the classroom (Chiu & Churchill, 2016; Ertmer et al., 2012; Ertmer &

Ottenbreit-Leftwich, 2013; Groff & Mouza, 2008; Inan & Lowther, 2010; Levin & Wadmany, 2008; Liu, 2011). Ertmer et al. (2012) found that there was now a "strong alignment among teachers' beliefs and practices" (p. 432), which is a development in the last decade. They attributed this to the change in access to the technologies, the change in the students (digital natives), and the change in curriculum focus (21st century skills). The implication is that barriers internal to the teacher, like attitudes and beliefs, are the "true gatekeepers" (Ertmer et al., 2012, p. 433) to technology integration and can mediate external barriers (Inan & Lowther, 2010). Based on her review of the literature on teacher beliefs, Ertmer (2005) supposed that, "beliefs are far more influential than knowledge in determining how individuals organize and define tasks and problems. This, then, makes them stronger predictors of behavior" (p. 28).

With this supposition, Ertmer (2005) proposed that studying teacher educational beliefs and their connection to technology integration is the key to affecting teacher learning. Research that attempts to understand teachers' beliefs, "requires making inferences based on what teachers say, intend, and do" (Ertmer, 2005, p. 29) and all the possible contradictions that may lie within. Similarly, McGrail's (2005) qualitative case study found that teacher beliefs and attitudes play "a key role in shaping their use of technology in their classroom practices" (p. 19). Findings showed that teachers would accept change if they thought it would mean learning gains for their students, but not if resources were not readily available, inefficient, or if they felt uncomfortable (McGrail, 2005). This was a result of their belief that their main purpose was to assist students in learning curriculum content and that technology was just a tool to aid in this endeavor, which is consistent with the literature (Judson, 2006; McGrail, 2005; Ottenbreit-Leftwich

et al., 2010). It also suggests that any attempt to understand the effective integration of technology into classroom practice cannot be separated from exploring, examining, and understanding the beliefs of teachers.

In summary, the teacher is the most vital aspect of implementing effective technology integration. Amongst the most important characteristics of the teacher are their personal beliefs and attitudes towards technology and the role it plays in improving student learning. If a teacher values technology integration, this *should* be reflected in his or her practice if external variables are controlled (i.e., high-stakes testing, resources, support). However, positive teacher beliefs do not immediately translate to *effective* technology integration according to best practices (Liu, 2011). The problem turns to what knowledge and skills teachers need in addition to positive beliefs and attitudes.

Knowledge and skills. In addition to a teacher's beliefs and attitude, certain knowledge and skills are necessary for the effective integration of technology into the classroom (Ertmer et al., 2001; Ertmer & Ottenbreit-Leftwich, 2013; Mishra & Koehler, 2006). Well stated by Mishra and Koehler (2006), "teaching is a complex cognitive skill occurring in an ill-structured, dynamic environment" (p. 1020). This seems apparent in light of the plethora of barriers reviewed in the previous section. To be effective, a teacher must possess content knowledge and pedagogical knowledge, but with ever evolving digital tools, teachers must also have technological knowledge and skills (Mishra & Koehler, 2006; Potter & Rockinson-Szapkiw, 2012; Snoeyink & Ertmer, 2002). Multiple studies have demonstrated that teachers must feel comfortable with the technology tools before they are willing to implement them with their students; this comfort comes from technical knowledge and skills (Blocher, Armfield, Sujo-Montes,

Tucker, & Willis, 2011; Chen & Chang, 2006; Mouza, 2003; Taralynn, Houbin, & Avinash, 2010). However, teaching the technical skills in isolation has not proven successful **(**Blocher et al., 2011; Potter & Rockinson-Szapkiw, 2012).

Is TPACK a good fit? Mishra and Koeler (2006) explicate the "dynamic transactional relationship" of all three forms of knowledge in their Technological Pedagogical Content Knowledge (TPACK as of 2007) framework (p. 1030). Their framework, shown in Figure 1, has come under critique from quantitative survey research that has found that the seven domains are difficult to distinguish in both research and practice (Archambault & Barnett, 2010; Koh, Chai, & Tsai, 2010; Kopcha, Ottenbreit-Leftwich, Jung, & Baser, 2014). If this is the case, the construct may lack value in studying and fashioning PD that improves technology integration practices. However, some researchers have also successfully used it as a framework to explore the day-to-day practices of teachers involved in TIPD programs based on the notion that "it rejects conceptions of technology integration that focus on teachers developing expertise in isolated technologies" (Morsink et al., 2010, p. 4).

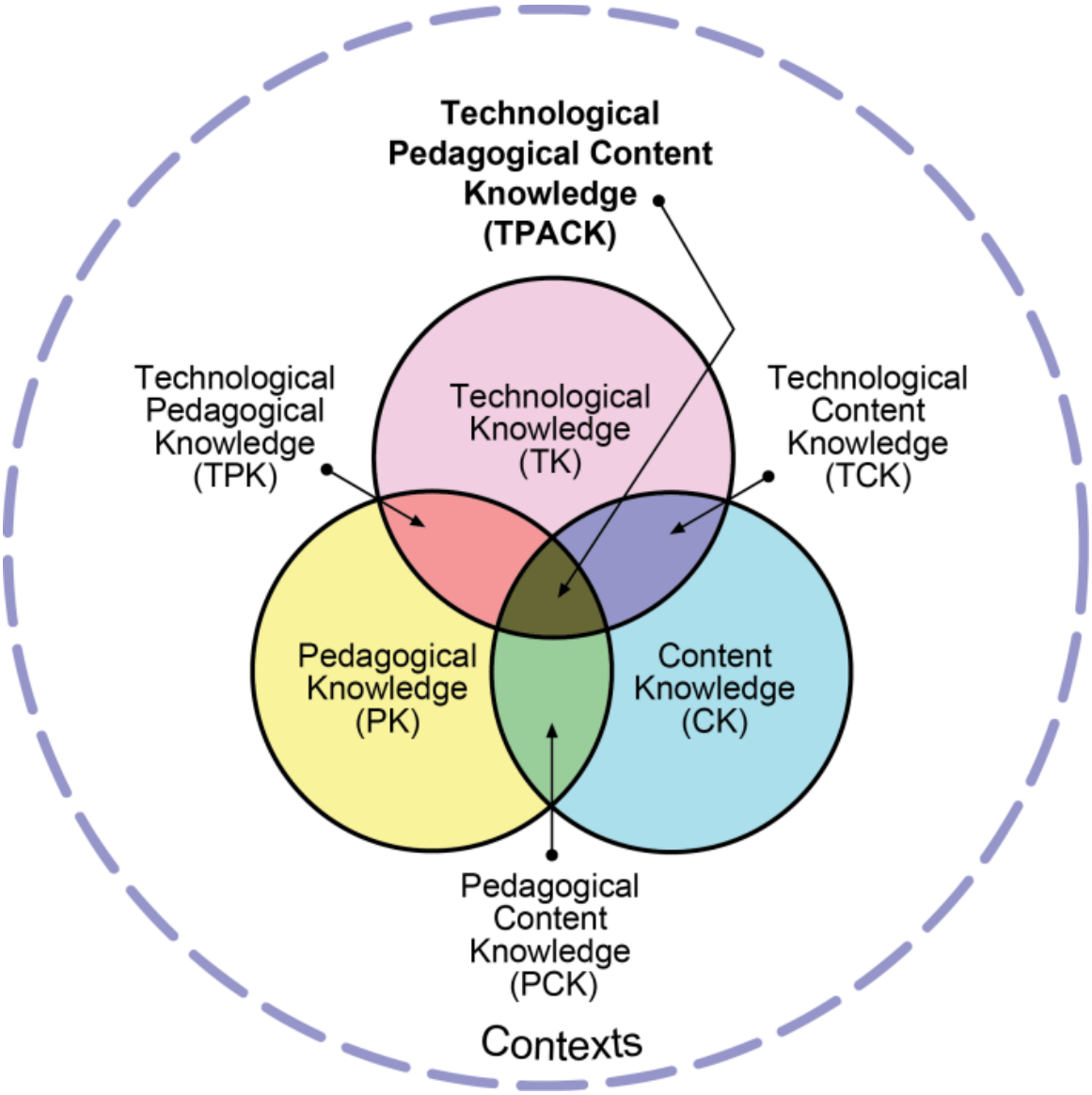

Figure 1. The relationship between three primary forms of knowledge: Content (CK), Pedagogy (PK), and Technology (TK) as described by Mishra and Koeler (2006).[1]

In 2013, two reviews of the literature were completed and provided recommendations, alterations, and/or alternatives to TPACK (Brantley-Dias & Ertmer, 2013; Chai, Koh, & Tsai, 2013). In Chai et al.'s (2013) review of the literature, they first defined the seven domains (TK, PK, CK, PCK, TPK, TCK, TPACK) in an attempt to

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bring resolution to the aforementioned fault found in the framework. Based on 74 studies—which employed both quantitative and qualitative approaches and included methods such as artifact evaluations, software development, case studies, intervention studies, instrument validation, survey studies, and document analysis—Chai et al. (2013) found the TPACK framework to be a valid model and capable of improving teacher learning and technology integration. However, they proposed a revised version of Mishra and Koehler's (2006) framework, which embeds the seven dimensions within contextual factors: cultural/institutional, interpersonal, physical/technological, and intrapersonal, and student learning (Chai et al., 2013). Once again, this confirms the critical role the aforementioned barriers and teacher beliefs and attitudes play in effectively integrating technology (Brantley-Dias & Ertmer, 2013).

From the case studies reviewed, Chai et al. (2013) found a gap in the literature: "more studies on how teachers' beliefs shape their TPACK and classroom practices are needed to clarify the relationship between beliefs, knowledge and skills, and contextual affordances and constraints" (p. 38). This recommendation for future research is seconded by Brantley-Dias and Ertmer's (2013) review. In addition, Deng, Chai, So, Qian, and Chen (2017) recommend research on subject-specific TPACK and beliefs about the subject itself and teaching practices. They recommended that a qualitative approach be taken when exploring "a teacher's difference and relation between the professed and enacted TPACK" (Deng et al., 2017, p. 10). Another gap was found: only 10 of 32 studies on TPACK and PD dealt with in-service teachers with the majority of studies dealing with pre-service teacher education (Chai et al., 2013).

Brantley-Dias and Ertmer (2013) took a more critical stance on the framework; they questioned the validity and reliability of the various measures (quantitative and qualitative) used to study the framework. They also questioned whether the framework is useful if it cannot be measured and ask if it is necessary at all. They argued that even if teachers have TPACK, which is difficult to determine, and as such, difficult to develop, it does not automatically translate to effective technology integration. In regard to future research, they recommend research on how "teacher knowledge of technology can be used to support students' learning of specific subject matter," (Brantley-Dias & Ertmer, 2013, p. 121) with the focus being on the individual disciplines (i.e., social studies, science, etc.), as well as actual student learning gains. Another area of research should be the methods employed to support the development of this type of teacher knowledge (Brantley-Dias & Ertmer). This will be addressed in the section below, as it is the phenomenon under investigation.

In summary, technology knowledge, pedagogical knowledge, and content knowledge are all requisites for teachers to effectively integrate technology into their practice; however, the seven dimensions of TPACK have proven problematic to isolate and investigate. As such, they will not be used as the framework of the study. Instead, it simply establishes an understanding that the various forms of knowledge must be taken into consideration when planning teachers' learning experiences. This is in addition to taking into consideration integration barriers and teacher beliefs/attitudes. Chen and Chang (2006) dubbed this the "whole-teacher approach" (para. 4) to PD.

Teacher Professional Development

Guskey (2002), like many, asserted that "high-quality professional development is a central component…for improving education," (p. 381) whilst simultaneously proclaiming that most PD programs are ineffective. He posited that a lack of consideration for teacher motivation to engage in PD and how change in teachers typically occurs are the main reasons for this failure. In regard to motivation to engage, a successful PD program is one where teachers believe that they will gain knowledge and skills that will help their students as well as give them "specific, concrete, and practical ideas that relate to the day-to-day operation of their classrooms" (Guskey, 2002, p. 382).

In regard to the second factor, Guskey proposed in his model of teacher change, that "significant change in teachers' attitudes and beliefs occurs primarily after they gain evidence of improvements in student learning" (Guskey, 2002, p. 383), which is brought about by a new instructional approach, materials, curricula, etcetera. In other words, teachers must make a change and see its benefits before their attitudes and beliefs will change, an "experientially based learning process" (Guskey, 2002, p. 384). He presented three implications for PD based on this model: recognize that change is a gradual and difficult process for teachers; ensure that teachers receive regular feedback on student learning progress; and provide continued follow-up, support, and pressure. The implications of this model suggest research that examines a PD program that is ongoing, engages teachers' students, and provides a consistent learning facilitator.

TPD can take many forms: courses, workshops, writing curricula, discussions with colleagues, professional literature, reading books, study groups, personal learning networks, group problem solving, advanced degree programs, teacher self-assessment,

mentoring, etcetera (Lai, 2010; O'Connor & Ertmer, 2006; Richter, Kunter, Klusmann, Lüdtke, & Baumert, 2011). A coach, unlike a mentor, provides support as an "inherent part of their role" and is "someone to learn with" (O'Connor & Ertmer, 2006, p. 98). A coach is someone who provides support in skill and strategy development in the teacher's classroom (O'Connor & Ertmer). In their study on media literacy coaches, O'Connor and Ertmer found that successful coaches needed an understanding of group dynamics, strong interpersonal communication skills, and effective leadership skills. Coaching and peer observation or modeling can be crucial pieces of the TPD puzzle (Kretlow & Bartholomew, 2010; Kretlow, Cooke, & Wood, 2012; Lai, 2010; O'Connor & Ertmer). In spite of this, research shows that this type of learning is mostly utilized by new and beginning teachers (Richter et al., 2011). Richter et al. (2011), however, posited that these "learning opportunities are often embedded in the classroom or school context, which allows teachers to reflect on their practice and to learn from their colleagues" (p. 117), which is a key factor of effective technology integration development programs discussed in the next section.

Educational technologists are often the ones tasked with the challenge of "designing effective formal and informal learning" to "ensure effective use of new technologies" in today's schools (Mayes, Natividad, & Spector, 2015, p. 222). They act as technology integration coaches to "support their organization's educational goals" (Mayes et al., 2015, p. 223). With all the technology devices and tools now available in classrooms, teaching pedagogies are becoming more student-centered with a focus on problem-based learning. This paradigm shift requires "time and training" (Mayes et al.,

2015, p. 229). It also requires "addressing teachers' beliefs and experiences" by educational technologists (Mayes et al., 2015, p. 233).

Stanhope and Corn (2014) referred to educational technologists as technology facilitators (TF). They found that their presence developed teachers who had more positive attitudes towards teaching, learning, and planning for and with technology in a 1:1 device environment (Stanhope & Corn). This was because TFs were able to provide "continuous support and guidance for teachers" (Stanhope & Corn, 2014, p. 268). They describe TFs as "change agents" who assist teachers in 1:1 device initiatives by modifying both their attitudes and behaviors. Role responsibilities include, "collaborate with teachers to develop curricula and lesson plans, modeling technology use and integration, providing access to technology resources, and planning and designing the technology infrastructure" (Stanhope & Corn, 2014, p. 255). TFs can influence teacher attitudes, beliefs, self-efficacy, knowledge, and skills (Stanhope & Corn).

Technology integration professional development (TIPD). The methods of PD for technology integration have often been ineffectual (Mouza, 2003; Potter & Rockson-Szapkiw, 2012). This is a critical issue considering in-service PD is essential for effective technology integration (Chen & Chang, 2006; Schnellert & Keengwe, 2012; Smolin & Lawless, 2011). The goal of TPD is to "change teachers' knowledge, beliefs, attitudes, and behaviors because these correlate with classroom practice, thereby influencing student learning" (Walker et al., 2012, p. 423).

Lawless and Pellegrino (2007) dubbed TPD for effective technology integration as TIPD. This is different from teacher training which just focuses on teaching knowledge and skills in isolation and the term will be used from this point on.

Traditional PD is often off site, uses transmission model instruction, is not directly or immediately relevant to the teachers' context, and provides no in-classroom support after instruction (Chen & Chang, 2006; Mouza, 2003). As such, it fails in affecting change in teacher behavior in the classroom. According to the literature, TIPD programs require further study (Lawless & Pellegrino, 2007; Smolin & Lawless, 2011).

First, the design of the PD experiences should include consideration for contextual factors or barriers (Mouza, 2003; Groff & Mouza, 2008). In addition, a variety of K-12 case studies of in-service teachers, both qualitative and quantitative, have isolated similar elements of successful TIPD. TIPD should be developed through a constructivist framework; as such, it should be collaborative and hands-on (Mouza, 2003; Potter & Rockinson-Szapkiw, 2012; Unger & Tracey, 2013). Following this, it should be ongoing/long-term, provide in-classroom support, provide a mentor or instructional guide, be embedded in the workday/classroom, and align with subject area content/curriculum (Chen & Chang, 2006; Ertmer, 2005; Hosman & Cvetanoska, 2013; Mouza, 2003; Potter & Rockson-Szapkiw, 2012; Schnellert & Keengwe, 2012).

While the framework for designing TIPD has changed from traditional to constructivist instructional practices, the format has changed little. National and international studies found on technology PD for teachers generally involved the use of workshops that were held after school, during summer months, or on weekends (Blocher et al., 2011; Chen & Chang, 2006; Chikasanda, Otrel-Cass, Williams, & Jones, 2013; Hosman & Cvetanoska, 2013; Mouza, 2003; Walker et al., 2012). The only two alternatives to the workshop model were lesson studies (Ndongfack, 2015) and web-based instruction (Unger & Tracey, 2013). Still, these also took place outside the

workday and outside of the teacher's direct context, the classroom and the student. Even though all the studies included or recommended an in-classroom component, the actual TIPD always treated the location of instruction (physical or online) and the location of practice (classroom) as two separate environments. Doherty (2011), in his study on using the workshop model as TPD for the adoption of Web 2.0 tools, found that "workshops do not result in high numbers of participants putting learning into practice" (p. 394). Instead, Doherty (2011) recommended future research on alternative forms of TPD such as embedded PD because it "can be effective in changing teaching beliefs and behaviours" (p. 394).

In summary, TIPD is critical to effective technology integration. It addresses the main influencer on student achievement, the teacher. It should be based on constructivist instructional principles, as well as be long-term, provide in-classroom support, provide a mentor or instructional guide, align with subject area content/curriculum, and be embedded in the teacher's context.

Project-based Learning

As noted previously, it was proposed that effective technology integration involves applying constructivist practices. Additionally, constructivism was a theme in the literature on the design of TPD. PBL is one way to move constructivism from theory to pedagogy (Wang et al., 2012). PBL is a model where learning is centered on the interests and actions of the learner. The teacher acts as a guide or facilitator in engaging the learner in an essential question, usually of their choosing. The learner then uses the resources available, often technology tools, to answer their question (Wang et al., 2012).

The learning is then shared with an audience by developing a "personally-meaningful" product (Wang et al., 2012, p. 125).

There are a plethora of recent national and international studies examining PBL and its positive influence on student learning, achievement, motivation, and more, with almost all of the studies featuring technology as an integral component (ChanLin, 2008; Hernandez-Ramos & De La Paz, 2009; Hung, Hwang, & Huang, 2012; Karaçalli & Korur, 2014; Lattimer & Riordan, 2011; Wang et al., 2012). With the rapid technological growth seen in the last decade, learners are no longer limited to the confines of their classrooms, but have access to technology tools that enable them to not only gather larger amounts of information, but also enable them to better collaborate with their peers in a PBL environment (Hernandez-Ramos & De La Paz, 2009; Thomas & MacGregor, 2005). Teacher perceptions of PBL have also been positive (Tamim & Grant, 2013; Wurdinger, Haar, Hugg, & Bezon, 2007). The research reviewed proposes that technology assisted PBL is a viable way of enabling learners to construct knowledge in the 21st century. It is challenging however, to find relevant literature on how in-service teachers are being engaged in technology assisted PBL in regard to their own PD.

In summary, technology assisted PBL is a constructivist approach to instruction that has been found successful in improving student engagement, motivation, and learning and is perceived positively by teachers. The possibility of combining student learning and teacher TIPD in a technology-assisted PBL environment requires exploration.

1:1 Device Programs

The technology-assisted environment in question is one in which each student has a mobile device at their disposal throughout the entire school day and year. These programs are an attempt to deal with "access, mobility, and student engagement issues" and to provide "choice, support life-long learning, offer flexible learning opportunities, and support digital and global learning opportunities" (Schnellert & Keengwe, 2012, p. 36-37). Schools, as well as entire districts and states, have moved to 1:1 device initiatives. Maine was the first to begin a 1:1 statewide initiative in 2002 with multiple states following in its wake and tens of millions of devices purchased since ("1-to-1 Laptop Initiatives," 2016).

Laptops. Laptop initiatives have been launched in school districts around the country in states like Louisiana Texas, Maine, Virginia, Florida, New Hampshire, and California (Grimes & Warschauer, 2008; Schnellert & Keengwe, 2012). Studies have found that laptop use in the classroom has had a positive effect on student participation, interest, and motivation (Trimmel & Bachmann, 2004). Large scale, mixed-methods studies have shown that 1:1 laptop programs can improve writing and literacy as well as support differentiation at the elementary level (Rosen & Beck-Hill, 2012; Zheng, Warschauer, & Farkas, 2013). Zheng, Warschauer, Lin, & Chang (2016) found that:

> Laptop environments are reshaping many aspects of education in K–12 schools. The most common changes noted in the reviewed studies include significantly increased academic achievement in science, writing, math, and English; increased technology use for varied learning purposes; more student-centered, individualized, and project-based instruction; enhanced engagement and

enthusiasm among students; and improved teacher–student and home–school relationships. (p. 1075)

In 2012, Schnellert and Keengwe reviewed the literature on 1:1 laptop programs in the U.S. and found that these programs can improve student achievement and engagement as well as support student-centered instruction. They also identified several barriers standing in the way: "poor administrative support; negative staff attitudes and lack of knowledge towards computers; problems with time, access, space, supervision, and operation; poor software; curriculum integration difficulties; and lack of technical support" (Schnellert & Keengwe, 2012, p. 39). One suggestion to overcome these barriers was to embed time into teachers' daily schedules to work with students, collaborate, and engage in PD (Schnellert & Keengwe, 2012). Other studies have shown that certain subjects, like mathematics, are less supported by 1:1 programs possibly because of teacher attitude, knowledge, and skills (Blackley & Walker, 2015; Zuber & Anderson, 2013). These mixed results suggest that further research is necessary and that TIPD in 1:1 programs should take subject matter into consideration.

iPads. There are fewer results for tablet use, namely iPads, in the 1:1 mobile device classroom as they only came on the market in mid-2010. Milman, Carlson-Bancroft, & Vanden Boogart (2014) call it a "paucity of research on iPads in P-12 classroom settings" (p. 120). However, studies have already examined how the iPad (and iPad apps) can support early-childhood learning, literacy, collaboration, and students with disabilities (Desai, Chow, Mumford, Hotze, & Chau, 2014; Falloon, 2015; Hutchison & Beschorner, 2015; Kucirkova, Messer, Sheehy, & Panadero, 2013). Hutchison and Beschorner (2015) explained the benefit of the iPad over other devices:

(1) students were able to apply prior knowledge of other digital resources to the iPad without requiring a lot of instruction from the teacher; (2) the abundant selection of apps made it simple to differentiate assignments for students; (3) iPads power on and off more quickly than computers and thus were not disruptive to the learning experience; and (4) iPads can be easily stored in desks and thus more spontaneously integrated into instruction than digital devices that are stored elsewhere.

Studies on 1:1 iPad programs in the elementary classroom are only emerging (Milman et al., 2014) while the presence of the devices in the classroom is increasing. According to Beauchamp, Burden, and Abbinett (2015), "research into the professional development needs of teachers when iPads are introduced into teaching is still at an emergent stage" (p. 164). Indeed, their study on PD and iPad integration was the only of its kind found. Beauchamp et al. (2015) suggested that alternative forms of PD for iPad integration were necessary such as "classroom-based training and opportunities to observe context-specific pedagogical applications" (p. 168) and learning that was "co-constructed with their pupils" (p. 170). Their mixed-method study of eleven schools in two different countries found that, "the intuitive and easy to use nature of the iPad acts as a critical factor in enabling teachers and pupils to co-construct their skills in a fashion which is non-linear, playful and experiential" (Beauchamp et al., 2015, p. 177).

Chromebooks. Chromebooks and education have been called a "perfect match" as they are "less expensive, easier to deploy, and more effective for learning in many classrooms" (Schoenbart, 2015, para. 1). An IESD survey showed Chromebook adoption in K-12 schools surged from 14% in 2012 to 47% in 2014 ("Chromebook Adoption

Surges," 2014). By 2015, Chromebook sales accounted for over half the devices sold to U.S. classrooms (Taylor, 2015). This may be in part because in 2014, Dell came out with a Chromebook for education, which enabled "centralized configuration and tracking. The management console allows IT administrators and teachers to quickly push or remove applications and enforce safe browsing practices" ("Chromebook," 2014, para. 1) in other words, it enabled ease of management.

Schoenbart (2015) argued that Chromebooks could be used to support, enhance, and transform learning. Because of the Google login feature, which gives access to both the device and the Google suite of applications, it is "quick and easy boot-up and log-in, teachers can maximize instructional time without worrying about the device" (Schoenbart, 2015, para. 3). In addition, the ability to bookmark sites, apps, and extensions in the Chrome browser and then access them on other devices is a valuable productivity tool. Finally, because students can create their own profile image and customize their own background, while still being able to share devices, they have a more authentic involvement in their education. However, some recommendations exist to optimize use: have a home for online learning so that students always know where to go for resources, assignments, extension activities, etcetera; create clear procedures, routines, and expectations for device use; and consider storage and charging issues (Schoenbart, 2015). Sahin et al. (2016) investigated the use of Chromebooks in relation to teacher attitudes and experiences in grades 6-12 as they reiterate that "teachers' attitudes towards technology use affect the quality of instruction" and as such teachers must be scaffolded in their attempts at technology integration (Sahin et al., 2016, p. 362). Since a Chromebook, in effect, acts as a laptop computer, its possible benefits in the

classroom have been well documented in regard to student motivation, active learning, availability of resources, productivity, etcetera (Sahin et al.). However, unlike most tablets, it is designed to be shared amongst users, which creates an ease of management for teachers and students. A Chromebook is an extremely affordable device, which can combine the mobility and touch features of a tablet as well and the productivity of a laptop. In addition, it is a cloud-based device. This means it requires an Internet connection for full functionality. Programs are run and files are accessed via the Internet. Sahin et al. (2016) argued that this is a benefit as it makes "users meet online, share files and communicate mutually with its unique features. Because students are very familiar with web-based environments, Chromebook use may provide students numerous inline opportunities for information access" (p. 366). However, their study found that restricting websites and applications, difficulty with connecting to printers, fragility of the device, and slow wireless connection could be barriers to successful integration. Teachers also felt that the devices were at times a distraction to the students, as they wanted to play games on them and use them socially. However, teachers were hopeful regarding Chromebook use and suggested careful monitoring, proper training, and not blocking and filtering content as ways to overcome these barriers.

In their study on designing digital science curriculum, Leary et al. (2016) found that students preferred Chromebooks to other mobile devices because they had keyboards, were compatible with Google Classroom, and the teachers wished for 1:1 Chromebooks in their classrooms. However, they also found that PD was critical for using this new technology as well as the ability to co-design instruction and curricula (with the researchers) and ongoing support.

Varier et al. (2017) conducted a qualitative study to examine the implementation of six different devices in K-12 classrooms in a 1:1 device environment. Results from students showed that the Chromebook benefits included easy access to Google docs and drive, short boot time, long battery life, keyboard, small size and weight, easy of learning, and access to textbooks. The limiting factors were storage space on the device, lack of traditional laptop features, inability to work and save offline, unhandy touchpad, and issues with camera feature. The teachers felt that the device was perfect for middle school students, provided easy access to Google docs, provided for security for young students, cost-effective, enjoyable to students, limited compared to a laptop, bound to internet, and that the cord and charger were easily breakable. Of the devices examined, only a Dell laptop and the Chromebook were recommended by teachers for 1:1 district adoption. In addition, the Chromebook was able to meet the needs for all academic activities as they related to 21st century skills.

In summary, 1:1 device programs have developed around the country to provide the resources and instruction deemed essential in schools today. There is a plethora of studies on 1:1 laptop programs that suggest their benefit to student achievement. Recent studies on iPad implementation appear positive and the device may be a tool to effectively integrate technology into the classroom. However, a Chromebook seems to combine the productivity of a laptop and the usability of an iPad in one cost effective bundle, with the perk of its cloud-based functionality. Studies on 1:1 Chromebook programs have only begun to emerge as the devices are rapidly acquired by schools. Research on Chromebook integration and TIPD is even more limited.

Theoretical Framework

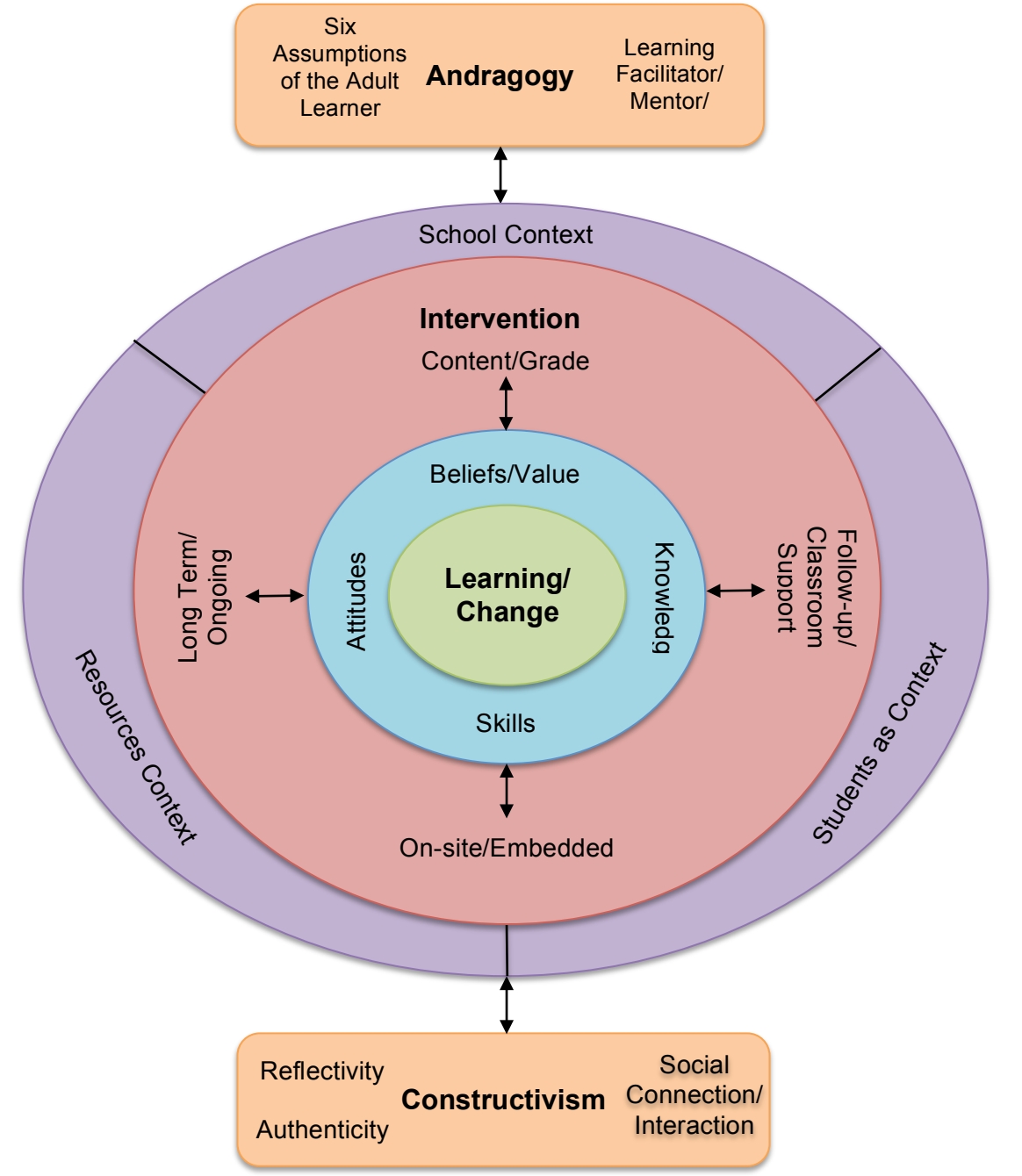
This section describes the critical components of the above literature that informed this study. At the heart of Figure 2 is learning and change. For any sort of improvement to be made in the classroom, "*change* is introduced, and *learning* makes it possible to make the change" (Hall & Hord, 2015, p. 9). In other words, before the technology tool can support, enhance, or transform student learning, teachers must change their teaching; and before they can change their teaching, they must learn the best way to do so.

Surrounding the proverbial heart is everything that may stand in the teacher's way, or conversely, lead to a willingness and/or ability to change. The teal ring is the teacher herself, or her beliefs, values, attitudes, knowledge, and skills in regard to technology integration. Research abounds on this concept, the conclusion being that these barriers, internal to the teacher, are the critical factor in achieving change and must be considered in developing TPD (Blocher et al., 2011; Ertmer et al., 2012; Ertmer & Ottenbreit-Leftwich, 2013; Groff & Mouza, 2008; Inan & Lowther, 2010; Liu, 2011; Mishra & Koehler, 2006; Taralynn et al., 2010; Wadmany, 2008).

The thickest ring, shown in pink, represents four necessary components of a successful intervention (referred to in this study as TIPD). The intervention must be long-term and ongoing (preferably three to seven years), be specific to the teacher's subject area and grade level, be on-site and embedded in the school day, and provide for consistent classroom support (Chai et al., 2013; Hall & Hord, 2015; Groff & Mouza, 2008). Also significant, but recently considered less so in regard to acting as a barrier, is the purple ring, or the external barriers. Organizational/contextual factors such as

administrative support, technology resources (physical and human), and the knowledge and skills of the students must be taken into consideration.

Finally, the rings are supported by both andragogy as a theory and constructivism as method (and theory) of education. The six assumptions of the adult learner (learner's need to know, self-concept of the learner, prior experiences of the learner, readiness to learn, orientation to learn, and motivation to learn) present not only that which must be considered when developing an intervention for teachers, but the nature of the learning facilitator working with the teacher to bring about the change (Knowles et al., 2015; Merriam & Bierema, 2014). These assumptions necessitate the use of a constructivist-based intervention, one that promotes reflectivity/reflexivity, authenticity, and social connection/interaction (the last amongst teachers, student, and learning facilitator).



Orange: Hall & Hord, 2015; Knowles et al., 2015; Levin & Wadmany, 2008, Merriam & Bierema, 2014
Purple: Chai et al., 2013; Hall & Hord, 2015; Groff & Mouza, 2008
Pink: Chang & Chen, 2006; Ertmer, 2005; Hall & Hord, 2015; Hosman & Cvetanoska, 2013; Mouza, 2003; Potter & Rockson-Szapkiw, 2012; Schnellert & Keengwe, 2012
Teal: Blocher et al., 2011; Ertmer et al., 2012; Ertmer & Ottenbreit-Leftwich, 2013; Groff & Mouza, 2008; Inan & Lowther, 2010; Liu, 2011; Mishra & Koehler, 2006; Taralynn et al., 2010; Wadmany, 2008
Green: Hall & Hord, 2015; Walker et al., 2012

Figure 2. Theoretical framework of this study.

Chapter Summary

Technology integration is a significant topic considering the millions of dollars spent on placing technology tools in schools. However, the literature demonstrates that a multitude of elements influence effective integration of technology into the classroom. Effective technology integration was defined in terms of both theory and the reality of the classroom. It should support or develop student-centered instruction, but also support, enhance, or transform the curriculum. A variety of barriers and contextual factors can prevent this type of integration. In this regard, understanding the role of the teacher, the project, and the technology were highlighted as linchpins to successful integration. A teacher's beliefs, attitudes, knowledge, and skills may be swayed by TIPD. Successful TIPD was defined as consisting of six factors, but the most recent data suggest a seventh, that it should situate the teacher as a co-learner. This study attempts to address the gap in the literature, that of studying alternative methods of TPD that are necessary and appropriate for the effective integration of technology into the classroom in a 1:1 Chromebook environment.

CHAPTER 3. METHODOLOGY

Depositing technology into the classroom and/or providing traditional forms of TPD (large group trainings/"one-shot" workshops) does not ensure effective technology integration in the classroom. The purpose of this qualitative case study was to describe and understand perceptions of a TIPD experience of elementary teachers at a suburban, independent school. The technology PD was an ongoing technology class led by an educational technologist, taking place in teachers' classrooms, engaging teachers and their students in a 1:1 Chromebook environment.

Restatement of the Research Questions

1. How do elementary teachers perceive effective technology integration in a 1:1 Chromebook environment?
2. How do elementary teachers perceive an ongoing technology class as a professional development experience in a 1:1 Chromebook environment?
3. How do teachers perceive an ongoing technology class as supporting "effective technology integration" in a 1:1 Chromebook environment?

Study Design

A qualitative research approach was selected because it allows one to understand "...how people interpret their experiences" (Merriam, 2009, p. 5). The questions sought to explore the thoughts and opinions of teachers in a way that necessitates qualitative methods of data collection: observations, teacher written reflections, and interviews.

The order of data collection was integral as the observations and written reflections would be coded and analyzed and assist in guiding the interviews. In addition, the interviews would not unduly influence teacher behavior in the observations were the interviews to occur first. Case study was chosen because it enables the understanding of lived experiences of one group of teachers at a specific school and grade (bounded system) in a "real-life" setting (Creswell, 2013, p. 97). A case study design supports exploring and then describing and analyzing these experiences (Merriam, 2009). This study was intrinsic because the focus was on the particular case itself, a group of teachers engaged in a technology class in the role of co-learner, with their students, as they tried to integrate technology in a 1:1 Chromebook environment (Creswell, 2013).

Role of the Researcher

The role of the researcher was to be the observer. The researcher was a member of the lower school educational design/technology department at Oakwood Prep (pseudonym) in grades pre-kindergarten 1. The process of data collection included document collection, classroom observations, collecting written reflections from teachers observed, and one-on-one interviews of teachers. The study was conducted to describe and analyze teacher perceptions of effective technology integration and a method of TIPD. Data were collected and analyzed, a report was written, and the report was shared with the study participants as well as the school's head of curriculum. The intent of the research was to see if/how the current literature on TDP and technology integration was visible/supportive of a unique form of TIPD program.

As a practitioner and a researcher, the researcher was aware of the most current literature on best practices for technology integration and how they can be achieved, but

had to maintain objectivity by following the interview protocols so as to not sway the perceptions of the participants. It was vital that interview and reflection questions could not lead the participants. This was achieved through committee and peer review of all questions. In addition, as a member of the faculty, the researcher had to hold all assumptions on the school's technology integration initiatives. All background information was strictly gathered from the documents provided by the school. In addition, when reviewing and coding the data, it was imperative that what the researcher knew about the purpose or intent of the technology class was not influencing the analysis. The use of a peer to review coding was crucial to this end.

Sampling Plan

Site. The site selection was criterion-based, as the technology class under exploration was unique to the school. The site selected for this study was Oakwood Preparatory School. It is a pre-kindergarten through grade eight independent school in an affluent, suburban community in Southeast Florida. It is accredited by the Southern Association of Colleges and Schools (SACS) and is a member of the National Association of Independent Schools (NAIS), as well as the Florida Council of Independent Schools (FCIS). The school's strategic plan shows a focus on preparing students for a "technology-driven world" and to do so "students and faculty will have access to innovative tools and resources that will maximize the use of technology to improve teaching and learning" (2014-2019 Oakwood Preparatory School, 2014, p. 9). In addition to access, they endeavor to "provide robust professional development opportunities for faculty" (2014-2019 Oakwood Preparatory School, 2014, p. 4).

In the 2011-2012 school year, traditional computer classes were removed from the curriculum. In place of teachers dropping their students off at a computer lab for instruction from a computer teacher, an educational technologist would support classroom teachers with integrating iPads into their instruction. In the 2012-2013 school year, computer classes were re-instated, but with classroom teachers remaining in the computer lab with the educational technologist during instruction for the first half of the school year. For the second half of the year, the teachers and educational technologist would work together to ingrate technology into the classroom.

This model was maintained through the 2015-2016 school year with one change; all instruction would take place in the teachers' classrooms using mobile devices. During the 2016-17 school year, the Computer Science Specialist and Educational Technologist positions were merged into one: Computer Science and Technology Specialist and grade bands were added for pre-kindergarten through grade one and grades two through five. The shared vision for the position included a 40-minute class once a week led by the Computer Science and Technology Specialist working with the classroom teacher to integrate learning with academics, computer science, and communication information technologies. The curriculum and format of instruction would be based on project- and problem-based learning. The classroom teacher would remain in the room and engage with the lesson and students when possible or when requested by the specialist.

Participants. The sample selected was "nonprobability" (Merriam, 2009, p. 82) criterion-based, or purposeful, as the case required teachers whose students both partook in the technology class and had a 1:1 Chromebook environment. In addition, the grade levels the participants were recruited from had previous experience with 1:1 iPads.

Recruitment began once the IRB exemption letter was received (see Appendix A). A brief recruitment script was used to verbally solicit participation from eight teachers during their bi-weekly team meetings (see Appendix C). The teachers chosen for this study were fourth and fifth grade elementary teachers with 1:1 Chromebooks. Teachers were Lead Teachers or Teacher IIs teaching science, math, or language arts. In addition to their specific subject area specialization, all teachers taught social studies to a homeroom class. A Teacher II was in a support role and was not responsible for the majority of planning or instruction. While all eight teachers signed consent forms, one lead teacher left the school after her observation (see Appendix B). As such, this participant's observation data was not analyzed for the study. All seven remaining teachers were full-time and held state teaching certificates. They had all taught at the school and engaged in the technology class for at least one year (see Table 2).

Table 2

Participant Data

Participant(s)	Grade	Position	Years Taught	Years Taught at Oakwood Prep	Level Technology User
Christy	4th for 10 yrs	Lead Language Arts; Social Studies	10	3	Intermediate to Proficient
Serena	4th for one yr	Teacher 2 Language Arts; Social Studies w/ Christy	11	9	
Carl	4th for 11 yrs	Lead Science; Social Studies	20	14	Beginner/Novice
Harlowe	4th for 10 years	Lead Mathematics; Social Studies	15	4	Proficient
Paula	4th for 1 year	Teacher 2 Language Arts; Social Studies; *Paula took over responsibilities as lead when the lead teacher left the school during the study	15	4	"Advanced" Proficient
Tiffany	5th for 27 years	Lead Language Arts; Social Studies	42	27	Intermediate
Rachel	5th for 13 years	Teacher 2 Language Arts; Social studies w/ Tiffany	15	10	Intermediate

Data Collection

Data were collected through observations, written reflections, documents, and interviews (see Figure 3). The purpose of these forms of data collection was to provide a platform for the voices of the teachers engaged in this unique form of TIPD. In their own words, they could express how they understood effective technology integration and how the PD experience influenced their own learning and technology integration practices.

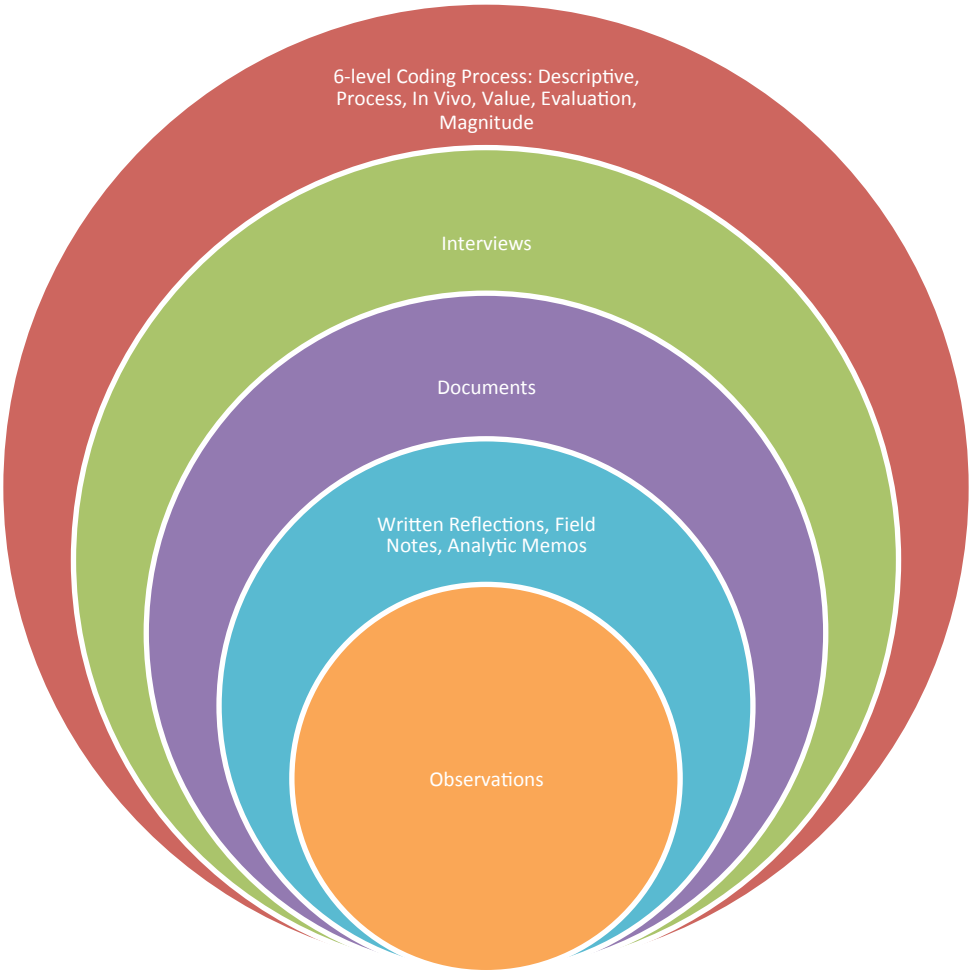


Figure 3. Data collection and analysis process of this study beginning in the center ring with observations and surrounded by continuous qualitative data analysis.

Observations. Classroom observations took place to describe teacher behavior, role, interactions, and engagement during a technology class. 40-minute observations (the duration of the class period) took place in the span of two weeks. The observations were scheduled by the 2-5th Grade Computer Science and Technology Specialist who leads the technology class and the classroom teachers. Five observations were conducted in all which included all seven teachers (see Table 3). Four fourth grade classroom observations took place on three consecutive days of the first week. Observations were made from the side of each classroom with a laptop during each observation. The first

observation was of a lead language arts teacher and the teacher II, the second was of the lead science teacher, and the third was of the teacher II in the second fourth grade language arts classroom. The fifth grade observation took place the following week and included a lead language arts teacher and the teacher II. An observation protocol was utilized (see Appendix D) and field notes and analytic memos were recorded via a laptop.

Table 3

Observation Data Collection

Participant(s)	Date	Time
Christy/Serena	5/10/2017	Start Time: 1:51 End Time: 2:30
Carl	5/10/2017	Start Time: 2:35 End Time: 3:10
Harlowe	5/11/2017	Start Time: 2:32 End Time: 3:10
Paula	5/12/2017	Start Time: 1:52 End Time: 2:30
Tiffany/Rachel	5/16/2017	Start Time: 1:50 End Time: 2:30

Reflections/Documents. Reflection forms were digitally collected following each observation, one from each of the teachers in the classroom. Directly following the classroom observation, the teachers were asked to complete a digital reflection form with three demographic questions and two open-ended guiding questions. The reflection form was a Google Form (see Appendix F) and accessible to teachers via a link sent to their email addresses directly after their observation. Responses were automatically collected in a Google Sheet and accessible in real time. This garnered explicit feedback on their experiences while they were fresh in their minds. In addition, the lesson plan designed by the Computer Science and Educational Technology Specialist leading the technology lesson was shared digitally. Finally, the director of the Educational Design Department

shared all relevant documents to the school's move from iPads to Chromebooks as the school's 1:1 device.

Interviews. In the three weeks following the observations and reflections, interviews with each of the seven teachers were scheduled at their convenience during various planning times. All interviews were confidential by use of pseudonyms. Interviews were face-to-face, taking place in a school boardroom or an unused administrative office space. One to two questions were based on observations and reflection sheets to support the interview protocol (see Appendix G). Each interview lasted approximately 35-45 minutes and was audio recorded with participant permission and transcribed at a later time by a third party. After transcription, they were reviewed and corrections were made. Following this, participants were asked to digitally review their transcripts to ensure they reflect the perceptions of their realities with the understanding that if they made no corrections in the span of week, then they wished none to be made. Two teachers responded with an "all good" and one responded with two minor corrections. Four teachers gave no response.

Limitations and Delimitations

With regard to delimitations, the PD experiences of the teachers were limited to the technology class. While teachers may have participated and even discussed other PD experiences at the school, they were not under observation or analysis. Only teachers at the school with 1:1 Chromebooks in their classrooms participated. Only documents collected, observation, interview, and written reflection data were used to understand and describe teacher perceptions.

The limitations of this study include that only one site was used with only seven teachers. Only teachers in grades four and five were included in the study. The frequency of observations (one) and duration of interviews (35-45 minutes in length) were limited by the time available from the teachers as well as the timeline of the study. In addition, the data gathered were based on human perceptions and as such were subject to interpretation by both the subject and researcher.

Data Analysis

Data analysis depended on finding meaning from field notes, analytic memos, teachers' written reflections, school documents, and interview transcripts using Atlas.ti software. The goal of coding was to "summarize, distill, or condense data" (Saldaña, 2013, p. 4) into categories and themes. Observation and reflection data were immediately reviewed to inform the interviews. The first cycle of coding began with the observation data. The field notes from each observation were input as separate text documents into a new Atlas.ti project. A first reading of each observation developed dozens of descriptive codes, as they were well suited for field notes and documents and allowed for the development of general topics (Saldaña, 2009). Process codes were also utilized for the "simple observable activity" that took place during the observations (Saldaña, 2009, p. 77). With a second reading, some of these codes were then merged. These codes were then grouped into code families or categories. Reflection data were then coded with the same process and categories were amended.

The interview transcriptions were then coded in accordance to the previous analysis where applicable, new codes were developed, and categories amended. Descriptive, in vivo codes, value coding, and/or evaluation coding were used because

they allowed for one to "attune" themselves to the "participants' language, perspectives, and worldviews" (Saldaña, 2009, p. 49). In vivo coding was especially crucial here since this study aimed to provide a voice for the participants. Value coding was critical as teacher beliefs, attitudes, and values were integral to the framework of the study (Saldaña, 2009). Evaluation coding was necessary as the participants were reflecting on an ongoing class or program that was intended to serve as PD.

Another cycle of coding included magnitude codes and subcodes to highlight the frequency or intensity of certain words, phrases, or emotions. This can be seen in reference to the times Carl shared a negative feeling or opinion towards technology integration, for example. This quantitative aspect served to strengthen the credibility of the themes or categories that emerged (Saldaña, 2013). Multiple coding cycles, member checking, and triangulating the data from the sample, as well as the observations, written reflections, and interviews led to themes or concepts that captured the essence of the data and led to major findings.

Credibility and Trustworthiness

Creswell and Miller (2000) stated that much like validating quantitative research, "qualitative researchers routinely employ member checking, triangulation, thick description, peer reviews…" (p. 124). First, member checking was used because as Creswell and Miller (2000) pointed out, "the qualitative paradigm assumes that reality is socially constructed and it is what participants perceive it to be" (p. 125). As such, it was important to allow the participants to review their interview transcriptions to ensure that they reflected their perceptions. Participants were asked to provide commentary on the transcriptions, but it was understood that if participants did not reply with feedback, no

changes would be necessary. Second, saturation and triangulation allowed for finding junctions between sources of information. In triangulating the methods of data collection (observations, written reflections, interviews, and documents), credible themes or categories were developed (Merriam, 2009). Third, it was crucial for the researcher to disclose "assumptions, beliefs, and biases" in the role of the researcher portion (Creswell & Miller, 2000, p. 127). This reflexivity provides a transparency of interpretation for the eventual reader (Merriam, 2009). Since the researcher has worked to develop a previous version of the technology class under investigation and had some knowledge of what the class could or should look like, biases were "bracketed" (Merriam, 2009, p. 26), or suspended, during data collection and analysis. This entailed strict adherence to protocols and avoiding a reliance on personal knowledge of the participants. The focus remained on the experiences and the interpretation of the participants' experiences and not the researcher's assumptions of them. Employing a researcher log and journal as an audit trail was useful to this end; tracking the process and the thinking behind it (Merriam, 2009).

Finally, the use of thick, rich description and peer review was paramount for demonstrating the credibility of the study. Vivid, detailed accounts of the observations coupled with the voices of the teachers, both written and oral, were included in the narrative. In vivo coding supported this endeavor by utilizing "words or short phrases from the participant's own language" as codes (Saldaña, 2013, p. 264). This type of description allows the readers to immerse themselves in the experiences and lives of the participants and the phenomenon under investigation. In addition, all codes, code families (categories), and quotes were exported from Atlas.ti and shared with a peer

reviewer. The peer reviewer provided feedback on which codes may not suite a specific quote and gave suggestions on alternative code options. The reviewer also gave suggestions on quotes that could be tagged with multiple codes. More informally, the aforementioned peer reviewer and another colleague reviewed a code and an associated quote on an as needed bases at the request of the researcher. The peer reviewer then reviewed the figures developed to represent the codes, categories, and findings.

Chapter Summary

This qualitative, intrinsic case study attempted to answer three research questions to investigate the perceptions of teachers engaged in a technology class as TPD to support effective technology integration. The participants were seven elementary teachers who partake in a technology class and have 1:1 Chromebooks in their classrooms at Oakwood Preparatory School, a pseudonym for an independent school in the Southeast of the United States. Data were collected using observations, written reflections, documents, and interviews. Data analysis included multiple coding cycles, member checking, and triangulation of data to develop a narrative with thick, rich description to evidence the major themes and categories that arose.

CHAPTER 4. FINDINGS

Data collected from multiple sources in this study underwent multiple cycles of coding and were organized into categories that help explain the "what" and the "why" behind teachers' perceptions of effective technology integration, the technology class as influencing effective integration, and the technology class as PD. From these categories, themes and findings relevant to the three research questions arose. First, an overview of the technology class under investigation is presented. Second, the transition to and management of 1:1 Chromebooks is explained. Third, participant profiles, or summaries, are presented to portray a holistic view of each participant. Fourth, going across cases (participants) themes are presented on teacher behavior and interactions during the technology classes. Finally, looking across all participants and sources of data, themes and findings emerged that address all three research questions.

1:1 Chromebooks

Transition. In 2015-2016, fourth and fifth grade classes had 1:1 iPads in the classroom. Oakwood Prep made the decision to transition to Chromebooks in the spring of 2016 and began using 1:1 Chromebooks in third through fifth grade in the fall of 2017. In February of 2016, faculty, technology specialists, and administration at the school met to evaluate iPad use and develop a "shared vision for technology integration." From this meeting, the document, "Follow Up to Future Planning for Student Device Usage," was created (see Appendix J). This documented reflected a decision to:

- Design a technology purchase plan to increase the number of student devices in the Lower School:
    - Extend 1:1 through second grade.
    - 1:2 in pre-primary (pre-kindergarten, kindergarten, and first grade).
- Explore more affordable alternatives for 1:1 devices in upper elementary grades and write a comparative analysis for review in budget decisions.

This comparative analysis revealed that that cost per device for an iPad was about $700 while a touchscreen Chromebook would be about $300. In March, technology specialists purchased and explored a variety of Chromebook models and made recommendations for purchasing. Also that month, faculty and administration made a school visit to a 1:1 Chromebook-using school. The following month, 1:1 Chromebook pilots were begun in a third and fourth grade classroom with two different Chromebook models, one that converted to a tablet and one that did not. At this point the decision to move away from 1:1 iPads and transition to 1:1 Chromebooks had been made because:

- Teachers resoundingly requested we put more devices in the hands of students.
- Teachers identified and prioritized how they currently use devices for learning, as well as how they would like to use them moving forward (Chromebooks facilitate this learning).
- Chromebooks answer the learning needs for the majority of students' day-to-day activities in grades three through five.
- A class set of iPads would remain in each grade level to support the specialized iPad functionalities, such as video recordings.

In addition to the significantly lower costs and perceived usefulness, the technical benefits of the Chromebook were the integration of the Google Apps for Education, built-in keyboard, integrated security, and simple deployment and management.

A few teachers expressed some concern over the transition, but came to like or even prefer the Chromebooks. Christy said, "We were hesitant to the Chromebooks, because we thought it would be very limiting compared to the iPads that we really loved having the year before," but now "we love them both." Serena, who was the only teacher who did not have 1:1 devices the year before said:

> Teachers were afraid about switching from iPads to Chromebooks, because any change is always a little bit difficult. If you're used to using one device, and then you are switched to another one, it takes time to find the beauty in that other device, or to see how it can be used. I feel that I enjoyed having Chromebooks.

Harlowe who used the 1:1 iPads daily in her classroom the year before shared her disappointment with the transition, "I was so sad last year when we found out" and explained:

> We have a set of 24 that we have to share with the grade, which is great, but I was used to always having iPads at my disposal. And so now, with having to share, you have to make sure no one else is using them and it's kind of a sign-out process. For me, it changed how I use technology in my classroom.

The other teachers however, did not seem concerned by the limiting of iPads, as Rachel said:

> We still have a set of 25 iPads in our neighborhood, out of the approximately 100 kids. So the good thing is we still have that, because we were concerned in the

beginning that because we have the Chromebooks, how are we still gonna be able to record and make these types of presentations. So we do have that, and we share as our four classes to make sure everybody can access them whenever they need them.

The Tiffany echoed the sentiments of four of the other teachers when she said now that "every child has a Chrome Book, we use it for just about everything."

Deployment and management. Teachers were notified of the transition to 1:1 Chromebooks before the end of the school year. An initial PD workshop entitled Chromebooks 101 and Google Apps for Education (GAFE) was held in early June for all third through fifth grade teachers. "Chromebook Rollout 2016-2017" (see Appendix H) shows the stages of the implementation in the fall of 2016:

- Friday, August 19: Email to all faculty in grades three through five explaining the thoughtful, comprehensive rollout.
- Week of August 22: Attend team meetings with Computer Science and Technology Specialists to address concerns and determine the organizational system (numbering).
- Week of August 29: Professional development on GoGuardian.
- Week of September 5: Professional development on digital citizenship.
- Week of September 12: Rollout Chromebooks in grades three through five with storage.

GoGuardian software is meant to lessen distractions and increase student focus when on the Chromebooks. It is designed to give teachers greater control over student devices and device use. In the GoGuardian PD program, teachers learned to:

- Set up their class(es) in GoGuardian.
- Send out a link to all of their students.
- Lock an individual student's Chromebook.
- Use GoGuardian to make an individual student's work visible to the class through the projector.
- Use the timeline data to review students' on-task time.

In addition to this software, the device management was carefully thought out. Paula and then Harlowe explained:

> Each child, obviously 1:1 means they would each have their own. Each Chromebook is assigned to that child for the year. They are numbered and labeled with their name and that Chromebook travels with them from class to class. In fourth grade, in their homeroom, they are located in a charging station that is a lockable container, compartment, and the children are responsible for storing that in there when they're not using it. (Paula)

> And we communicate with each other. We created some tags that we put on the boards outside each classroom from science, math, and reading and writing, letting the students know they [Chromebooks] are needed that day for science. So you will find the tag in front of the magnetic tag that attaches, so the students know. So we will use it in our classroom, and that's it, they know that science and math they are not required to take them, they will put them back and charge them again. If not, they just keep them on their desk and travel with them. (Harlowe)

Rachel explained the logistics in fifth grade:

> They take them out in the morning, and they keep them with them….We have six periods a day, so they take them with them to each class. They have to carry them in their hands. We don't let them put them in their backpacks from class to class. And then they go back to their homeroom class at the end of the day. They go back, and they are numbered very neatly and organized. They put them right back into their number, they charge it overnight, and then the come get it the next morning.

In regard to managing daily use, 1:1 Chromebook policies were developed by the specialists and shared with teachers and students after a couple months of use (see Appendix I). They addressed best practices for technology integration, student Chromebook care, general precautions, carrying the Chromebook, screen care, charging instructions, problem solving, frequently asked questions, and Chromebook apps and extensions. Teachers also managed appropriate device use with GoGuardian, by circulating the classroom, and my prompting students to stay on task.

Benefits of a Chromebook. One of the main benefits of the Chromebook, was its cost effectiveness. By moving to Chromebooks the school was able to add another grade level to its 1:1 device initiative (third grade) and create a 2:1 ratio of iPads without new purchases in pre-kindergarten through second grade. The school's internal review highlighted the desire for 1:1 devices by the specialists and teachers and five of the seven participants echoed this sentiment (see Table 4).

Table 4

Teacher Sentiments on 1:1 Devices

Teacher	Teacher Comments	Overall Feeling
Christy	I love it.	Positive
	There's no limit, because they all have a device.	
Serena	I love the power that it gives each child to have their own device.	Positive
	It provided a lot of flexibility and I knew I could bring anything to the table that required technology the next day, and the kids were ready. I had everything ready. I didn't have to worry about getting devices. That I really thought was very helpful.	
Harlowe	Well, [it's good because] they work on it independent or in partners. I find that when you have too big of a group it doesn't work as smoothly.	Negative w/Chromebooks
	Sometimes I think it's a little too much. Sometimes I feel like we have to go back to the basics.	More Positive w/iPads
	I don't feel like, because everything is one-to-one, that they collaborate as well.	
Carl	Sometimes I feel good that they have it because it does give them that tool that they can be using during class time....It's a feeling of security that there's something there. There's a certain entertainment value to it, so the kids do like using it. Again, sometimes that may take away from the effectiveness. I'm not sure.	Hesitant/Unsure
Paula	I love it. I think it's great. It's a wonderful resource to have.	Positive
Tiffany	I think it's been fantastic, I really do.	Positive
Rachel	I just feel like, it's part of who they are, and we have to trust them, and we have to go with it and be creative.	Positive

Logistically, the Chromebooks were easier to setup, provided a way to track student usage (with GoGuardian), allowed for printing, were durable, were a time-saver, and felt similar to a laptop. More than anything, the teachers felt the Chromebook was a good choice because it helped them overcome the greatest barrier to integration, time.

The teachers found that the Chromebooks were easy to turn on, start up, log into, and troubleshoot. They were "fast and easy" and had less "glitches." Christy explained: "The Chromebooks allow you to not have to wait for things to load, which I found really makes a big difference compared to last year when we used computers."

The second most frequent benefit cited was how closely the Chromebook resembled the productivity of laptop, but without the time and technical difficulties of one. It was efficient for word processing, web browsing, and researching. The two fifth grade teachers explained that it was important for their students to be able to smoothly transition to using 1:1 laptops in middle school and the Chromebook allowed for this more than an iPad. The major benefit to the Chromebook however was its integration with Google Credentials and the G Suite for Education Applications. Since the students all had Google accounts, once they logged into their device, they immediately had access to their individualized Chrome browser and Google Drive and applications like Google Docs, Forms, Slides, etcetera. The greatest benefit was the ability of the teachers to utilize the Chromebook to facilitate effective technology integration, described in a later section.

Limitations of a Chromebook. Two major limitations of the Chromebook were noted in the planning and transition stage; the front facing camera and the inability to record video. Christy, Harlowe, Serena, and Rachel indeed found these to be limitations to the device. Harlowe was very frustrated that the students could not easily scan QR codes that she had created for them to access content she had prepared the year before. For this reason, a class set of iPads was retained for each grade level that complemented 1:1 with the Chromebooks. The inability to use it as a handheld video recording device

led the teachers to use the classroom/shared set of iPads for recording and film editing in iMovie. Three of the teachers noted the inability to use the same applications they had used in iMovie, but one Harlowe felt like this was a significant limitation. Rachel shared that the specialist had helped them find Google applications to compensate, while Harlowe explained the same was promised to her, but had not happened.

The Technology Class

In fourth grade, the technology class took place on a weekly basis. Each of the four fourth grade classrooms had a pre-arranged time at one of the two final periods of the day. The class lasted about 40-45 minutes. It followed a typical structure, which Paula explained:

> It usually starts in a gathering type of mini lesson, and the instruction is delivered whole group. The goals are provided like, "Here's what objective is for the lesson. This is what you're going to be learning about, and here's how we're going to do it." Then there's a hands-on component where the children usually are able to either log in to something or put to use some sort of technology that was brought in….It's explained very clearly for them, and then they have some time to independently work or work in small groups together to do it.

In fifth grade, Tiffany and Rachel shared that the class was every other week due to scheduling difficulties. They both expressed a strong desire to have it weekly, "Last year, when we had it every week, it was infinitely more beneficial" shared Tiffany. The subject area content of the lesson and the technology resources presented were mostly based off of collaboration between the specialist and classroom teachers. For the class, the specialist developed objectives for both the students and the teachers (see Appendix

E). Each class could be a discreet lesson or it was part of an ongoing project either in the technology class or in the general classroom.

Teacher behavior and interactions in technology classes. Data collected from the observations, reflections, and interviews demonstrated teacher behavior and interactions during a typical technology class. Teacher behavior was subdivided into attention, classroom management, and movement. Teacher interactions were subdivided by interactions with specialist, interactions with students, and interactions with the content. This garnered how the class worked to influence technology integration and how it worked as a learning experience for the teachers.

Teacher behavior. Teacher behaviors were categorized into three subgroups: attention, classroom management, and movement. Their behavior showed a commitment to the technology class content, their students, and the specialist. Teacher attention, while there were distractions, was consistently on the specialist, the technology, or the students. The teachers, leaving the majority of direction and instruction of the class to the specialist, focused mainly on classroom management. Their physical location in the class showed consistent involvement.

Attention. The classroom teachers' attention for the duration of each observation was noted to be either on the specialist leading the class, the technology involved, the students, or a "distraction." Attention to the specialist included directing one's eyes to her, turning one's head to track her movement around the room, verbally interacting by asking her questions, or repeating her comments or instructions for the students. Attention was given to the technology for docking the specialist's laptop at the teacher's desk, when students needed to get, turn on/turn off their Chromebooks, providing

technical or procedural assistance to a student on their Chromebook, redirecting improper Chromebook use, or when a technical issue arose. Attention to students involved prompting for comments and answers, looking at students and nodding when they spoke, behavior redirection, and engaging with students during independent work time. However, the teachers, at times, gave their attention to something outside the scope of the technology class. Twenty-six of these distractions were noted from six of the seven teachers. These distractions looked like marking papers, picking up an item, answering a phone call, stepping out to speak to colleague, looking at a cell phone, looking at one's computer, using the restroom, or leaving the room to locate a student. However, these distractions lasted for not longer than 2-3 minutes, most only a few seconds, and did not seem to detract from the teacher's involvement in the class. This can be inferred from the number and type of interactions the teachers had with the students, specialists, and content, which is discussed below.

Classroom management. In each instance, the classroom teacher(s) either had the students already prepared for class with Chromebooks at their seats or were directing students to get their Chromebooks from the charging stations at the back of the room as the specialist entered the class. Students were directed by the specialist to keep their devices closed until told otherwise and the teachers repeated these instructions and enforced them. For instance, Christy gave out reward "tickets" for those who quickly got their devices and readied themselves for class. As a result, all students were ready to begin within three minutes. The speed in which students prepared or setup devices for class, through teacher encouragement, was consistent. Teachers also took the lead with student behavior management. They redirected off-task behavior and corrected

misbehaviors. For example, nonverbal behavior such as moving to stand near a student or pointing to the specialist were used to redirect student attention by three of the teachers; Paula took away play items from two students and reminded students they were not to be changing their desktop backgrounds during class.

Movement. The teachers were rarely stationary during the class. Only one teacher sat at her desk. The remaining teachers moved between sitting or standing at the back, front, or side of the room. Teachers observed the mini-lesson being given by the specialist either at the back or side of the room. Four of the teachers moved to the front of the room to write on the marker board or take a closer look at the resource being shared by the specialist on the SmartBoard. However, the majority of their time was spent circulating the room during student work time, leaning over students to look at their screens, or listening and/or talking with student groups. Only three instances of leaving the room were noted: to use the restroom, to speak to a colleague, and to locate a student.

Interactions. The interactions the teachers had with the specialist, students, and the content demonstrated the value they held for the class. Teachers engaged by asking questions of the students and the specialist, spoke appreciatively of and showed interested in the new technology resources shared with them, and related student learning in the class with their own content and instruction. With the specialist leading the instruction and content of the class, the majority of the time the classroom teacher(s) was(were) quiet. Their interactions with the specialist however included asking clarifying questions of the specialist for the student, offering support to the specialist, discussing the actual subject matter content, sharing or asking about a technical issue, or asking about the new technology resource/tool being shared, shown in Table 5 below. Overall, verbal

interactions with the specialist were quite minimal and "interactions" mostly consisted of nodding when the specialist made a seemingly interesting or relevant point. This gave the impression that the classroom teachers were used to taking a backseat during the class and only interacting when they felt the students or the specialist needed the support. It should be noted that the greatest frequency of verbal interaction with the specialist was for questions regarding the new technology resource the specialist was introducing, discussed in more detail below.

Table 5

Interactions Between Teacher and Specialist During Observations

Interaction	Example
Clarification for Students	During mini-lesson, Carl asks the specialist to rephrase the question on digital versus analog media.
Support Specialist	Tiffany shares that she has converted one of the documents the students need to a Google Doc so they can use it with the Read&Write software
Subject Matter	Paula shows the specialist and the class a student notebook, which shows notes on Media Literacy that the specialist has just asked a question about.
Technical Issue	Tiffany notes that she is not seeing the documents in Google Docs correctly.
The Technology/ Resource	Harlowe asks the specialist if the Padlet can be printed and then posted to the school's LMS (learning management system).
Off Topic	Tiffany asks when the last day for Chromebook use is before the end of the school year.

Many of the teachers' verbal and nonverbal interactions were with the students. Nonverbally, teachers kept their eyes on the students and nodded their heads as the students asked or answered questions. Six of the seven teachers also leaned over students' shoulders to look at Chromebook screens during instruction or independent work time. Verbally, teachers repeated the specialist's instructions for the students,

assisted students with following the specialist's instructions with the new technology resource on the Chromebooks, reminding students to stay on track, prompting students to think about and answer specialist's questions, engaged with students when the specialists asked them to discuss a question in small groups, and prompted students at setup and cleanup, as shown in Table 6. Only one teacher, Tiffany, had no student interactions, as she was located at her desk for the duration of the class period. However, it should be noted that Tiffany seemed to be actively working on a technical issue related to the digital format of the documents being used during the lesson. Even though Tiffany had no student interactions, she did interact with the specialist and the content.

Table 6

Teachers' Interactions With Students During Observations

Interaction	Example
Repeating Specialist	Carl reminds students to stop reading all the comments, but to do their comments first as the specialist instructed. Tells students to go to Epic, find a fact, post it with a page number, and think about the four categories and to make sure their fact really fits.
Assisting with following Specialist's instructions	Christy, Harlowe, Paula, and Carl help a student log into Epic by showing them they must scroll down to enter the class code.
Prompt students to think/answer questions	Specialist asks a question and receives no hands, Paula asks, "Think about when cameras were invented" as a prompt.
Prompt students to stay on task	Carl reminds students that they only have a few minutes left and that they can skim the content.
Engage during discussion sessions	Christy walks over to one table, leans in, looks at the image presented on the board and speaks with students at the table.
Prompt students to setup/cleanup	Harlowe tells students to please put their Chromebooks away, prompts with specific student names to put Chromebooks away at the end of the class.

The teachers' most frequent form of interaction was with the content of the specialist's lesson. The subject matter content of the fourth grade lesson related directly to the work the students were doing in the class, which was answering document-based questions on the Everglades. The new technology resources were a website for historical images (dp.la), an eBook site (Epic!), and a "digital corkboard" for posting findings (Padlet). The subject matter content in the fifth grade lesson was a "paying it forward" article and the new technology resource was Padlet. Teachers interacted with the content of the lesson by writing notes on the board, connecting how the content was related to their in class studies, and asking questions or making comments about the technology resources presented as shown in Table 7.

Table 7

Interactions With the Content of the Lesson

Interaction	Examples
Note Taking	Christy walks to front of room and begins to make a list on the whiteboard: Types of media: ads, books, images, books, websites, and articles as a flow chart.
Making Subject Matter Connections	Christy: "I am ok if we find something valuable today, we can cite this to support your thesis statement."
	Carl points out a graphic related to the content that is already on the marker board.
	Harlowe points out the example on the glass wall that parallels this in a non-digital format.
New Technology	Carl clarifies that these are everglades books, in Epic!, not DBQ books.
	Carl asks the specialist about the resource (Padlet) and how to use it. Listens while specialist explains how to use a Padlet on his own computer.
	Harlowe: "This is very cool, I must say. Does the teacher get her own account? Can I use my Google Account?" in regard to Padlet.
	Harlowe asks if students can use this resource (Epic!) on a Kindle and iPad because the school's digital library only allows one book per student.
	Rachel takes notes of resource names in notepad as specialists introduces them.
	Paula asks if each student can have their own Padlet.

Participant Profiles

Each participant's data set (observation, demographics, reflection, and interview) was reviewed and went through two cycles of coding to create a case-by-case analysis to address the three research questions. A participant profile, or summary, was then developed to depict the teacher in regard to teaching experience, level of technology proficiency, how they define effective technology integration, barriers they face to integrating technology effectively, how they overcome these barriers, what supports exist

in their attempts to integrate technology, how they engage with the technology class, how they perceive the technology class' influence on integration, and how they perceive the technology class as a learning experience for themselves.

Christy. Christy had taught Language Arts and Social Studies at Oakwood Prep for three years. She is the lead teacher and has a teacher II in the room with her each day. She rated herself between an intermediate and proficient technology user both personally and professionally and felt like she picked up technology skills easily. She defined effective technology integration as that which helped her enhance, support, or supplement her curriculum as well as enhance student learning in regard to both content and skills. She also noted that certain technology tools could transform assessment and instruction. She felt that time was the greatest barrier for her attempts to integrate technology into the curriculum. Fear and a lack of comfort with the technology could also act as barriers. However, Christy felt like she was able to overcome barriers as a result of her ability to adapt, her classroom management strategies, the availability of devices, and knowing that integration was worthwhile.

Christy demonstrated a commitment to being involved in the technology class. She consistently interacted with the students and the content of the lesson during the technology class. She directed students to get their Chromebooks ready for class, rewarded those who did so quickly, encouraged students to think about what the specialist was asking them, engaged with students during small group discussion. She also connected the content to what they were doing in class and encouraged students to take what they were learning during the technology class and apply it to the writing piece they were working on. Even though she faced distractions, internal and external,

throughout the class, Christy usually attended to the lesson and her students. She appreciated being able to collaborate with the specialist on subject matter content and necessary skills for this class.

Christy learned two of the three new technology resources presented during the observation lesson. She was able to explain their usefulness as it related to her curriculum and instruction. Even though she did not feel like she learned something pertinent in each class, she felt that the class was always beneficial to her students and she almost always came away from it learning something. She perceived the class to be useful because she was learning right along with the students and was able to take what she learned and integrate it into her teacher. However, she expressed that she would need more time to practice using these and other tools before she felt comfortable using them on her own without the specialist in the room. Christy liked having the specialist introduce the tools because she can, "see how they work and think about how I can continue to use them." Christy felt that the technology class was effective PD for her and supported her efforts to integrate technology into the classroom along with support from the IT department, the technology specialist, colleagues, and the availability of devices. She also expressed the usefulness of the Chromebooks and her preference of them over the iPad, citing start up time, not needing to load apps, the cloud-based operating system, and Google Apps integration.

Serena. Serena had taught at Oakwood Prep for nine years, but only one year as a fourth grade Language Arts and Social Studies teacher. Serena was a teacher II and worked with Christy in their classroom. She rated herself proficient in technology use both personally and professionally. She had embraced using technology in business

before entering into education, and as such she felt comfortable learning and applying new technology tools into her instruction. Serena defined effective technology integration as anything that enhanced the "current curriculum and current learning." It had to have a clear purpose understood by both the teacher and the students. It could enhance instruction by increasing productivity, enabling communication, promoting collaboration, and supporting student independence. Effective technology integration could enhance the curriculum by providing more, and better, materials and resources. She felt that barriers to integration included fear and certain negative mindsets. Fear that using the technology—for example, word processing instead of handwriting—was not the right thing for the students and a mindset from colleagues that did not embrace the value of technology in the classroom. She used academic research to inform herself and pilot new technologies as a method to surmount these barriers.

Serena was observed to quietly move amongst students or sit with a student during the technology class. She walked around and looked at Chromebook screens or engaged students in discussion when appropriate or when they initiated. She felt like her role during the class was that of classroom manager, but also that of an observer and learner. She was learning about her students as technology users as well as the technology resources themselves. While Serena did not name the specific tools she had learned about during the technology class observation, she wrote she learned "how to use 1:1 devices and applications to engage students and enrich my curriculum" and make "student feedback more effective." Collaboration between the classroom teachers and the specialist on the content of the technology class was vital to Serena. With this

collaboration she felt that the technology class could support technology integration into her classroom.

Serena believed that technology, especially the 1:1 Chromebooks, allowed a level of independence in students that enabled differentiated learning. She had a very positive view of incorporating technology into the classroom and wished other teachers embraced it more. Serena felt it engaged students "at their level" and allowed them to learn "beyond the classroom." Unlike Carl and Harlowe, she loved that students each had their own device and felt like it gave them a positive sense of ownership and responsibility. Serena had not used 1:1 iPads the year before and so did not feel the sense of loss that Harlowe did. She felt that 1:1 Chromebooks with a class set of iPads to supplement was ideal.

Carl. Carl taught fourth grade Science at Oakwood Prep for 11 years. He was the lead teacher and did not have a teacher II in the classroom with him. He rated himself as a beginner or novice for technology use who had to constantly ask for assistance. He did not use much technology in his personal life and had only very recently gotten a smart phone. He shared that he had a personal bias against technology because he had negative experiences with integrating it when computers first entered the classroom. He was not quite sure about its value and felt that low or no technology was better at times. He wondered if the advent of so much personal technology use was making his students more "feeble." Carl defined effective technology integration as anything that enhanced or supplemented his current curriculum. He found it effective when technology provided his students supplemental resources through online videos and readings and enabled him to transform learning through the flipped classroom model. He found the specialist to be

especially useful with providing him with the necessary knowledge and tools to do this. Carl faced many barriers in integrating technology into his classroom. He felt it often distracted his students, took too much time to implement and troubleshoot, and was possibly less effective for kinesthetic learning. He was quite open about why this was, "probably goes back to maybe my bias against so much technology, and my lack of confidence of using it, implementing it, and having it work for me. I'm kind of old fashioned, and I just go back to my old ways." However, he felt when he was exposed to the specialists at Oakwood Prep, integration had been "raised to a new level."

During the lesson observed, Carl was attentive to the specialist, the students, and the content of the lesson. He directed students to setup their Chromebooks and put them away at the end of class. He asked for clarification from the specialist on questions or instructions to students, engaged with students during small group discussion, attempted to help students with technical assistance or asked another student to help them, and expressed curiosity and interest in using one of the technology resources presented. However, his interactions were usually limited during the technology as he shared, "I let the technology teacher run the show and I'm just there. Make sure that they're following along with what the teacher is asking them to do." Upon reflection, Carl could remember the name of one of the resources, but not the name of the other. He felt that the class gave a good introduction to them, but that it perhaps "didn't go anywhere."

While Carl felt that the class was always a learning experience for himself, he spent a lot of time "putting out fires" instead of learning himself. He did feel that what he had learned in the class in the past was useful as long as he felt very confident in using and troubleshooting the tool or had help from the specialist. Although Carl did not feel

like the technology class was currently an effective method of PD, he made a suggestion on how it could be:

> I'd prefer if the instructor said, "This is for teachers too. You don't have to be walking around and monitoring the kids. Take the device and learn along. I don't expect you to know this, and maybe you'll get something out of it." That would kind of give me permission to be a student in the class rather than to be the teacher or the assistant teacher.

It should be noted that two other teachers did take this approach during the class. In addition, Carl shared that in regard to the technology class influencing his attempts at integrating technology into the classroom he was in a "unique position, this being the end of my teaching career here too. In that respect, I'm not even thinking about that."

Harlowe. Harlowe had taught fourth grade Mathematics and Social Studies at Oakwood Prep for three years. She is the lead teacher and has no teacher II in the room with her. She rated her personal technology use as expert on Apple products because she felt they were more user-friendly and she could troubleshoot more easily and more proficiently than with a PC. Professionally, regarding the use of a PC, Apple products, or Chromebooks, she rated herself (as well as her students) as proficient. She felt comfortable with the technologies although she did not use them with her students as much as she thought she should. She defined effective technology integration as anything that was a purposeful use. This looked like a technology tool or resource that could help her to differentiate student learning or make students more independent, allow her to supplement materials, be more productive, or transform assessments for students with special learning needs. Harlowe felt that as long as it was not "busy work" it could

be effective and felt that integrating technology into her classroom helped to engage her tech savvy students. Harlowe felt like time was the biggest barrier:

> I have four math classes at 40 minutes a pop and I have to provide direct instruction, practice time, and follow a curriculum using the Pearson series. So at the end, sometimes there's time for Chromebooks, but not a lot.

Students could also become easily distracted when using the Chromebooks. She felt like she overcame barriers through classroom management practices and because she was willing and capable of learning technology on her own through trial and error to use with her students. During the technology class observed Harlowe was very involved. She had the students get their Chromebook ready in advance of the specialist coming into the room, turned on the projector for the specialist, and helped dock her computer. She consistently interacted with the students, specialist, and the content. Even though she faced a few distractions, she appeared to be very interested in the lesson and expressed how excited she was with the new technology resources presented. Harlowe mostly sat on a countertop at the side of the room with her laptop and followed along with the lesson as a student. She switched to her role as a teacher throughout to address student questions or requests for technical assistance. A student even called out that their teacher had "learned something new today." She was looking forward to using two of the three new technology resources presented because they were "teacher friendly" and could assist her in social studies. Harlowe felt like the technology class was a learning experience for her where she learned right along with her students. However, this was only if the content of the lesson applied to her curriculum and instruction. For example, she did not feel particularly engaged during lessons on coding or programming, but felt

they were useful for the students. When the focus of the class was on curricular resources, websites, or applications she used the class to learn and integrate what she learned into her own teaching.

Harlowe had mixed feelings about having 1:1 Chromebooks. At times, she felt that technology and the Chromebook took away the collaborative aspect of learning. She also felt that it might be too soon for students, at this age, to be responsible for their own device. However, she also felt that students worked better individually or in pairs in her class and the devices were good for going to websites and word processing. Mostly, she felt like the Chromebooks themselves were a barrier to her attempts at integrating because they did not share the same features as the 1:1 iPads she had used the year prior. The Chromebooks did not have a camera that could scan QR codes easily or the whiteboard application she had begun to utilize the year before. She felt that the Chromebook was more useful for other subject areas, but noted that she had not received any support on how to transition to the Chromebooks for math.

Paula. Paula had worked at Oakwood Prep for four years, but only one year as a fourth Grade Language Arts and Social Studies teacher. Although Paula was a teacher II, she took over lead teacher responsibilities when the teacher in her room left the school midyear. Paula rated herself a proficient technology user, just short of expert in both her personal and professional life. She used her smart phone for a variety of reasons, including social media. She felt that using technology was absolutely necessary and natural in her personal life to do things like upload photographs or download music. Paula described herself as a digital native and explained her comfort level by saying, “It is at our fingertips at all times, and it’s just something that we’re immersed in in this

century." Her mindset was such that she always wanted to figure out a new technology on her own and did not require direct instruction. She felt it came easy to her because of her mindset and exposure to computers as a young child.

Professionally, technology was an integral part of her daily instruction. It was used to supplement materials, for productivity and collaborative work, to communicate with students and parents, deliver content, and enhance learning. Paula defined effective technology integration as when both students and teacher understand the technology itself and have a clear purpose for using it. For it to be purposeful, it must meet the objectives of the curriculum. The only barrier to integration could be students not using the technology resources wisely or being distracted by them. However, Paula felt that this was easily overcome by setting clear boundaries and discussing appropriate use with the students. Because of the abundance of devices available, including the 1:1 Chromebooks, Paula felt that, "I really feel as though I want to integrate technology, it's always available to do."

During the technology class observed, Paula spent the majority of the time sitting at a table with a group of students or getting up to redirect a student or correct a behavior. While she was very attentive to the specialist and the content of the lesson, she was also clearly in charge of classroom management. Paula interacted with the students at her table during discussion time and to provide technical assistance. Paula felt like it was her role in the class to support both the students and the specialist since 22 students on 22 devices was a lot to manage. Paula circulated the room at times, but was able to monitor student work from her own laptop using the GoGuardian software where she could see all the student screens in real time. From the class, Paula learned about two of the

technology resources, Padlet and Epic and how they could "supplement my instruction." She thought the tools could be used as a substitution for verbal discussion, for collaboration, or as supplemental reading material. By watching the specialist, she also gained an idea of how to integrate technology into direct instruction. Paula liked the resources presented because they were applicable to multiple subject areas, but especially to reading and writing, which she taught.

Even though Paula thought the technology class was beneficial to both herself and her students, she did not feel like it was an optimal form of PD for herself. Because she was a very advanced user, she wanted to see more of the "behind the scenes" action to the technology being introduced in the classes. However, Paula felt that because she was already there and with her students, she wanted it to be more beneficial to her. She suggested that the specialist could work with her, while the students did independent work, to explain the workings and the uses of the technology. She also suggested that the specialist could email the teachers with the objectives for teacher learning in advance, possibly focusing on them every other week. Overall, Paula was very confident with integrating technology into her classroom and excited about using the 1:1 Chromebooks. She felt like Chromebooks were an asset to her subject areas, language arts and social studies. Much of this was attributed to seeing herself and her students as digital natives.

Tiffany. Tiffany had taught fifth grade language arts at Oakwood Prep for 27 years. During the study, she was the lead teacher for language arts and social studies. Tiffany identified herself as an intermediate technology user in her personal life "because of all the access from school, from the specialists." Professionally, she rated herself between a beginner and an intermediate user because she did not use a large variety of

tools, but what she did use she felt she was proficient in and she sought the support of the specialist otherwise. Tiffany defined effective technology integration as anything that extends or enhances the learning experience. This included the ability to enhance the curriculum, transform instruction and assessment, provide for differentiation, increase productivity, substitute traditional methods, and provide supplemental learning materials. Tiffany felt that effectively integrating technology helped students learn better and reveal their knowledge better. Tiffany did not feel like she faced any barriers in her attempts to integrate technology into the classroom. She felt the curriculum provided enough flexibility for her to do so and she always had the specialist to support her efforts when she did not have enough technical knowledge. To this effect, Tiffany benefited from formal trainings on new technologies; having the specialist in the classroom weekly and as needed; and social media, such as YouTube.

During the technology class observed Tiffany remained seated at her desk. She explained that she is normally intently watching or circulating to make sure that the students were following. In the observation she was attentive to the specialist as she introduced the lesson and interacted with her throughout the class period regarding content and technical issues. As the specialist began the lesson Tiffany noticed that the document that the students would be reviewing was not in the format that she wanted (Google Doc). She pointed out that the students could not access it in Read&Write, a Chrome extension, as a result. She displayed some frustration and spent the instructional time changing over the format. As the students worked independently, Tiffany inquired about the new technology resource since she had been distracted by the technical issues. Even though she was distracted by the technical issues and did not interact with the

students or new technology, Tiffany still "learned how the new application could be used to enhance retrieving information and comparing research" and thought it could be "used for the students to answer questions for the teacher to make sure they understand the material."

Tiffany felt like she was asked to be in classroom during instruction so she could learn with the students. She wanted to know what the students were doing and learning so she could then use it with them herself. She felt like the resources and applications presented were always useful, but some more than others. Resources that were directly tied into her subject areas were the most beneficial. Tiffany felt that the collaboration on content for the class with the specialist was integral to supporting her integration efforts and that this just "makes more sense" for the students. Tiffany had a very positive attitude towards the 1:1 Chromebooks and their efficacy in the classroom. She attributed this to the way the transition was "rolled out and presented in the school. That it enables the teachers to feel like they want to embrace it, not run away from it." She thought that the Chromebooks were an essential part of the classroom and the students learning experience.

Rachel. Rachel had taught fifth grade at Oakwood Prep for 10 years. She was currently teaching Language Arts and Social Studies as a teacher II, sharing a classroom with Tiffany. She described herself as an intermediate, or average tech user both personally and professionally. She used her smart phone to text and for social media, but noted that she did not "go above and beyond" with it. Professionally, Rachel used technology in class every day, but felt like her students were the true experts since they were the digital natives. Rachel struggled to define effective technology integration; she

explained that the students need to understand "what their outcome is supposed to be." Effective integration was setting a goal for the students and them using technology to make it easier to reach that goal. Rachel described integration that involved supplementing materials and substituting instruction methods. Time and technical issues were the only possible barriers to integration for Rachel. She felt that things like testing or assemblies could be detractors, but not often. When using laptops, they had a lot of technical issues, but felt that things had been very smooth using the Chromebooks, especially with the availability of student and information technology experts in the classroom and at the school.

During technology classes, Rachel said she likes to "sit and watch" and assist students as necessary to support the specialist. During the observation Rachel mainly stood at the back of the room observing and taking notes on the names of the new technology resources presented. She faced a few distractions such as looking at her computer, phone, conversing with the lead teacher, or going to the door when a teacher entered, but otherwise she remained attentive. She explained that she followed along and listened because she, in her words, "wanted to learn too." From the class, she learned about one of the technology resources presented, Padlet and was very excited about its use. Rachel felt like the class was always a learning experience for her. At times this was challenging because she was trying to manage the behavior of the students or provide them with assistance. She attempted to balance this with learning the skills herself.

Rachel felt like the Chromebooks were an integral part of their day. Since the students were always reading or writing on them, she noted that "It's an aspect of every class situation." She explained that the transition from iPads to Chromebooks had been a

bit of a challenge since the Chromebooks did not have the same apps; however, she felt like they had found Google applications to substitute the loss. She also explained that Chromebooks had less "glitches" and were a better transition for students moving into middle school where they would need to use 1:1 laptops. Her highest point of praise was the seamless integration with the cloud-based Google Applications.

Effective Technology Integration

Research question one asked, "How do elementary teachers perceive effective technology integration in a 1:1 device environment?" Figure 4 shows how codes were distilled into four categories: engaging and developing the student, increasing productivity, purposefully meeting curricular objectives to enhance learning or transforming learning, and barriers and supports for integration. Three findings further emerged from these categories. Finding 1: Teachers perceive technology integration to be effective if it benefited the skills or productivity of themselves or their students. Finding 2: Teachers perceive technology integration to be effective if it directly relates to their curriculum. Finding 3: Teachers require the support of their colleagues, technology specialist, information technology department, as well as traditional and alternative forms of PD to overcome internal and external barriers to integration.

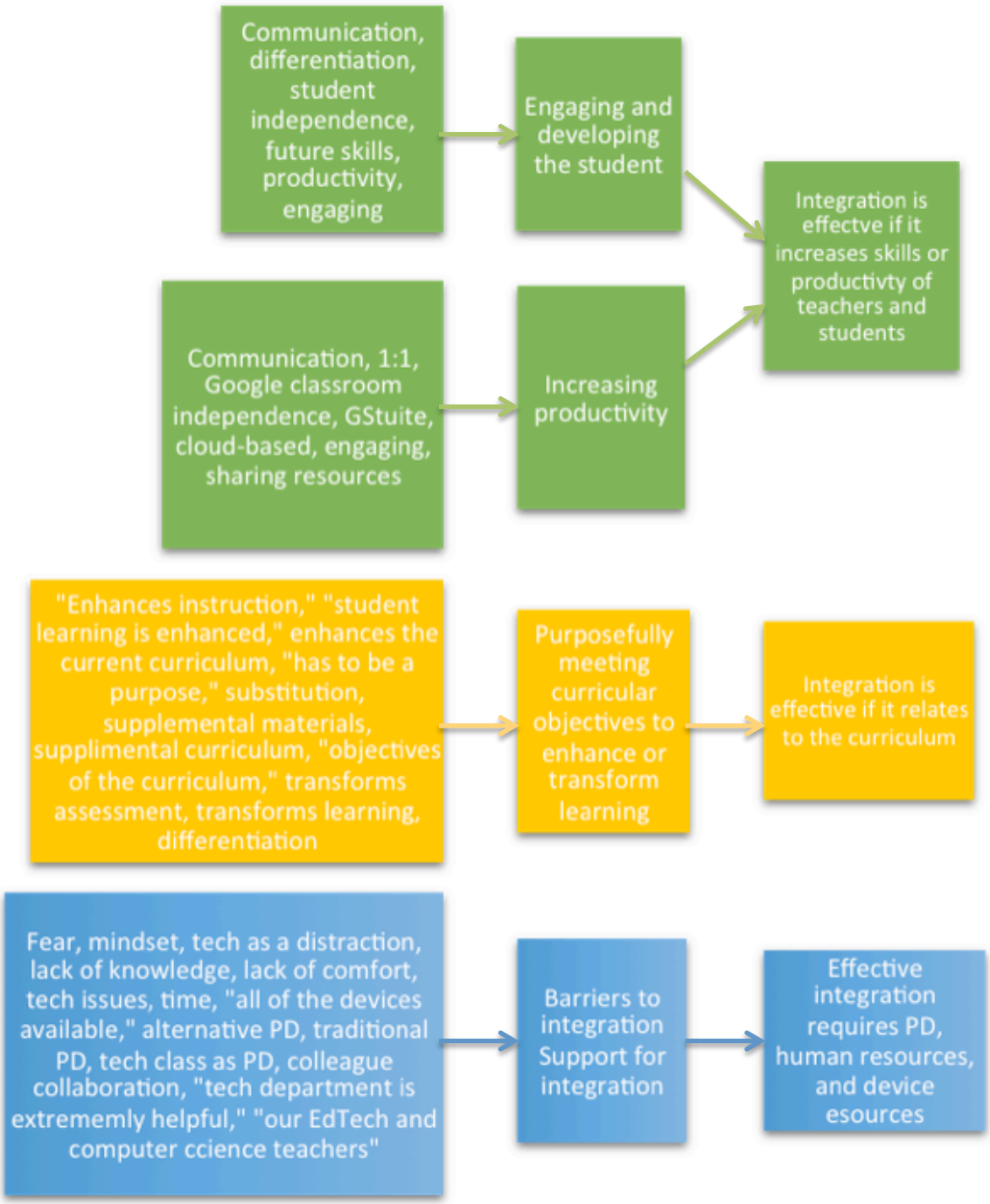


Figure 4. Codes, categories, and findings for effective technology integration.

Engaging and developing the student. Teachers perceived technology integration to be effective if it engaged the student, supported or developed student independence, and gave them strategies or skills for the future. All seven teachers felt

that effective technology integration was engaging to the students. It was both an aspect of integration and a reason for integration. Teachers felt that using the technology itself excited the students. Christy shared, "I think the kids are very, very excited to use it" and "The kids were like wow, this is so amazing" speaking of an online game (Kahoot) and a Chrome extension (Read&Write). Serena felt like she could use Google Classroom to excite the students about learning in general: "You can make announcements…and they get excited about what's coming the next day because they've already had a little preview." Paula felt like the supplemental materials, such as eBooks, exited students by engaging them. Although she was concerned that students reading online could damage their eyesight, she said:

> It is nice because it gets them excited about it. A lot of times, the vivid colorful images, at this age, you don't really get books that are full of colorful pictures any longer so I think it does lend itself to being intriguing to the children.

Effective technology integration engaged the students because it acknowledged that they were digital natives and expected to use it, but also because it was fun. Harlowe said, "It has to keep their minds engaged and so, technology, because they're so tech savvy, you have to try to incorporate some technology to keep them engaged, because, otherwise, they become bored." Serena summed it up by saying, "Technology allow us to engage students at their level. They are surrounded by technology. It makes it fun." Paula added, "They're very much in love with devices and technology. It's just something that comes natural to them and it excites them and it's intriguing."

The teachers pointed out how the "hands-on" aspect of using a device and having 1:1 devices engaged the students. Paula explained: "I think it changes the dynamic of the

classroom when you do introduce technology because immediately you have the attention of the students because they are so hands-on and they do want to be using the device." Tiffany highlighted the connection between engagement, fun, and learning when she said, "Because they're having a good time with what they're learning, and there's no other way for learning to happen."

Effective technology integration was also defined by its ability to enable or develop independence in students. Four of the seven teachers highlighted this as an important feature. Carl, who was the most reticent of using 1:1 devices and technology in general, felt that the Chromebooks enabled students to work independently. Because each student had a device to keep them engaged, he was then able to meet with students one-on-one. Harlowe felt like she could use technology to facilitate independent practice through skill reinforcement software like IXL and QR codes that allowed students to "self-check and self-monitor," again because each student had their own device. Serena felt that because each student had a Chromebook and could access Google Classroom from it, it could provide for and encourage independence. She was able to post assignments, resources, links, and so on in Google Classroom and students could access them without teacher prompting or support. She explained: "Students can go directly there and they can be more independent. So if I wanted independence, I wanted effectiveness, so I use Classroom." She also felt like having a Chromebooks gave students a resource to solve a problem and learn beyond the teacher:

> If they're writing a piece, and…they are giving me words that are not sophisticated enough for fourth graders…I don't have to be the one, "How 'bout this? How 'bout that?" I say, OK. Use the tool you have in front of you,"…."So

find synonyms. Challenge yourself to think." And so I think technology gives students a tool to become independent, to take their learning to their own level without waiting for a teacher to allow that to happen.

All of the teachers expressed effective technology integration as developing or supporting certain skills or strategies that would serve the students well in the future. As all the teachers expressed and Christy stated, "It's a part of our future, and they need to be exposed to all forms of technology and different programs." These future necessities were categorized into technology knowledge and skills, the ability to problem solve, and the ability to collaborate.

Six of the teachers perceived effective technology integration to develop technical skills or knowledge. Christy felt that it was important to meet with the technology specialist to make sure not only that her curricular objectives were covered, but that of the specialist's were covered as well. Although the teachers felt that the computer science and programming content was not beneficial to their own PD, they did feel like it was, as Paula stated, "cool for the kids and I think, certainly, they need to be exposed to that and understand that because that is going to be their future." Effective technology integration meant developing knowledge of digital literacy. It was the subject of a formal PD for the teachers and of both lessons observed. The teacher did a lot of web searches and content research with the students and they felt that it was important for the students' future to know how to do them well. Paula explained:

We've talked to the kids a lot of times about finding resources when they're online, that there are a lot of resources that are not reliable, and just talking to them about using appropriate sources when you're doing research, and you just

> can't believe everything you read, that you have to make sure it's a credible source.

The teachers also expressed the importance of being able to develop a digital multimedia presentation, whether it was through a slide show or a video. This was integral to being a "21st century learner."

Rachel, Christy, and Serena also perceived effective technology integration to develop students' problem solving skills. Rachel explained that technology helps the students not only problem solve, but learn to "problem solve together." Serena explained how effective technology integration encourages students:

> They are better problem solvers when they have technology in front of them. Sometimes they stand there with a pencil and a piece of paper, "Where do I write my name: to the left or to the right?" Whatever! But when they have technology they take risks.

Christy felt like dealing with technical issues made students better problems solvers:

> Oh, and I think that encountering problems is good for children to see. They're going to see that nothing is perfect and nothing always works the first time around or the second or maybe even the third...."Do I talk to someone who seems to be an expert? Do I use another tool that's been presented to me before?" I think being problem solvers can only help them in their lives.

Being a problem solver tied in closely with student independence as well as collaboration.

Effective technology integration means supporting or enabling collaboration. Harlowe, who preferred the 1:1 iPads from the year before, felt like the 1:1

Chromebooks, or 1:1 devices in general, did not support collaboration in her math class, saying:

> I wish there was more collaboration. I don't feel like, because everything is one-to-one, that they collaborate as well. And part of it's because they're 10 years old, so that's a developmental piece, but you really have to work hard on them communicating with each other. And we're all guilty of that. It's a lot easier to text than to pick up a phone and I feel like that's this generation coming up. And you want them to collaborate because that's part of....It's a double-edged sword. You want them to be tech savvy, but you also want them to collaborate with one another, and that one-to-one piece....I don't know.

However, she did provide examples where it enabled collaboration in her social studies class. She had struggled with using Google Docs for collaboration, but intended to use a tool that she had learned about in the technology class, Padlet, in its place. The five language arts teachers, however, repeatedly spoke of using the Chromebooks for teacher-to-students and student-to-student collaboration. Using Google Classroom, as well as Google Docs and Google Slides, teachers were able to provide students with feedback during class or on their own time on a variety of writing pieces. The teachers also had the students use the cloud-based technology to peer edit, as Christy explained:

> Today, we were editing and revising in partnerships. They have a checklist that they have to run through. Instead of just sitting in front of one device and reading each other's essays, they shared [via Google Drive] each other's essays. Then, were able to comment on them. Having that ability to access each other's work is really helpful.

Paula explained how the teachers and the entire class were able to collaborate to brainstorm or plan for an essay: "Sometimes we add to a document together and the children will edit a document as their peers are editing as well so it's more of a collaborative interaction." Effective technology integration was also enabling and supporting collaboration for group work. Groups of students used Google Docs, Google Slides, Padlet, Explain Everything, Educreations (iPads), and iMovie (iPads) for group projects and presentations. Rachel explained how the Chromebooks and Google apps allow for easy collaboration when group work must be done outside the classroom:

> …to collaborate with one another. If we're doing group projects, they sometimes will start projects in the classroom on, let's say, a Google Slides activity, and then they can finish it at home. They can edit while one another is working on it. Like let's say there was a spelling error, or there's content error, they can go on and correct one another's and kind of collaborate.

Using 1:1 Chromebooks enabled and supported collaboration because it allowed for more effective teacher feedback to students, peer editing, whole group brainstorming, and small group work. Serena explained why this was so important, "We collaborate a lot with technology. It helps them work with other people…in order to create, you cannot just be one person creating. You need a group of people who think from different perspectives."

Productivity. All of the teachers expressed effective technology integration as allowing them or their students to be more productive. Teachers could deliver, and students could access, resources and content faster and easier, mainly using Google Classroom. They could save time by communicating more effectively with both parents

and students using the school's learning management system (LMS), which they called eLearning, Google Classroom, or a web-based texting system, Remind101. Using Google Classroom, the teachers could share an announcement, document, template, link, or video to all the students instantly and at any time; it could make each student a copy with their name on it; allow the students to complete an assignment and submit it, and allow for teachers to see who had submitted. Christy said of the efficiency, "We don't have to tell them anything. We don't have to write anything on the board. It's something we can make previously and scheduled to be uploaded and opened at that time, which has been nice." Paula explained that it changed the way they did their reading logs:

> We also use the Chromebooks, we push out our reading logs. We used to print out a reading log and hand it to each child, "Put it in your folder and take it home." Now they are posted on Google Classroom so that when the children are traveling, let's say, they can pull that up on their iPad or other device and actually update their reading log from anywhere that they're able to access Google Drive.

The teachers also pointed out that because everything the students did on the Chromebook was cloud-based it was always saved, never lost, and always accessible. Tiffany explained how it nullified the need for a physical binder and Rachel pointed out that it provided a great digital binder that the students could always go back to. If students thought they lost their work, it was always retrievable. If students claimed to have done work, it was traceable.

The LMS and Remind101 were also used to increase productivity my enabling communication with parents and students. Paula explained the two:

> eLearning is what we use with our parents to keep them up to date, the students as well, to keep them up to date on what's going on in each subject area and calendars as far as what are upcoming events and certain things. Remind101 is an app where we can push out a reminder that tells the parents, "Don't forget to pick up your children tomorrow. It's early dismissal," or "Please wear a specific shirt for an event that we have tomorrow."

Harlowe also used the LMS to provide students with direct web links for math reinforcement practice which she found was more efficient because it removed the frustration of students trying to filter them on their own. Carl used it to post videos of him teaching which students could watch over and over again. The teachers perceived the Chromebooks, in combination with Google Applications, the school's LMS, and Remind101 as effective technology integration because they increased productivity.

Purposefully meeting curricular objectives to enhance or transform learning.

Purposeful, meets curricular objectives. When asked to define or explain effective technology integration all seven teachers said it had to be purposeful and meet the objectives of the curriculum. Paula further explained, "We know what our goal is, what our objectives are and then from there, we can look and see how could technology support or enhance these learning goals and objectives." Table 8 shows the aspects of the teachers' definitions that deal with purpose. For technology integration to be purposeful it had to match the objectives of the curriculum. Christy explained that what was most beneficial about the weekly technology class was when she could, "try to relate it to what I'm responsible for teaching, my curriculum and my goals and objectives."

Table 8

Purposeful Use of Technology and Meeting Curricular Objectives in Teacher Definitions

Teacher	Purposeful Use	Curricular Objectives
Christy		That I meet the objectives of the curriculum.
Harlowe	There has to be a purpose in what they're doing.	The skills that I want them to be proficient, to go along with the topic we're studying.
Carl	I think the kids get really hung up on let me get the great music and the wonderful scrolling of the text. Make it look like a movie trailer, and they're not really doing anything with the content.	I think having an eye on what is already being taught in the curriculum, and an expert knowing what kinds of technology is available that could best boost what's being taught.
Serena	Has a clear purpose that the students can see, so they themselves can say, "Okay, I understand why we're using this tool instead of using a more paper and pencil system or so." I feel that it has to have a purpose, a clear purpose.	
Paula	In order to be effective, you have to, I think as an instructor, you would have to have a deep understanding of the purpose.	Because, of course, you could look at YouTube as a source of technology in the classroom but if it's being used to look up video game cheats, that's not really effective because it's not related to what your curriculum is, so if you're using YouTube, it would need to be in a way that's directly linked to your academic goal.
Rachel	It looks like you set your goal out to the kids, they apply that goal, they use it…	
Tiffany	I'm very specific as to what they need to use it for.	

Enhancing Learning. According to the teachers, effective technology integration enhanced the curriculum and/or instruction. The word "enhance" was used in this context 21 times; Table 9 portrays some of the usage.

Table 9

Effective Technology Integration Enhances Learning

Teacher	Enhancement Quotes
Christy	That I meet the objectives of the curriculum and that my students' learning is enhanced.
	I just think it enhances our learning overall.
Serena	I think it's the use of technology in the classroom that enhances the current curriculum and the current learning.
	I just hope that more and more people see what technology can do to enhance the learning of the students and to take the learning beyond the classroom.
Carl	I don't think it has changed what I teach. I think that there are some ways that it can enhance it.
Paula	You're using it in order to enhance your learning and support your learning.
	So while it's not just driving the curriculum, it's very supportive of what we're doing and it enhances it.
Tiffany	I think it enhances it. We may in all truth cover less…but that's because we are enhancing each experience with the technology and enabling the students to become proficient in revealing their knowledge in other ways other than just a written response.
Rachel	I'm more liking how can technology enhance what I do in the classroom.

Technology integration enhanced the delivery of content, resources, assessments or assignments. Tiffany explained, "…whatever you want them to [have/do], let's say articles, to read a template or a rubric to follow and a template to type their responses, it's right there." Teachers were able to deliver resources and content by linking or uploading videos, tutorials, documents, valuable websites, and readings through Google Classroom or eLearning. Using Google Classroom, the language arts teachers could bring up a document or a piece of student work on their own computer and project it on their SmartBoard for analysis. Assignments were disseminated via Google Classroom and

students could access and begin working on them any place and any time. The assignment could include a template for each student to edit. Tiffany even felt that when students had the assignments in front of them on their Chromebooks, they did better work. Three of the teachers even mentioned being able to have students complete tests on Google Classroom or eLearning since each student had their own device.

The most common way technology integration improved learning was by providing supplemental materials or content. This included eBooks, eTextbooks, skill reinforcement software like IXL, BrainPop and Discovery Education videos, online dictionary/thesaurus, and research databases or websites. The students used their Chromebooks and Google Classroom or eLearning to access these materials. The social studies, math, and science textbooks were all available online and students could read, be read to, or watch videos depending on the book.

Christy pointed out that having the textbooks available on the Chromebook meant that the students could zoom in on the text or images as needed. It also enhanced learning through student engagement and collaboration, as presented in the previous section.

Transforming learning.

Differentiation. Meeting the needs of all students was important to the teachers and effective technology integration facilitated this. Tiffany explained that the students are "meeting the challenges and surpassing them because they have all these different modalities now of learning the information." 1:1 Chromebooks and headphones support auditory learning. Students could have text read to them by eBooks or eTextbooks or via the Read&Write Chrome extension. They could also have their own writing read back to them to help them edit as Christy explained, "If you don't tab correctly to create your

paragraphs, it's just one big chunk of writing. It really helps them hear it, because a lot of them are auditory learners. I find it very helpful." Paula explained that students could also use Chrome add-ons to transcribe their work if they required it. Using the Chromebooks, students could also learn at their own level and pace. They could read at their own level, define words as necessary, practice grammar and math skills, and take reading assessments independently as they finished a book. Serena also felt that the devices enabled the students to learn beyond what the classroom could offer them:

> I feel that with the use of technology, kids can be more curious about certain topics. I always say that if I just make you curious about something you're gonna learn more on your own, and learning on your own requires the use of technology because that's just the way we learn now.

Assessment. The way students were assessed changed with effective technology integration. Harlowe spoke about how she could meet the needs of certain students by changing her assessments:

> So my kids who have learning differences, when they have an assessment, I can upload it into their Google Drive or I can share the assessment with them and then, for word problems, they can have the word problems read to them. It's kind of funky sometimes with numbers. Read&Write Gold doesn't love the numbers, but that's something that I've done that's been easy.

Although traditional tests could be take on the devices, most teachers spoke about project based assessments, Christy gave an example:

> Instead of an assessment, like a paper and pencil multiple choice or essay questions, they had to incorporate what they understood from our unit into their

project and we can use that as our assessment grade or project grade in social studies.

Students made slideshows, videos, and games to demonstrate their learning independently and in small groups. Teachers noted that the Chromebooks could be used for all projects, except for iMovies. Informal assessments could also be done through tools like Padlet and Kahoot! Serena explained a fun informal assessment, "Kahoot! not only allows a teacher to really determine what concept students know….What you want, as a teacher, for the students to know and master, but also to get kids excited to do that." As Tiffany said, using technology for assessment allows for "expressing their and revealing their knowledge."

Research and writing. 1:1 Chromebooks, Google Classroom and Google Docs, and the Read&Write Google Chrome extension seemed to change how the teachers had the students do research and writing. It was important to teach and review digital literacy so that the students knew how to find and use reliable and credible web resources. Using Read&Write the students could then read information or have it read to them, highlight and gather facts, and organize information. Students were also able to use cloud-based (Google Docs) or online (Padlet) platforms to brainstorm and plan with their peers and their teachers. They were able to share ideas, while also making sure they did not copy each other's work. By writing in Google Docs, they could easily get feedback on their work from the teacher and their peers. Both could provide feedback and suggest changes directly on students' writing without affecting original work, at any time and any place. Students could also self-edit by opening their work in Read&Write and listening to their work being read back to them so that they could catch errors. The teachers appreciated

the flexibility and not needing to bring stacks of papers home with them. The students could then easily revise and publish it.

Barriers and Support for Integration

Barriers. The teachers faced some barriers that were internal to the teacher and external to the teacher, as shown in Figure 5. Only two of the teachers, Carl and Harlowe, perceived them as significant barriers to effective technology integration. Internal barriers included fear or lack of knowledge and mindset towards the technology and integration. Christy expressed that if teachers did not know enough about the technology, but were required or forced to use it, it made them scared. She explained that because she had not been part of the first formal training on Read&Write, she "stayed back for a little while" until the specialist taught it to the students. Carl also expressed that he had felt "helpless" using programming software that he had not received training on. Lack of knowledge on the tool as well as the subject matter meant that the teachers did not feel confident enough to integrate technology on their own. Serena, Carl, and Paula's fear was not about their ability to use the technology, but about using it too much. For example, Serena said a barrier was "Fear of our kids not getting something they need to get, by not writing enough. It is the fear of: Am I getting them too much to a point where there is no return?"

Teachers' mindset or their attitudes and beliefs regarding the device or technology affected their integration efforts. Carl and Harlowe believed that using technology was not necessarily as effective as traditional methods. Carl wanted to students to manually write things for retention and thought physical/live demonstration were preferable over digital ones for science. Harlowe felt like the students needed more "back to basics"

methods of skill practice and game play in math. Carl freely expressed his bias towards technology affecting his attempts at integration, "I'm still not 100% sold on using a lot of technology." He expressed negative emotions on technology eight times, four more than the next highest, Harlowe. While the other teachers expressed mild concern or some hesitation, they felt like this was easily overcome by the value of technology integration and the support available to them. Serena reflected on this type of thinking, saying, "a barrier could be our own misconceptions of things, so what we think is valuable."

External barriers included the device distracting the students, technical problems, and time. Teachers felt like the greatest barrier to effective technology integration was the device or technology being distracting. Like Christy, who said, "It can be distracting, but I think if you have good management in your classroom, I think it can only be good" most of the teachers felt that this was overcome. Carl felt like integrating the technology detracted from the content itself, "It certainly has a certain wow-factor to it, but sometimes I think we can get distracted with the wow-factor." The nature of the 1:1 Chromebooks could also be a distraction because the students always had a device that had Internet access that allowed for game play, device personalization, inappropriate content, socialization, ads, etcetera. But again, classroom management and setting clear boundaries could be used to overcome this as Harlowe explained:

> You're guiding them if they're going on a website, making sure they're on the appropriate website, and that the website is providing good information because they're kids. So something will pop up and they'll go look on the ad for Toys-R-Us. So you have to be circulating. You can't just sit at your desk and expect that they're doing the right thing.

Four of the teachers felt that technical issues or limitations could be a barrier to integration. When a tool or a device did not work for the teacher or the students immediately, it caused frustration and slowed the flow of the lesson. If they could not troubleshoot it fast enough, they would give up on using it. Harlowe explained that even though the Chromebook had a camera, it was front facing and her students could not use it effectively. However, most of the technical issues were attributed to traditional laptops as the Chromebooks were much more reliable in regard to start up time, battery life, and "glitches." The technical limitations of the Chromebook were overcome by sharing the class set of iPads.

Time was considered a barrier by four of the teachers. Christy said, "We have very limited time to cover our curriculum" so effective integration had to directly connect to the content objectives. Similarly, Harlowe expressed that with "four math classes at 40 minutes a pop and I have to provide direct instruction, practice time, and follow a curriculum" there was not always time to integrate the Chromebooks. Tiffany, on the other hand, felt like the curriculum was flexible and technology integration was necessary to enhance and extend it. The teachers also needed time to find online resources, time to learn the technology, and enough time to practice what they had learned to feel comfortable enough to use it.

Supports. The teachers all expressed that for effective technology to occur they had to be supported in a variety of ways, as shown in Figure 5. Support took the form of PD sessions, human resources, and device resources. PD included tradition workshops led by an expert, as well as those led by colleagues. Five of the teachers cited traditional workshops or trainings as supporting their efforts. From Christy:

> We do have trainings throughout the year where we formally sit down as groups and learn a new application or use of technology…like our training last year when we were going to implement the Chromebooks. That training just to introduce it was very helpful.

Carl, however, highlighted the drawbacks of these types of PD opportunities: "There have been different in-services and trainings. I think that just like with any learning, unless you start to apply it right away you lose it. I often times I lose that. I shed it."

Another PD opportunity supportive of the teachers were when teachers selected to attend 45-minute sessions led by other teachers explaining a best practice. Lab sites, organized by instructional coaches, were comprised of a group of teachers observing a lesson in another teacher's classroom while the specialist explained what they were seeing and how it could be helpful to them.

Teachers also found human resources in the form of colleagues, the information technology department staff, and the technology specialist to be supportive. Three of the teachers felt like the teacher they shared a classroom with and the teachers on their grade level helped them to integrate technology effectively. Rachel provided an example:

> The teachers are helpful if, let's say, Mrs. Y and Mrs. X are starting some new type of virtual book report, and we've never seen it. They'll show us the process of how they create it, and they'll show examples from the kids. If we want to come in their class and watch them teach it and model it, we get to do that. So it's a really good opportunity.

Four of the teachers also felt "extremely" supported by the information technology department staff members who were always available. Harlowe explicated:

> Well, we have a great technology department. Anytime we call down with a problem, within, I would say, 15 minutes someone is up to help us. If a kid's Chromebook breaks, we can send them right down and they will either get a loaner or the tech department will have it back within a day to repair.

Third, identified by the all the teachers as the greatest source of support, was the technology specialist. The specialist provided support towards effective technology integration in her capacity as teacher of the technology class, collaborating with teachers to plan for project based learning, suggesting helpful tools and resources, and leading PD. Carl, who shared his bias against technology integration because of past experiences shared, "I think that since I've been at Oakwood Prep and since we've had some experts like the specialists come in, it has raised it to a new level." Serena explains how and why this is achieved:

> I know that if I want to try something out, but it's probably too difficult for me to figure out all on my own, I can call, and it's not gonna take a month, because then I lost my interest in it. But I can write an e-mail and then the person is there the next day trying to help me figure out. So knowing that it's not just me in this journey, but someone else is to support me.

Tiffany highlighted the value of the specialist when she said, "she's on my speed dial" and appreciate that the specialist is "gentle" with her and explains things in words she can understand. The fact that the specialist was in their rooms every week or every other week for the technology class was also highlighted by all of the teachers and will be discussed when addressing research questions two and three.

Finally, device access was a critical support. Even though not all the teachers thought 1:1 Chromebooks were the ideal option for their students or subject area, the availability of the devices was beneficial. In addition to 1:1 Chromebooks, they had class sets of laptops, iPads, and a projector for the SmartBoard and document camera. Teachers had their own laptop and iPad as well. The Chromebooks were lauded however as a support, Christy said that, "it allows us to do everything, everything in the classroom. There's no limit, because they all have a device." Each child having a Chromebook enabled to teachers to engage students, develop student skills, increase productivity, meet curricular objectives, enhance learning, and transform learning.

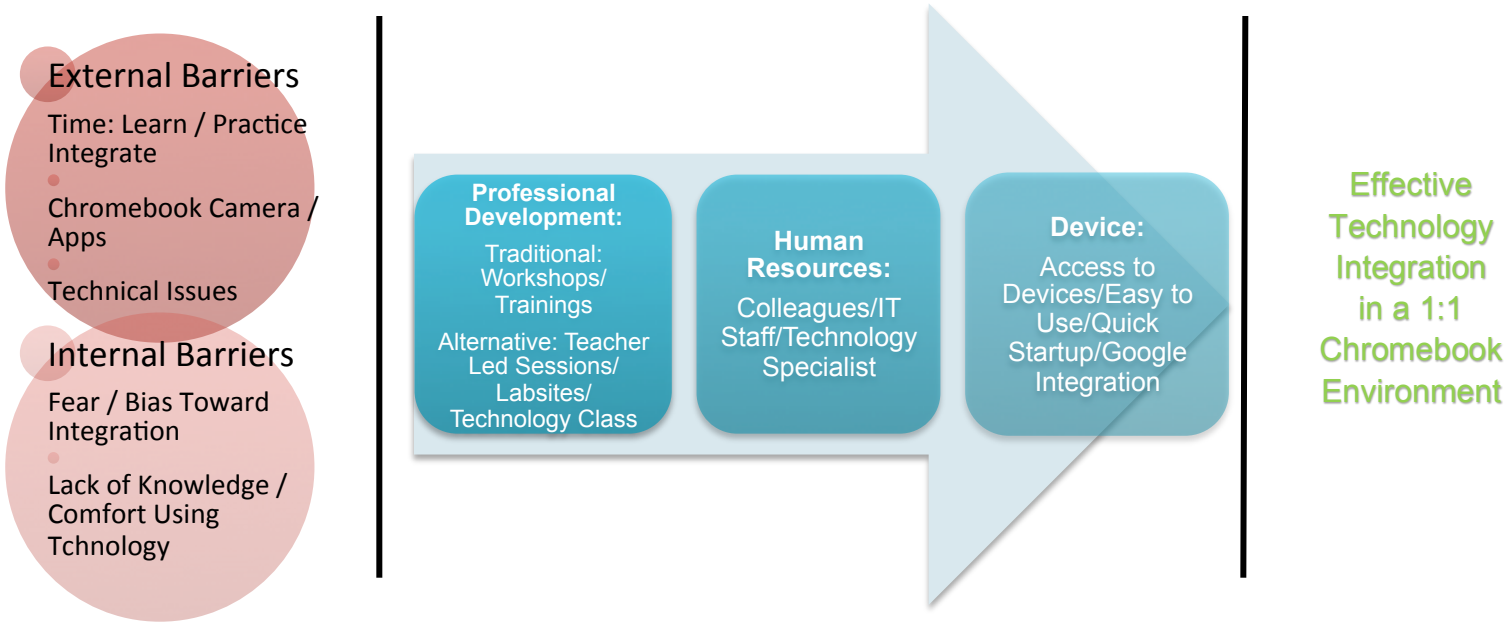


Figure 5. Barriers and supports for effective technology integration.

Technology Class for Teacher Learning

Research question two asked: "How do elementary teachers perceive an ongoing technology class as a professional development experience in a 1:1 Chromebook environment?" Observations, reflections, and interviews went through multiple cycles of coding, first looking at the data on a case by case basis for each participant and then looking across cases to formulate cohesive categories and themes to address the research question. Table 10 shows teachers' answers when asked explicitly asked at the end of the interviews whether the class was effective as PD. Four teachers said it was, two felt as it could be at times, and one thought it was ineffective.

Table 10

Teachers' Answers to: "Is the Technology Class Effective Professional Development?"

Teacher	Technology Class as Professional Development	Suggestions to Make it Effective
Christy	Yes. Absolutely.	
Carl	I would have to say no. It's not effective development for me.	Carl did not know that the class want *meant* to be a learning experience. He felt like this needed to be made clear so he could benefit from it by following along with the students on a device.
Harlowe	Yes. Definitely.	
Serena	Absolutely, yes, yes.	
Paula	…it's not necessarily as much professional development…	Felt that she was too proficient with technology for it to be deemed professional development, but felt that if the specialist consulted with her during the class as students worked, it would be. She also suggested the specialist share the learning objectives she had for the teachers in advance.
Rachel	I think it's helpful, but I don't think that's enough for ourselves.	Felt that because the students were so proficient with technology, she needed more time to learn outside the class.
Tiffany	Absolutely.	

In analyzing the data, however, it was found that all seven teachers were learning in at least one of three categories (see Figure 6). Finding 4: Teachers either explicitly conveyed that the technology class was effective TIPD; or expressed learning about a technology tool or resource, technical knowledge or skills, or ideas for integration. With the exception of Carl, the teachers directly expressed that they were learning right along with the students. Harlowe, Christy, and Rachel all felt like they were students too. Harlowe defined herself as co-learner with her students, "Yeah. They're [technology classes] great because I'm a student as well." Christy explained why this is a valuable role: "I try to learn with the kids because I want to use it in the class."

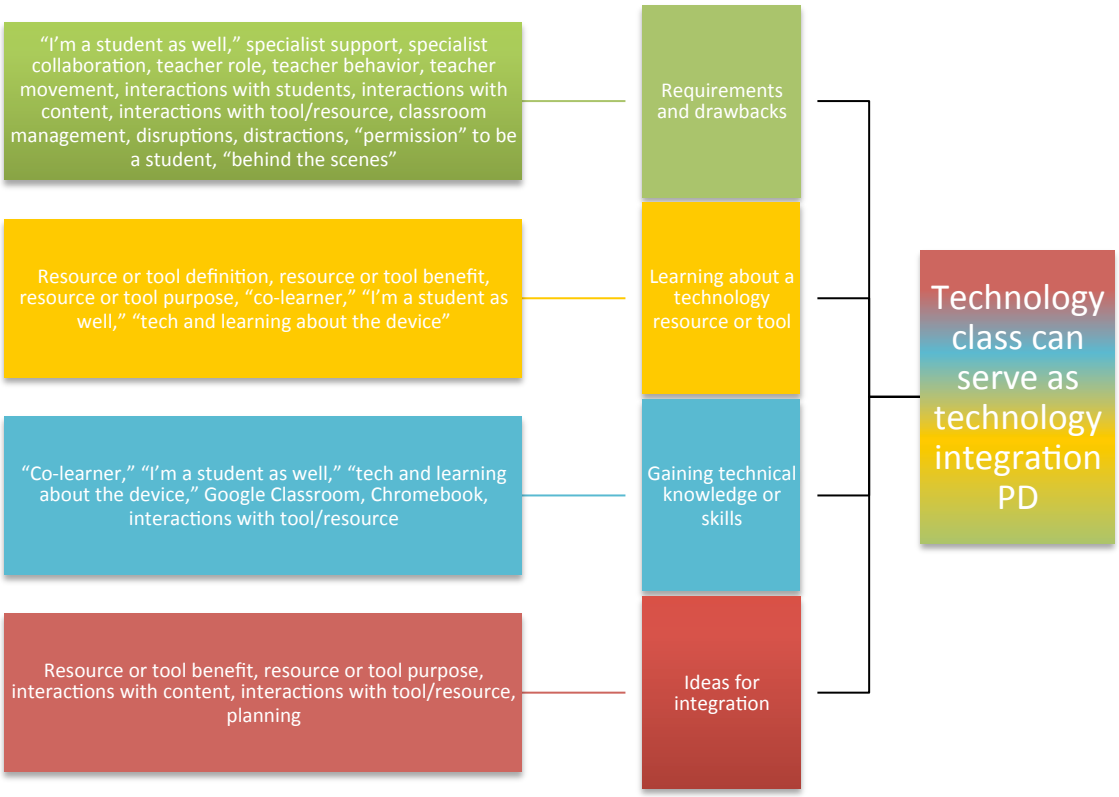


Figure 6. Codes, categories, and finding for technology class for teacher learning.

Codes assigned to each category in Figure 6 follow below.

Requirements and drawbacks: “I’m a student as well,” specialist support, specialist collaboration, teacher role, teacher behavior, teacher movement, interactions with students, interactions with content, interactions with tool/resource, classroom management, disruptions, distractions, “permission” to be a student, and “behind the scenes.”

Ideas for integration: resource or tool benefit, resource or tool purpose, interactions with content, interactions with tool/resource, and planning.

Learning about a tool/resource: resource or tool definition, resource or tool benefit, resource or tool purpose, “co-learner,” “I’m a student as well,” and “tech and learning about the device.”

Gaining tech knowledge/skills: “co-learner,” “I’m a student as well,” “tech and learning about the device,” Google classroom, Chromebook, interactions with tool/resource

The most common type of learning was picking up on a technology tool or resource that they felt could help themselves or their students. Serena said: “When it comes to technology, there are certain tools that they learn that I won’t normally have learned. So I go through the learning process with them.” Christy gave the example where what she learned in the class helped with her duties outside the classroom, “All the committee work that we do now was all Google Suite. Actually, using it in the classroom has helped me a lot.” However, what mostly constituted a learning experience for the teachers was when they learned a new tool or resource to integrate into their curriculum. The teachers expressed that even though they were the experts in their field, they count on the specialist to keep up with the latest technologies and identify what would be most

beneficial to their teaching. Then, by collaborating with the specialist on upcoming units, these tools could be taught and used during the technology class and then applied outside of it. Paula explained why the specialist was so crucial to this process:

> There are things out in the world that I may not have heard of. By the time that it gets to me, it could be archaic. I'm not constantly searching…when it comes to things in the classroom that can be integrated into the classroom, the Educational Technologists are really the experts because that is what they are asked to do.

For the technology class observed, the specialist had multiple learning objectives for the teachers, two related to the technology (see Appendix E):

- Develop a general understanding of a variety of digital research resources, such as Epic! DP.LA.
- Participate in a live virtual "chalk talk," or silent, yet collaborative communication forum in which teachers and students share ideas and information on a specific topic and/or respond to questions (Padlet).

From their reflections and interviews, the teachers showed that they did develop a general understanding of at least one of the digital resources. Five of the teachers could name and define the resource(s) while the other two expressed their purpose and benefits. Paula wrote of Epic!

> I also enjoyed seeing how the app Epic was used to narrow down the available resources and provide credible information on a specific topic. It is often a struggle to find online resources that will hold the students' attention at this level while still remaining age appropriate.

Rachel explained Padlet:

> I mostly learned about Padlet today. This is a website that the students are all now logged on to. It is a forum in which the teacher can post multiple questions related to the assignment given….Padlet is a forum, kind of like a blog, in which students can share their ideas in a public place and learn from one another. I would definitely use this in the future with my students.

Overall, teachers learned about Chrome extensions, subject area resources, iPad and Chrome web store apps, and web applications through the technology class and the specialist leading it.

Through the class, the teachers learned not just about the tools, but how to use them. Mostly, they learned how to use many of the Google Suite for Education applications. Serena explained:

> I learned how to do a Google form…Google Slides. I think more Google applications because we use Chromebooks this year. I work with Drive, but I learned to use Google Slides and other applications or extensions of Google that I didn't use before.

Sometimes it was technical knowledge to better utilize a program like Google Classroom or eLearning, to which Christy explained, "we learn how to link things so that they can go to resources that are reliable and trusted." Paula explained that even though she felt proficient and could figure things out independently, the specialist could come in and show her things she had not figured out.

The technology class was not always an ideal learning environment for the teachers. The teachers felt that they were responsible for classroom management during the class period, so they were often distracted by having to redirect a student or circulate

the room to ensure that students were on task. They also faced distractions, such as interruptions by other faculty. Because the classes were at the end of the day, they were also distracted by papers to grade and copies to be made. In addition to classroom management, the teachers felt that they were there to assist with technical issues and often circulated the room to help students with log in or access issues on their Chromebooks instead of following along with the instruction. Carl pointed out that if he had permission to sit down with a device and follow along (as two of the other teachers did) he could learn along with the students.

While most of the teachers felt this student view would be beneficial, Paula pointed out it left her without the "behind the scenes" information that the teacher needed. She suggested that the specialist could meet with her while the students were independently working on their devices to make the class more effective for her. The teachers also felt that the class was not effective PD in the sense of helping them with integration when it dealt with computer science content. Harlowe explained that while the programming content was not often useful to her, "the actually tech and learning about the device, and the different apps or websites that are available, that, to me, is where I get the most out of the learning." Rachel also felt like computer science content was not meant for her, but said: "I mean, every class there's some new concept that I learned, a new way to present material that I would not have thought of, you know, technology based."

Technology Class for Technology Integration

Research question three asked: "How do teachers perceive an ongoing technology class as supporting effective technology integration in a 1:1 Chromebook environment?" The observations, reflections, and interviews went through multiple cycles of coding, first looking at the data on a case by case basis for each participant and then looking across cases to formulate cohesive categories and themes to address the research questions. Research questions two and three were inextricably linked as teachers had to learn about the technology and how to use it to get to effectively integrate it.

The following findings emerged (see Figure 7). Finding 5: The technology class enabled reflection, which led to ideas for integration. Finding 6: The technology class enabled integration when the content of the class or the digital tools introduced were explicitly related/applicable to the teachers' subject area. Finding 7: The technology class provided the collaboration necessary for integration to occur.

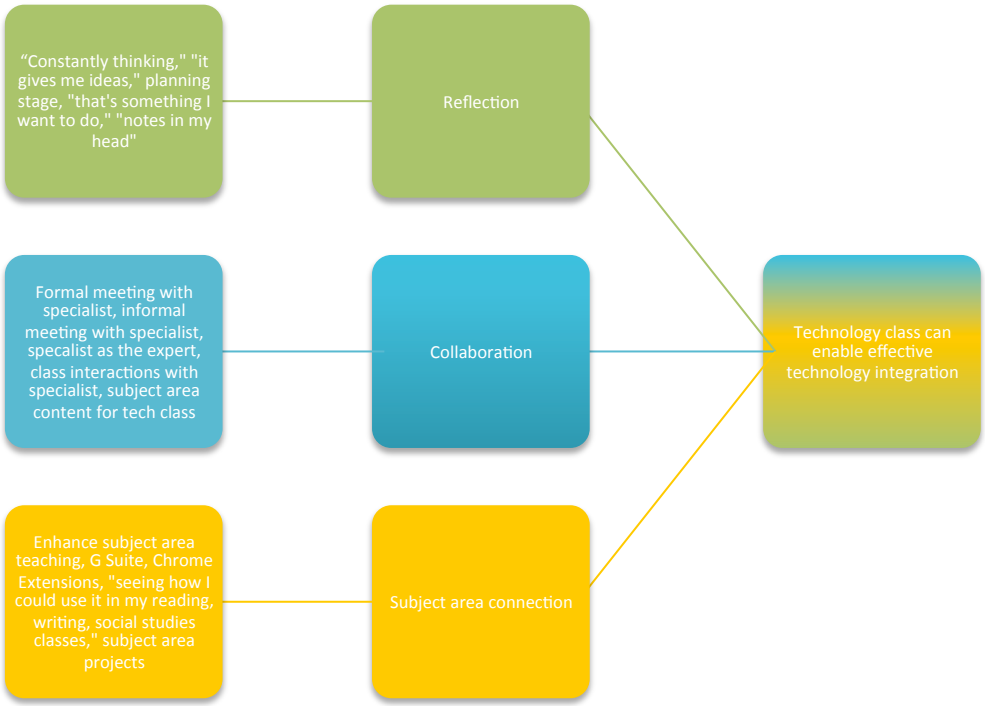


Figure 7. Codes, categories, and finding for technology class for technology integration.

Reflection to integration. The technology class made the teachers think about integration. Only Carl, who explained that this was his last year teaching, said he was not really thinking about what he could do with what he learned. The teachers felt that as long as the tools or resources presented related to their curriculum, they reflected on how they could be integrated into their classrooms. Tiffany and Harlowe explained that this reflection happened during the class period. Tiffany said: "Look, as a teacher, you have to be in the moment, and you have to be constantly thinking about wow, this could be good for this…," and Harlowe said, "Yeah, like that Padlet. I immediately thought when the kids were making it, 'Oh. We could easily integrate this into our social studies curriculum and the kids would enjoy it.'" For Paula, this happened at the planning stage:

> It's more so when I'm planning something, it'll pop in my head and remind me, "Oh wow. This is something I want to do. I'm sure that the Padlet application

that was demonstrated during Ed Tech would be beneficial because…" and I have different reasons. It's more like I take notes in my head and I think about things as I'm planning them. I don't really look at the app and think, "Oh, I could use this for this, this, this, this and this…," but in the moment when I am planning something, I think, "Well, that resource would lend itself well to it." I do reflect, but it's in a different way, I guess you could say.

For Christy, the class may not influence her instruction immediately, but in the year ahead, "I think rolling it out slowly and thinking what can I use for next year and how do I make everything better?" She felt like she learned from the class because it gave her ideas she "would've never thought of before, because it's not my area of specialty." Serena suggested that the teachers keep records of what they learned in the class so that they could refer to them for integrations purposes later: "I don't think we keep enough records of what has been taught, and maybe a weekly record of the tool, a weekly record of that reflection; how you think these can farther help you."

Subject appropriate integration. The technology class influenced integration when the content dealt with the teachers' subject area or when the tools presented could enhance their teaching in their subject area. The Google Suite for Education applications featured prominently with six of the seven teachers. The Chromebooks were introduced by the specialist during the technology classes and the Google applications followed. The teachers explained how the students and they learned about Google Classroom, Google Drive, Google Docs, Google Slides, and Google Forms. They also learned about the Google Chrome extension, Read&Write. The teachers then integrated these tools into their language arts or social studies classes.

Harlowe explained how she learned along with the students during the class, "I didn't teach them that. The tech department taught them how to use Google Classroom. So that's been a neat experience and I just kind of learned along the way." Christy explained that having the students learn the skills during the technology class was a time saver for her and said: "The children learn to use the whole Google Suite at the beginning of the year. My writing class can't function without that, just at all." Google Forms was an application that was introduced during the class that Serena felt would be useful to integrate into her own teaching in the future. She also explained how the class helped integrate technology into social studies: "The kids learn about Google Slides in the technology class, and then at the end of our social studies unit about Florida natives, we created a Google Slides show to present our findings about each of the tribes." Using the tools learned during the technology class and applying it to subject area projects and presentations was a theme for all the teachers. Rachel said, "We've done about three different projects this year [in the technology class], and then after…they would apply that to a project we're doing in class." The teachers had students share their learning at the end of the units by making slideshows, videos, movie trailers, and multimedia presentations using a variety of Chromebook and iPad applications that they had been introduced to in the technology class.

The technology class influenced the way in which reading and writing was taught. The teachers learned how to develop and share templates for students to access, complete, and submit via Google Classroom. They found that by using the Chromebooks with Google Docs for word processing allowed for better and more collaborative brainstorming and planning. It also transformed the editing, revising, and publishing

process. The teachers found that the students were the most detail-oriented and were able to catch and correct their mistakes when writing using the Chromebooks. They were used for everything from quick "stop and jots," to answering critical thinking questions, to writing essays. Having the specialist use the teacher's subject area content helped with integration, as Tiffany explained:

> Some of the lessons were done directly with my material that I'm using for whether it be social studies or more recently for a kindness DBQ that I developed. So as long as Sarah was using my materials, then we have that integration, and it makes more sense to the kids.

The Chrome extension, Read&Write, introduced in the technology class, had also changed how the teachers taught reading, writing, as well as gave access to content in social studies and math. The tool had a variety of accessibility features: read documents to students, allowed for transcription, highlighting, organizing information. Paula provides an example where a feature supports students with learning difficulties:

> The Read&Write Gold application for Google has become a very, very beneficial resource for a number of my students, especially my students that struggle with the reading and writing process because with that tool, the kids are able to speak into a headphone and it transcribes it for them on the Chromebook.

Tiffany found a variety of uses for it, "not just for highlighting collecting, but for vocabulary. And most recently, the kids used it to highlight the articles for their DBQ. And to collect the information." Christy explained that ever since they had learned the basics of the Read&Write extension in the technology class, she had applied it to her own teaching, "Ever since then, I use it as editing lessons for reading writing workshop,

which I've never done before." As long as what the technology specialist was presenting during class dealt with the teachers' subject area or presented tools, which could enhance their subject area, it was deemed beneficial for integration.

Collaboration for integration. The relationship established and nurtured by the teachers and the specialist was described by Serena: "It was conscious. That was actually a collaboration between the teachers, classroom teachers and the technology." Making the technology class support classroom technology integration was established in three ways. It was accomplished through formal planning at team meetings or through informal discussions for upcoming classes, through teacher involvement and interactions during the technology class, and after class support to teachers or students in the classroom. Christy explained one way that planning worked:

> We have a meeting time. It's not set that we meet every week, but it's open so that the teachers of fourth grade can meet with the computer science teacher if needed to plan or to discuss what's coming up or units of study. Then, she has blocks of time that actually coincide with our special area time, so that we can just sit down and just chat and brainstorm ideas. It's been very nice.

Selena explained that classes are effective, or not, based on this planning:

> Some classes are more effective than others, dependent on the topic, and dependent on how much planning we are able to do with a person who delivers it. I think a huge piece is communicating strongly between the person who is in the technology class and the teachers and classroom. I think the key to integration is based on how much communication happens.

Paula explained that because the fourth grade teachers met as a team with the specialist, they could work things out to make sure that they supported integration: "It's not perfect, but we work out the kinks and just make sure it's aligned with what our curricular goals are prior to it being implemented in the classroom." With Tiffany, this planning was often an informal discussion between herself and the specialist, "How can I present that? Or, what are you doing now in reading and writing? Or, what are you doing now in social studies?"

During the actual class time, the teachers remained in the room because they knew they were there to learn. They were attentive to the specialist during instructional time even with some distractions. They interacted with the specialist to ask questions about the content or the tools. They also interacted with the students as they interacted with the tools, providing technical or content assistance. They also interacted with the content of the lesson or the technology tools themselves. For example, Harlowe logged in and interacted as both a teacher and as a student in both resources presented during the class observed.

Collaboration continued beyond the completion of a class. Classes often consisted of an ongoing project that required the specialist to come in and provide addition support. As Tiffany said, the specialist had to "come back and help during the actual other classes." Also, as teachers attempted to integrate tools they learned during the technology class, they were able to request the assistance of the specialist. This made them more comfortable attempting the integration that Paula felt was an important aspect of effective technology integration: "It's a situation where both members of the

classroom, meaning students and teachers, are comfortable in using the technology." She also summed up the entire process:

> We obviously have our Ed Tech and Computer Science teachers that come around once a week and implement a full class period of 40 minutes. They are there as a support system….We provide curricular activities in each subject area and then they are the experts on technology….They are able to bring the ideas back to the team….Then from there, we are able to better choose what we think would work with our class. If it weren't for the Educational Technologists and the Computer Science class, there are certain things that the teachers may not be aware of….For them to help us and guide us and let us know what is available and work closely with us in order to help tailor lessons that are directly related to our curriculum at that time.

The teachers' hesitation to integrate came only when they felt like the lesson they saw was more computer science based, they needed to learn more about the tool, or it did not seem easy enough to manage on their own.

Chapter Summary

The current study aimed to describe and understand the perceptions of elementary teachers in a suburban, independent school regarding effective technology integration and of a TIPD experience in 1:1 Chromebook environment. Qualitative methods of data collection were used including documents, observations, teacher written reflections, and interviews to address the research questions. Presented in this chapter were an overview of the school's transition to 1:1 Chromebooks including deployment, management, benefits, and limitations; a description of the technology class; teacher behavior and

interactions; profiles or summaries of each participant's analyzed data set; teacher perceptions of effective technology integration; and teacher perceptions of the technology class supporting effective technology integration.

Categories, themes, and findings were derived from multiple coding cycles. The findings are as follows.

Finding 1: Teachers perceive technology integration to be effective if it benefited the skills or productivity of themselves or their students.

Finding 2: Teachers perceive technology integration to be effective if it directly relates to their curriculum.

Finding 3: Teachers require the support of their colleagues, technology specialist, information technology department, as well as traditional and alternative forms of professional development to overcome internal and external barriers to integration.

Finding 4: Teachers either explicitly conveyed that the technology class was effective technology integration professional development or expressed learning about a technology tool or resource, technical knowledge or skills, or ideas for integration.

Finding 5: The technology class enabled reflection, which led to ideas for integration.

Finding 6: The technology class enabled integration when the content of the class or the digital tools introduced were explicitly related/applicable to the teachers' subject area.

Findings 7: The technology class provided the collaboration necessary for integration to occur.

CHAPTER 5. CONCLUSION

Discussion

The following chapter discusses the results of the qualitative analyses of the study and how they addressed each research question and additional concepts that arose. It explores the implications of those findings and discusses how they relate to the problem of understanding effective technology integration and providing TIPD for said integration. Finally, pulling from the conclusions of the study, recommendations for future research are made.

The purpose of this qualitative case study was to describe and understand perceptions of effective technology integration and a TIPD experience of seven elementary teachers at a suburban, independent school. The TIPD was an ongoing, 40-minute class led by a technology specialist, taking place in teachers' classrooms, engaging teachers and their students in a 1:1 Chromebook environment. The study is significant because the use of mobile digital devices in the classroom has been heavily encouraged and funded in the last two decades. However, the inclusion of devices in the physical classroom does not translate to ready adoption and proper integration of the devices by teachers. TPD is needed to establish the habits of mind (attitude), knowledge, and skills necessary to implement devices in an authentic, and possibly transformative, way. Studying the perceptions of a group of teachers in regard to their understanding of effective technology integration and a unique method of TPD may lead to the adoption of a specific instructional method, or even a technology integration model.

A qualitative research design was chosen because it allowed for the understanding of interpreted experiences (Merriam, 2009). Because the research questions sought to explore the thoughts and opinions of teachers, qualitative methods of data collection were necessitated: observations, teacher written reflections, and interviews. The order of data collection was integral as the observations and written reflections were reviewed first and assisted in guiding the interviews. In addition, teacher behavior in the observations may have been influenced were the interviews to occur first. Case study was chosen because it enabled the understanding of lived experiences of one group of teachers in a specific setting (Creswell, 2013). It also supported exploring and then describing and analyzing these experiences (Merriam, 2009). This study was intrinsic because the focus was on the particular case itself, a group of teachers engaged in a technology class with their students as they tried to integrate technology in a 1:1 Chromebook environment (Creswell, 2013).

Data analysis then depended on finding meaning from field notes, analytic memos, teachers' written reflections, school documents, and interview transcripts using Atlas.ti software. The first cycle of coding began with the observation and then reflection data. Field notes were input from each observation and reflection as separate text documents into a new Atlas.ti project. A first reading developed many descriptive codes as they were well suited for field notes and documents and allowed for the development of general topics (Saldaña, 2009). Process codes were also utilized for the observable activity that took place during the observations (Saldaña, 2009). With a second reading, some of these codes were then merged. These codes were then grouped into code families or categories.

The interview transcriptions were then coded in accordance to the previous analysis where at all applicable, but many new codes were developed. Descriptive, in vivo, value, and/or evaluation coding were used because they allowed the researcher to "attune" to the "participants' language, perspectives, and worldviews" (Saldaña, 2009, p. 49). A third cycle of coding included magnitude codes and subcodes to highlight the frequency or intensity of certain words, phrases, or emotions. This quantitative aspect served to strengthen the credibility of the themes or categories that emerged (Saldaña, 2013). Multiple coding cycles, member checking, and triangulating the data from the sample and the observations, written reflections, and interviews led to themes or concepts that captured the essence of the data and led to these findings.

Research question 1. How do elementary teachers perceive effective technology integration in a 1:1 Chromebook environment? To address this question, observations were made on how technology was utilized in the technology class. Also, reflection questions asked how teachers would integrate the resources and tools that they were to learn about in the technology class. Interview questions were included that directly and indirectly asked teachers to define and give examples of effective technology integration. Analysis showed that teachers perceived technology integration to be effective if it engaged their students and developed their skills for current or future success. The use of technology had to feel purposeful to both the teachers and the students. They had to know exactly why the technology was being used instead of traditional methods. Integrating technology had to meet the curricular objectives that the teachers had for their students. Only one teacher felt that the technology could drive the curriculum and it is important to note that this was the teacher with the most teaching

experience. The other teachers felt strongly that the curriculum drove the instruction, but that the technology enhanced it. As such, technology's role was that it improved the value of the preset curriculum by altering its instruction. Effective technology integration could also be transformative; however, the teachers did not use the term itself, which is prevalent in the literature. It could make assessments more engaging and authentic. It could also support differentiation by addressing learning modalities, learning styles, and individual learning interests. It was especially transformative for literacy via the Google Suite Applications. Teachers did face a few barriers to their integration efforts and required the support of their colleagues, technology specialist, information technology department staff, and PD to overcome them.

Technology integration was effective if it engaged the students. The teachers felt that it was engaging because the use of digital devices is second nature to their students and they expect to use them. The teachers also allowed for activities and lessons that were fun and exciting to the students, and provided materials that caught and held their students' attention. Having the students on 1:1 Chromebooks also supported and developed students' independence. They were more capable of working and learning on their own with all the "knowledge at their fingertips" without constant teacher prompting. In addition, by using the 1:1 Chromebooks the students developed technology knowledge and skills, the ability to problem solve, and the ability to collaborate, which the teachers felt that students will need in future schooling, as well as in their future careers.

Effective technology integration was also important to student and teacher productivity in the classroom. Teachers were able to deliver content in a faster, easier, and in a more effective fashion. Students had an easier time of accessing the content and

resources. Teachers could also communicate more effectively and efficiently with parents and students by integrating technology. Google integration with the Chromebooks and the 1:1 environment played a key role in this productivity. Teachers were able to provide content and resources and students were able to access them and complete work through the use of Google Classroom and a variety of Google applications.

Any use of technology had to feel purposeful to the teachers. Often this purpose was that it helped them to meet the objectives of the curriculum. The teachers knew *what* they wanted the students to learn and they wanted the technology to enhance instruction. This enhancement was through the way that the content was delivered, but also through the supplemental content and resources made available to them and their students because they each had an Internet-connected Chromebook. Students could access content that the teachers had meticulously curated for them, such as digital textbooks, multimedia, and skill reinforcement software. In addition to enhancing learning, effective integration could transform learning through differentiated instruction by making traditional assessments more accessible or by providing more authentic forms of assessment through project-based learning. It also transformed the way research and writing was taught. With 1:1 Chromebooks, Google applications, and the Read&Write Chrome extension, students were able to access and understand reliable and credible web resources for research. With the same tools, the students were able to engage in a more authentic, meaningful, and collaborative writing process.

The teachers were not without barriers in regard to effective technology integration, but only two of the teachers felt them to be significant. It is important to note

that these were the only two non-Language Arts teachers. Harlowe, a Math teacher, felt hampered by the lack of a camera on the Chromebook—an external barrier—and a lack of knowledge on how it could be utilized in her math class—an internal barrier. She has used QR codes for student independent work and whiteboard apps for small group instruction, which she felt unable to replicate using the Chromebooks. The iPads were available to her for checkout, but these were shared devices and this was an inconvenience. Harlowe was also frustrated with the change of 1:1 device from iPad to Chromebook because she felt they did not support student collaboration. Lack of knowledge or teacher mindset could act as internal barriers. Carl, a science teacher, felt that his proficiency level and personal bias against technology was an internal barrier. As a result, he did not use the Chromebooks often. It is important to note that the content of the Technology Classes was often pulled from the Social Studies curriculum, a class that all the teachers taught. As a result, it seems as if Harlowe's and Carl's needs may not have been fully realized in regard to opportunity for reflection and ideas for integration. This highlights the importance of professional development that is subject matter specific.

External barriers included the device being distracting to the students; experiencing technical problems; and lack of time to learn the technology, practice the technology, and integrate it in a tight and rigid schedule. Barriers were easily overcome for most of the teachers because the Chromebooks were easy to use and devices were plentiful; they had support from colleagues, information technology, and the technology specialist; and they had a variety of PD experiences, including the technology class.

Research question 2. How do elementary teachers perceive an ongoing technology class as a professional development experience in a 1:1 device environment? Looking at each participant's data set, four of the teachers felt that the technology class was very much an effective form of PD. They knew the multiple purposes of them remaining in the room during class time, saw themselves as students, and were eager to learn and integrate what they learned into their teaching. One of the teachers felt that it was effective at times. Rachel, less proficient with technology, felt that the class was sometimes too advanced. She wanted more formal training during after school planning time. Two teachers said it was not effective PD. Paula, who was the most advanced technology user, felt like it was sometimes at too low of a level for her. However, she felt that since she was already in the classroom with the students and it did not require extra time, she wanted the class to be more beneficial to her. She suggested that the specialist share her teacher objectives with her in advance and discuss the "behind the scenes" of the technology with her during class time. Carl did not know that the class was intended as a learning experience for him, but would have liked acting as a student in the class and sitting with a device so he could take advantage of it.

When looking across all forms of data collected all the teachers learned from the technology classes. The teachers learned about valuable tools or resources, technology knowledge or skills, and ideas for integration. From the analysis of the teachers' lesson plans, the observations, and reflections, it was discovered that the teachers all met two or three of the specialists' objectives for the lesson. The interviews garnered that all the teachers had taken something they had learned during the technology class and integrated it into their teaching. The technology class was not sufficient TIPD, however. The

teachers also required formal trainings through workshops lead by a specialist or PD where they could learn from a colleague demonstrating a best practice.

Research question 3: How do teachers perceive an ongoing technology class as supporting effective technology integration in a 1:1 Chromebook environment? There was no way to address research question three without addressing research question two. The teachers had to be in the room learning about the tools and resources, learning how to best use them, seeing how the students used them, and getting ideas for integration for the class to support effective integration in their own subject areas. The technology class enabled reflection, which led to integration. The technology class enabled integration when the content was related to, or the tools were useful for, their subject area. The technology class provided the collaboration necessary for integration to occur.

The teachers reflected on what they were seeing in the class either as it was happening or when it came time to plan. They would think about how a tool or resource that they had been introduced to could enhance learning in their subject area. The class would introduce them to the tool, excite them to use it, or improve their current use of it. The fact that the students had been taught to use the tool or resource already saved them time and effort and made them more comfortable utilizing it outside of the technology class. It was vital that the tools or resources presented dealt directly with the teachers' own content or could be utilized in their subject areas. Harlowe was a good example of this. The content used for the class was often from the social studies curriculum that each teacher was responsible for and that she found relatable and useful. However, she struggled to find a connection from the technology class to her math class. It did happen,

but without an obvious subject area connection, it was rare. Carl, who taught science, while he appreciated some of the multimedia resources that had science content, struggled to integrate as well. What was found to be very useful was teaching the students to use Google Classroom, Google applications, and the Read&Write Chrome extension. This transformed how social studies and writing was taught.

Connecting the technology class with effective technology integration was enabled by the collaboration between the classroom teachers and the technology specialist. This was done in three parts: planning for the classes, attending and interacting during the classes, and follow up support after the classes. The teachers had formal meetings with the specialist where they discussed upcoming units and brainstormed applicable resources and tools. They also had informal discussion about what was going on in the class and how the specialist could assist.

During the classes, the classroom teachers remained in the room and interacted with the students, the specialist, and the content. They engaged with their students, as it was important for them to see what the students were learning and doing. Since many of the classes involved an ongoing project, the specialist was always there to support. She was also available to provide support when the teachers utilized the tools or resources for their own classes, which gave teachers a sense of comfort. The class was not always sufficient to initiate integration because the class at times only served as an introduction to the tool or resource and teachers needed more time to the functionality of the tool or resource before they felt comfortable integrating it.

Implications for Success

The current study has implications for a variety of stakeholders in independent elementary education. It has implications for classroom teachers, technology specialists or instructional coaches, information technology staff, and school administration. This study addresses the problem of depositing new technology, in this case 1:1 computing devices, into the physical classroom without seeing them integrated in a student-centered and constructivist manner (Ertmer, 2005; Ertmer et al., 2012; Liu, 2011; McGrail, 2005; Ottenbreit-Leftwich et al., 2010; Wang et al., 2012). Effective integration of devices should enable learners to construct knowledge in a meaningful way (Levin & Wadmany, 2008). This study first looked at what teachers perceived as effective technology integration. Findings showed that teachers' perceptions closely aligned with Ramorola's (2013) view of "transformative," which was "bringing together or combining technology with teaching and learning strategies in order to meet the curriculum standards and learning outcomes of each lesson, unit or activity" (p. 656). They also aligned with Dawson's (2012) interpretation that for technology integration to be effective it must be "authentic, purposeful, and supportive of higher-level thinking" (p. 117). While the technology integration was not always working to support high-level thinking, it did at times, and it always had to be purposeful. Findings also aligned with research on the focus of effective integration being supportive of collaboration and differentiation (Ertmer et al., 2012; Wang et al., 2012).

It is significant that the perceptions of the teachers on effective technology integration aligned with the literature's attempts to define it. As the literature also suggests, the teacher is the key to successful integration. A teacher's beliefs and attitudes

toward technology and its integration are critical (Ertmer et al., 2012). This proved to be the case in the current study as most of the negative feelings regarding the Chromebook or technology integration came from the two teachers who felt that they were integrating technology the least; implying that any PD for these teachers must explicitly demonstrate how the tool and the technology will provide direct support to their students, as Guskey (2002) maintained. In this vein, the literature also showed that teachers face a variety of internal and external barriers in their efforts to integrate technology (Ertmer & Hruskocy, 1999; Groff & Mouza, 2008; Inan & Lowther, 2010; Levin & Wadmany, 2008). The current study revealed a few barriers consistent with the research that had mostly been overcome through an abundance of devices, the variety of PD including the technology class, and support from school personnel.

The technology class itself did work to provide the knowledge and skills, as well as the integration ideas, necessary for effective technology integration (Mishra & Koehler, 2006; Potter & Rockinson-Szapkiw, 2012; Snoeyink & Ertmer, 2002). When the teachers acted as both students and teacher during the technology class, it became an effective form of TIPD. However, this could only occur if the teachers were present, attentive, and interacted with the specialist, students, and content. The teachers can watch and circulate or they can actually be hands-on on with a device and follow along as a student. It is important for teachers and technology specialists to be aware of this because distractions are plenty. If administration does not make the expectations of the class abundantly clear (be present, be attentive, be interactive), then teachers will not be able to integrate what their students are learning during the class.

The class may have been successful because of its ongoing nature and the direct involvement with the students. As Guskey argued (2002), it is important for teachers to make a change and see the benefits to change their beliefs, and this class provided the opportunity for that. The literature suggests that effective PD should be ongoing, provide in-classroom support, provide an instructional guide or learning facilitator, be embedded in the work day, and align with subject area content (Chen & Chang, 2006; Ertmer, 2005; Hosman & Cvetanoska, 2013; Mouza, 2003; Potter & Rockson-Szapkiw, 2012; Schnellert & Keengwe, 2012). The technology class did all of this; however, it did not often align with math and science content, which made integration difficult for the two teachers in these subject areas.

A technology facilitator, in this case the technology specialist, played a vital role in making the technology class effective and in supporting effective technology integration, as the literature suggests (Stanhope & Corn, 2014). The facilitator was available to meet, discuss, and plan with the teachers. She served as a model during the technology class, as well as provided support outside of it. Tiffany explained how "gentle" the specialist was with her and how she explained things in a simple and easy to understand way. The teachers were able to collaborate with the specialist on their integration efforts. They provided her with the content and she provided them (and their students) with the ideas, tools, and knowledge to enhance it.

As a result, it can be inferred that the tools, instructional methods, and PD utilized at this site were supportive of effective technology integration. The 1:1 Chromebooks, Google applications, and the variety of digital tools and resources incorporated in daily instruction met the requirements of effective technology integration in the literature. It is

imperative when attempting a 1:1 device program that all stakeholders at the school be involved in the discussion for the understanding of effective technology integration and which device can meet that understanding, plan for the deployment and management of devices, as well provide a thoughtful rollout that involves ongoing PD and in-classroom support.

Figure 8 below addresses the interplay of factors for effective technology integration. The goal of effective technology integration is achieved when technology is used purposely to engage students and develop their skills, improves teacher and student productivity, and enhances or transform learning by aligning with the established curriculum. This goal is achieved by providing three levels of support: knowledgeable and supportive personnel, an abundance of devices, and professional development. A unique form of professional development is the Technology Class. By providing professional development that is embedded in the teachers' classroom and related to their content area, the teachers can learn the technology, reflect on what they learn, and get ideas for integration. However, for this to be achieved the expectations and the role for the teacher during the class must be clear. The teacher must know that they are expected to collaborate with the technology specialist, engage in and learn from the class, minimize distractions, and avoid disruptions whenever possible.

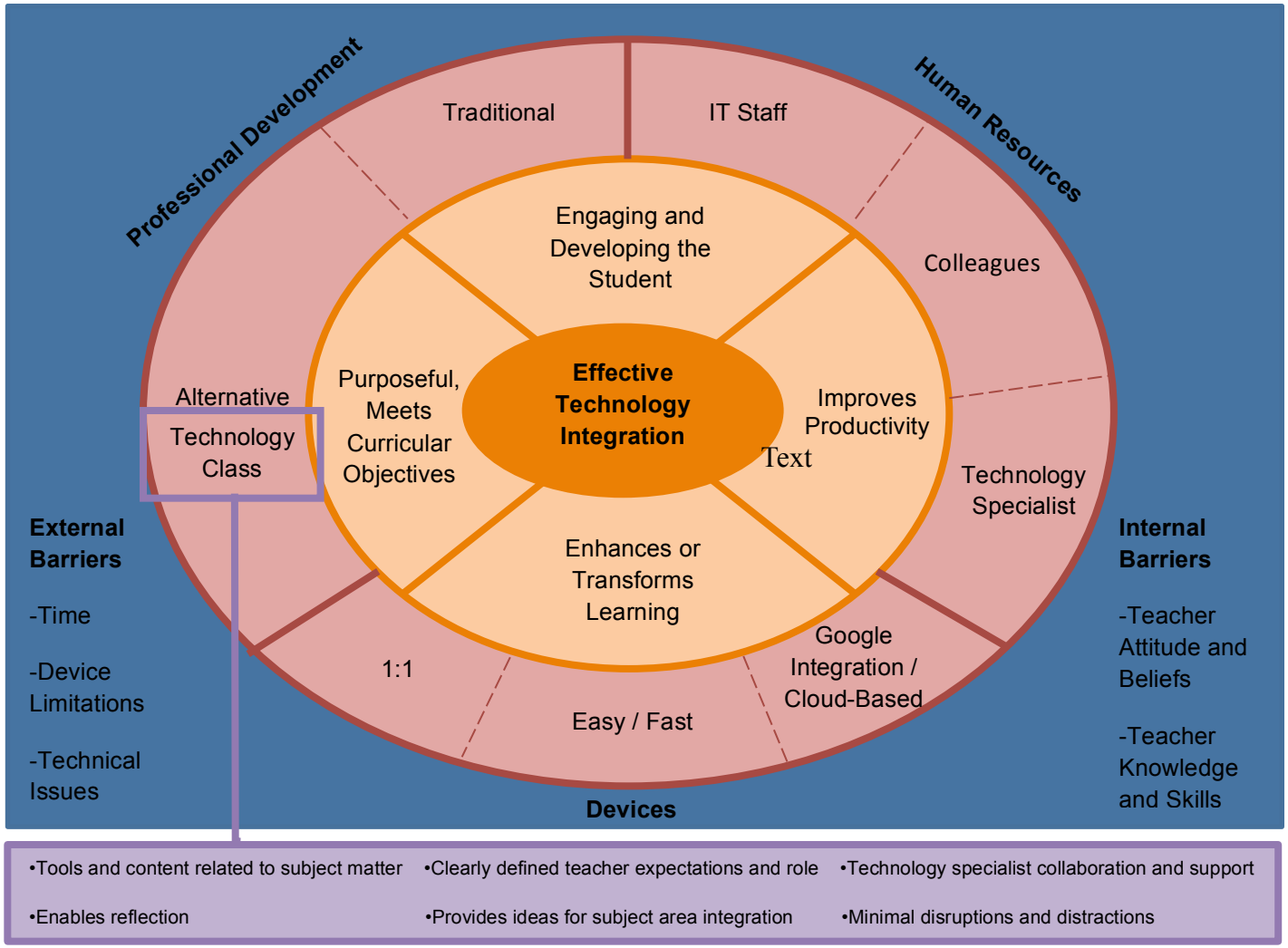


Figure 8. Barriers, supports, and aspects of effective technology integration with technology class.

Recommendations for Future Research

The current study aimed to describe and understand how seven fourth and fifth grade teachers perceived effective technology integration in a 1:1 Chromebook environment. In addition, it sought to understand how the teachers perceived a student technology class as serving as PD for teachers and supporting their efforts to integrate technology into their classroom. Even though findings provided sufficient data to address the research questions, it is recommended that future research include a larger number of varied participants, preferably all third through fifth grade teachers at this school, and at a sister campus, who have 1:1 Chromebooks as well as the technology class.

The participants in this study all had over 10 years of teaching experience. It would be beneficial to include teachers with less classroom experience and those coming directly out of teacher education programs. Five out of seven of the teachers in this study taught language arts. It is important to note that the math and science teachers found technology integration with the Chromebooks challenging with the professional development experiences provided to them. Further research is recommended on how math and science teachers understand and implement effective technology integration. It would also be beneficial to reevaluate if the specialist and the math and/or science teachers developed technology class lessons that directly related to math and/or science content, not just social studies content.

Even though the findings showed that the teachers learned from the technology class and applied what they had learned to integrate technology into their classroom, it was not sufficient support on its own. Further research is recommended on the types of

formal trainings and workshops teachers experienced and why they were effective in supporting their integration efforts. The teachers also highlighted the value of learning from their colleagues through informal discussions, observations, team meetings, lab sites, and teachers-teaching-teachers sessions. Future research can address the value of a personal teaching community to encourage effective technology integration. In addition, the workshop alternatives, lab sites, and teachers-teaching-teachers sessions demand further study. The technology specialist was also integral to the success of the class and integration. As such, further studies should include observations of and interviews from multiple technology facilitators to explore the attributes that make them successful.

Further research is also necessary on the value of 1:1 devices, specifically cloud-based devices like Chromebooks versus tablets like iPads. A few teachers in this study touched on their uses and opinions of 1:1 iPads, but a study on teachers using 1:1 iPads for multiple years would provide a much needed comparison. Computing devices are varied and can be very costly. Research on which device promotes effective technology integration for various subject areas would assist schools in making cost-effective decisions for their teachers and students. Finally, the integration of Google accounts, web browser, and applications were inherent in the teachers' perceptions of effective technology integration. Further research is recommended to study how cloud-based software supports, enhances, or transforms classroom instruction.

Summary

In summary, the current study took a qualitative case study approach to address the problem of ineffective integration of devices in the classroom. Through qualitative methods of data collection and analysis three questions were addressed. The study

addressed teachers' perceptions of technology integration, how a technology class acted as PD, and how a technology class supported their efforts to integrate technology into the classroom. In regard to perceptions of effective technology integration, findings showed that teachers perceived technology integration to be effective if it benefits the skills or productivity of themselves or their students, if it directly related to their content or curriculum, and that they required the support of their colleagues, technology specialist, information technology department, as well as traditional and alternative forms of PD, to overcome any perceived barriers to integration.

In regard to the technology class serving as PD, findings showed that the class led to teachers learning about technology tools or resources, technical knowledge or skills, and ideas for integration. In regard to the class's influence on teacher integration efforts, the findings showed that the class enabled reflection, which led to ideas for integration. It enabled integration when the content was related to, or the tools were useful for, their subject area, and the class provided for the collaboration necessary for integration to occur.

This study suggests that teachers needed to have a clear understanding of effective technology integration that aligns with the literature to be successful. It is imperative that the device selected meet the needs of the teachers in their discrete subject areas. The technology class could be effective if teachers worked with the specialist in the planning of it; and if the teachers were present, attentive, and interactive with the students, specialist, and the content of the class. The teachers also required a technology facilitator that collaborated with their integration efforts and provided continued support. Future research should focus on expanding the current study with a larger, more diverse sample

of teachers, include 1:1 tablet programs, and study other alternative forms of PD for effective technology integration.

APPENDICES

Appendix A. IRB Exemption

Institutional Review Board
Division of Research
777 Glades Rd.
Boca Raton, FL 33431
Tel: 561.297.1383
fau.edu/research/researchint

Charles Dukes, Ed.D., Chair

DATE:	April 12, 2017
TO:	Roberta Weber, Ed.D Curriculum & Instruction
FROM:	Florida Atlantic University Social, Behavioral and Educational Research IRB
PROTOCOL #:	1011938-1
PROTOCOL TITLE:	[1011938-1] Teacher Perceptions of Technology Integration Professional Development in a 1:1 Device Environment
SUBMISSION TYPE:	New Project
REVIEW CATEGORY:	Exemption category # *A2*
ACTION:	DETERMINATION OF EXEMPT STATUS
EFFECTIVE DATE:	April 5, 2017

Thank you for your submission of New Project materials for this research study. The Florida Atlantic University Social, Behavioral and Educational Research IRB has determined this project is EXEMPT FROM FEDERAL REGULATIONS. Therefore, you may initiate your research study.

We will keep a copy of this correspondence on file in our office. Please keep the IRB informed of any substantive change in your procedures, so that the exemption status may be re-evaluated if needed. Substantive changes are changes that are not minor and may result in increased risk or burden or decreased benefits to participants. Please also inform our office if you encounter any problem involving human subjects while conducting your research.

If you have any questions or comments about this correspondence, please contact Donna Simonovitch at:

Institutional Review Board
Research Integrity/Division of Research
Florida Atlantic University
Boca Raton, FL 33431
Phone: 561.297.1383
researchintegrity@fau.edu

* Please include your protocol number and title in all correspondence with this office.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within our records.

Appendix B. Consent Form

ADULT CONSENT FORM

Version 3.0 – 02/01/2017

1) Title of Research Study: Teacher Perceptions of Technology Integration Professional Development in a 1:1 Device Environment

2) Investigator(s): Dr. Roberta K. Weber; Eleonora Yankelevich

3) Purpose: The purpose of this study is to understand your perceptions of a technology integration professional development experience, as teacher at your school. The professional development is the ongoing, 40-minute class led by a technology specialist in your classroom, engaging you and your students in a 1:1 device environment.

4) Procedures: You will be observed, in your classroom, during one of your 40-minute technology classes. After the observation, you will complete a Google survey. This will take 10 minutes. After the survey, an interview time will be scheduled. This interview will take place at the school and take 45-60 minutes. It will be audio-recorded and transcribed. You will be asked to make comments regarding any needed corrections on the transcription. This may take 5-10 minutes. If no comments are made, it will be accepted that no corrections are needed. If you choose to no longer participate in the study, any data collected in relation to you can be discarded.

5) Risks: There are very minimal risks for participants in this study. The research questions are not sensitive and do not pose a social or legal threat for yourself personally or at work. All data collected will be immediately marked with a pseudonym. The study topic is unlikely to cause any psychological harm.

6) Benefits: The results of the study may improve your experiences in the technology class and may assist in your efforts to integration technology in a 1:1 device environment.

7) Data Collection & Storage: All information collected will be kept confidential and secure and only the people working with the study will see your data, unless required by law. All information will be marked with a pseudonym. All information will be stored in the researcher's Florida Atlantic University's Google Drive Account, password protected and utilizing secure data centers. The laptop and recording device used are password protected and kept secured. After three years, paper data will be destroyed by shredding and electronic data will be permanently deleted. We may publish what we learn from this study. If we do, we will not let anyone know your name/identity.

8) Contact Information:

- If you have questions about the study, you should call or email the investigator(s) Dr. Roberta K Weber 561.799.8519 or rweber@fau.edu or Eleonora Yankelevich at 954.608.0316 or eyankelevich2013@fau.edu.
- If you have questions or concerns about your rights as a research participant, contact the Florida Atlantic University Division of Research, Research Integrity Office at (561) 297-1383 or send an email to researchintegrity@fau.edu.

9) Consent Statement:

*I have read or had read to me the information describing this study. All my questions have been answered to my satisfaction. I am 18 years of age or older and freely consent to participate. I understand that I am free to withdraw from the study at any time without penalty. I have received a copy of this consent form.

I agree ____ I do not agree ___ to be audiotaped.
Printed Name of Participant: _____
Signature of Participant:_____ Date: _____
Printed Name of Investigator: _____
Signature of Investigator: _____ Date: _____

Appendix C. Recruitment Script

Verbal Face-to-Face Recruitment Script for Teachers

Hi, thank you for taking time out of your team meeting to speak with me. As a graduate student at Florida Atlantic University in the Curriculum, Culture, and Educational Inquiry Department, I am conducting research in partial completion for my Dissertation on technology integration professional development for teachers in a 1:1 device environment. I am inviting you to participate because you are in the unique situation of taking part in a weekly technology class with your students and having 1:1 devices for at least one school year.

Participation in this research includes one 40 minute classroom observation, completion of a reflection form after the observation that will take about 10 minutes, one 45-60 minute interview, and review of the interview transcript. If you would like to participate in this research, please complete a consent form and return it to me by the end of the day. If you have any questions, please email me at eyankelevich2013@fau.edu.

Appendix D. Observation Protocol

1. Lead and Teacher II actions during mini-lesson (ex: sitting with the students, redirecting behavior, making a chart during instruction etc.).
2. Teacher actions during gathering of materials (ex: passing out devices, assisting students will device setup, monitoring student behavior).
3. Teacher actions during student independent work time (ex: moving around the classroom, answering questions, etc.).
4. Teacher actions during wrap-up and cleanup.

Actions: behavior, location, overall participation, engagement

Appendix E. Dissertation Observation Lesson

4th Grade Everglades DBQ Preparation	
Objectives:	● The students will read informational text (e.g., directions, graphs, charts, signs, captions) to follow multistep instructions, answer literal questions, perform tasks, learn tasks, and sequentially carry out the steps of a procedure.
Skills:	**Students will know and be able to…** ● use a systematic process for the collection, processing, and presentation of information. ● develop and demonstrate an understanding of media literacy as a life skill that is integral to informed decision making. ● use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways ● plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits ● evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources. ● curate information from digital sources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions. ● build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions. **Teachers will know and be able to…** ● Differentiate between analogue and digital media ● Develop a general understanding of a variety of digital research resources; such as Epic! DP.LA ● Participate in a live virtual "chalk talk," or silent, yet collaborative communication forum in which teachers and students share ideas and information on a specific topic and/or respond to questions (Padlet) ● Strategize future plans for technology integration into core content curriculum
Lesson:	● Intro: Review *digital & media literacy* definitions through whole group discussion ● Transition: Show students image of Everglades (source: DP.LA); Teacher States: This image is possible research or supporting evidence for your position on the primary reason to save the Everglades. ● Think-Pair-Share the following questions: What year was the picture taken? Does the image help support the primary reason you selected (why/why not)? ● Explore DP.LA & Epic! Library for kids (look at curated leveled readers on the topic of Everglades) ● Transition to Assessment: Padlet
Independent Work:	Padlet: Response to DBQ Essential Questions while using a primary resource from Epic!
Wrap Up:	● Whole group discussion/reflection on exercise of Padlet experience: ○ What can we tell about our research of the Everglades by looking at our digital "chalk talk?" ○ How might we use this as an outline to help us write our essay? ○ What do you wonder about the credibility of the Epic! Site? ● Who group reflection on Digital & Media Literacy: ○ What is digital & media literacy? ○ What is the difference between analog & digital literacy?

5th Grade “Pay It Forward” DBQ Preparation	
Objectives:	● The students will read informational text (e.g., directions, graphs, charts, signs, captions) to follow multistep instructions, answer literal questions, perform tasks, learn tasks, and sequentially carry out the steps of a procedure.
Skills:	**Students will know and be able to…** ● use a systematic process for the collection, processing, and presentation of information. ● develop and demonstrate an understanding of media literacy as a life skill that is integral to informed decision making. ● use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways ● plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits ● evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources. ● curate information from digital sources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions. ● build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions. **Teachers will know and be able to…** ● Differentiate between analogue and digital media ● Develop a general understanding of a variety of digital research resources; such as Epic! DP.LA ● Participate in a live virtual “chalk talk,” or silent, yet collaborative communication forum in which teachers and students share ideas and information on a specific topic and/or respond to questions (Padlet) ● Strategize future plans for technology integration into core content curriculum
Lesson:	● Intro: *digital & media literacy* definitions through whole group discussion/examination of websites. Students explore the difference between analog & digital media. ● Transition: Google Classroom articles on the “Pay It Forward Movement.” ● Think-Pair-Share the following questions: Who wrote these articles? What year was it written? How do we know these are credible sources? ● Explore DP.LA & Epic! Library for kids (look at curated leveled readers on the topic of Kindness) ● Transition to Assessment: Padlet
Independent Work:	Padlet: Response to DBQ Essential Questions while using a primary resource from Epic!
Wrap Up:	● Whole group discussion/reflection on exercise of Padlet experience: ○ What can we tell about our research of the “Pay It Forward Movement” by looking at our digital “chalk talk?” ○ How might we use this as an outline to help us write our essay? ○ What do you wonder about the credibility of the Epic! Site? ● Who group reflection on Digital & Media Literacy: ○ What is digital & media literacy? ○ What is the difference between analog & digital literacy?

Appendix F. Reflection Form

Directions: Please take a few moments to answer a few demographic questions. Then consider the technology class you and your students engaged in, answer the questions below in *as detailed a manner as you can*.

1. How many years have you been teaching?

2. How many years have you been teaching at Oakwood Preparatory School?

3. What grade level do you teach and for how many years have you been in your current grade level?

4. What knowledge and/or skills did you gain during the technology class today? How do you feel about what you learned?

(Explanation of terms: **knowledge -** I learned that a writing workshop mini-lesson is a focused 5-10 minute delivery of instruction on a specific strategy at the start of the workshop session; **skill -** I learned how to make a mini-lesson anchor chart with both text and images).

5. How do you envision using this software and the Chromebook in your classroom moving forward? Please provide examples of how you think you would apply it to the subject area(s) you teach.

> (Digital Form: A digital form was created using Google Forms and available during the data collection phase. The ability to submit a response was revoked after all responses had been collected.)

Appendix G. Interview Protocol

Introduction: Hi, thank you for taking the time to speak with me. This will take about 45-60 minutes. I am interested in understanding a bit about your thoughts on technology integration and the weekly technology class you and your students have. This is for dissertation research. Do you mind if I record it so I can accurately transcribe what you share with me? This will be kept confidential and pseudonyms will be used. Thank you for completing the demographic questions. So you have been teaching for ___ years and ___ of those at Oakwood Prep, that's great.

1. What "level" of technology user do you think you are Personally? Professionally? (Ex: Beginner → Intermediate → Proficient → Expert). Why?
2. How would you define "effective technology integration"?
3. How do you think technology impacts your curriculum?
4. What supports exist to help you integrate technology into your classroom?
5. What barriers exist that prevent you from integrating technology into your classroom?
    a. What supports exist to help you overcome these barriers?
6. Can you describe how you use Chromebooks in your classroom?
7. How do you feel about using the Chromebooks in your classroom?
8. Can you tell me about the technology class you and your students have had over the years?
9. Do you perceive your students' weekly technology class as a learning experience for yourself? Why or why not? What have you learned?
10. Can you describe how you interact with students during this class?
11. Do you find the resources and applications presented during the technology class to be useful to your students? Why or why not?
12. What are your thoughts on the structure of the class?
13. Do you reflect on the resources/applications during the technology class and consider how you could implement them in your classroom?
    a. If not, how do you think this could be achieved?
14. Can you give examples of when you have integrated something you learned from the technology class into your classroom?
15. Do you consider the technology class an effective method of professional development? Why or why not?
16. Is there anything else you'd like to add?

Closing: Thank you so much for taking the time to speak with me. I really appreciate your contribution to my study. I would like to provide you with a digital copy of the transcript via Google Docs when it is ready, for your review. You will receive it within 2-3 days of this interview, would that be all right? I would appreciate if you left commentary or provided clarification on the transcript within a week of its receipt. If I do not receive any feedback, I will understand that you wish no changes to be made. Would it be okay if I contact you for follow-up questions?

Appendix H. Chromebook Rollout

Chromebook Rollout Plan

- Friday, August 19: Email to all faculty in grades 3 - 5 explaining the thoughtful, comprehensive rollout
- Week of August 22: Attend team meetings with Computer Science & Technology Specialists to address concerns and determine the organizational system (numbering)
    - See: https://www.youtube.com/watch?v=RIL4Qn4XgU4 for safety
- Week of August 29: Professional Development on Go Guardian
- Week of September 5: Digital Citizenship
- Week of September 12: Rollout Chromebooks in grades 3 - 5 with storage

To Do Notes:

- Follow up with Steve on removing desks from Boca data closet to store Chromebooks
- Remove Chromebooks from [redacted] classroom neighborhoods
- Set up Go Guardian PD for [redacted] for week of August 22
- Plan & schedule teacher PD Go Guardian for week of August 29
- Plan & schedule teacher PD on Digital Citizenship & Go Guardian for week of September 5
- Week of Google SignIn in the classroom
- Get additional laptop cart for [redacted] fifth grade for on demand writing week of August 22 - check all laptops are working
- Touch base with Spanish teachers in [redacted] regarding Chromebooks for Spanish
- Communication to families on Chromebooks in the classroom? Talking points for Back-to-School Nights?

Week of August 22 Email

Dear Colleagues,

From the initial spring work session with Lower School teachers, administrators, and technologists identifying the need for Chromebooks, to budget requests, to the pilot, to purchasing and configuration, it's been a community effort to bring the one-to-one Chromebook program to grades 3 - 5 at [redacted]. A big thank you to [redacted] and [redacted] for piloting Chromebooks in their classrooms! And a big thank you to the Technology team for planning, purchasing, troubleshooting, and supporting the implementation of over 600 new devices!

As excited as we are to get Chromebooks in the hands of our students, we also know that an organized and comprehensive rollout is essential for the success of a one-to-one program. The current schedule is as follows:

- Week of August 22: Grade teams meet with Computer Science & Technology Specialists to plan for organization (i.e. numbering, cabinet placement, ect.) of Chromebooks and develop solutions for students' use of alternative devices prior to arrival of Chromebooks in classrooms
- Week of August 29: Teachers participate in professional development on the device management tool--Go Guardian
- Week of September 5: Teachers participate in professional development on fostering digital citizenship
- Week of September 12: Rollout Chromebooks and storage cabinets to all classrooms in grades 3 - 5

Please do not hesitate to call (ext. 4145) or email me if you have any suggestions or if I can provide any additional clarification on our Chromebook rollout plan.

Yours,
[redacted]

Week of August 29 Email

Dear Colleagues,

GoGuardian is the Chromebook management tool we will be using in the classroom to monitor and filter student internet and app usage. Click here to watch an 80 second video on GoGuardian.

This week [redacted] and [redacted] will be reaching out to grade level teams to schedule a professional development training session (approximately 40 minutes) at a mutually convenient time.

Please check your email for an account creation email from GoGuardian with a link to set your password. If the email is not available for your reference, go to the GoGuardian teacher login and select forgotten password using your [redacted] email address as the login. Prior to your team's professional development session, set the password and check that you are able to login. Click here for help with account set-up. We ask that you wait until your team's session before setting up any classes or sessions.

Highlights of the session will include:

- Setting up your class(es) in GoGuardian
- How to send out a link to all of your students
- How to lock an individual student's Chromebook
- Using GoGuardian to make an individual student's work visible to the class through the projector
- Using the timeline data to review students' on-task time

The entire GoGuardian teacher video playlist is available here for your reference.

Sincerely,

[redacted]

Appendix I. Chromebook Policies (Grades 3-5)

Vision Statement for Educational Technology:

[redacted] School seeks to give our students and faculty access to innovative technologies that promote learning through collaboration, creativity, communication, and critical thinking. Our students will become thoughtful, responsible, and ethical consumers and producers of information prepared to thrive in a global economy.

Successful use of student devices in classrooms:

- Raises students' independence for practice and learning
- Increases engagement
- Aides in differentiation
- "Gamifies" learning to promote growth
- Facilitates greater diversity in students' expressions/creations/projects
- Gives teachers and students immediate feedback on understanding
- Individualizes and personalizes learning
- Aides in teachers' abilities to delve into teachable moments and promotes executive functioning skills

Student Chromebook Care:

Students are responsible for the general care of the Chromebook which they have been issued by the school.

[redacted] *Lower School Repair Procedure*

- Chromebooks that are not working properly should be taken to the student's Computer Science and Technology Specialist for repair pre-evaluation. Computer Science and Technology Specialist will determine if Chromebooks will need to be taken to laptop repair.
- Students will be issued a loaner Chromebook from their assigned Computer Science and Technology Specialist while it is being repaired or replaced.
- Lower School students should not walk to the high school area to speak to IT unaccompanied.
-

[redacted] *Lower School Repair Procedure*

- Chromebooks that are not working properly should be taken to the Technology Department.
- Students will be issued a loaner Chromebook by the Technology Department while it is being repaired or replaced.

General Precautions:

- No food or drink is allowed next to your Chromebook while it is in use.
- Cords and cables must be inserted carefully into the Chromebook.
- Students should never carry their Chromebook while the screen is open.
- Chromebooks should be shut down when not in use to conserve battery life.

- Chromebooks should not be exposed to extreme temperature or direct sunlight for extended periods of time. Extreme heat or cold may cause damage to the chromebook.
- Never leave the Chromebook in an unsecure location.
- Students may not remove or interfere with the serial number or other identification tags.
- Students may not attempt to remove or change the physical structure of the Chromebook, including the keys, screen cover or plastic case.
- Students can change the background and bookmarks as long as they are school appropriate.

Carrying the Chromebook:

- The protective shell of the Chromebook will provide basic protection from everyday use. Students should not run with Chromebooks in their hands.
- All faculty and staff should be on alert for how students appropriately handle devices.
- All faculty and staff should assist students with recommendations as to where to place devices while changing classes.

Screen Care:

- Chromebooks screens can be damaged if subjected to rough treatment. The screens are particularly sensitive to damage from excessive pressure on the screen.
- Do not place anything on the keyboard before closing the lid. (e.g. pens, pencils, notebooks)
- Clean the screen with a soft, micro-fiber cloth. Do not use window cleaner or any type of liquid or water on the Chromebook.

Chromebook Charging Instructions:

- When Chromebooks are not in use, they should be stored in the charging cabinet.
- Chromebooks should be placed on the shelf of the charging cabinet that has the corresponding number that is located on the Chromebook.
- Chromebooks should be connected to the corresponding number on the charger in the charging cabinet.
- Students should not tug or pull on the power cord charger.

Proactive Problem Solving:

- Available Chromebooks from absentee students can be used by another student as student signins are a secure feature to login to a different device.

Frequently Asked Questions:

Q. Can students download additional software to their Chromebook?

A. No. Students are unable to install additional software or apps on their Chromebook other than what has been approved by [redacted].

Q. Can students take their Chromebook home?

A. No. Our policy states that Lower School Chromebooks will remain on campus and are not to be taken home by the students.

Clarification on software, apps, and extensions for Chromebooks

- ***Chromebook apps*** are located next to the omnibar next (which is considered the address bar). Apps are maps or URLS to interactive web pages (or web apps). Students should not be downloading these apps without teacher and technologist permission. Explain Everything is an example of a Chromebook app.

- ***Chromebook extensions*** are retrieved from the Chrome store called the web store. Extensions extend the functionality of the Chrome web browser, or the Google Chrome OS, as a whole (or universally). Students may only download Google extensions with permission from teacher or Computer Science and Technology Specialist. Read Write Gold is an example of a Chromebook extension.

Appendix J. Follow-up to Future Planning for Student Device Usage

March 5, 2016

Dear [Name Redacted] School Colleagues,

During the height of the space race, legend has it, NASA scientists spent millions to develop a pen that would write in space, whereas the Soviet Cosmonauts...used a pencil. This cautionary tale of simplicity and purpose, although more myth than history, resonates with me as we wade into the world of future technology planning.

We met on Friday, Feb. 19, with three big goals:

1. Identify and celebrate the successful use of iPads to elevate teaching and learning.
2. Use the SAMR Model to reflect and evaluate how and why we use student devices in different learning contexts and experiences.
3. Develop a shared vision for technology integration using input from faculty, administration, and technologists.

We were able to generalize the successful use of student devices in classrooms into the following categories:

- raises students' independence for practice and learning
- increases engagement
- aides in differentiation
- "gamifies" learning to promote growth
- facilitates greater diversity in students' expressions/creations/projects
- gives teachers and students immediate feedback on understanding
- individualizes and personalizes learning
- aides in teachers' abilities to delve into teachable moments

We used the SAMR Model (Substitution, Augmentation, Modification, and Redefinition) as a framework to reflect on our current use of student devices, to facilitate discussion around why we use a specific technology, and to plan for the design of future tasks that enable higher-order thinking skills and engage students in rich learning experiences.

We agreed that the explicit and discerning use of digital technologies can **transform** the way teaching and learning takes place. We agreed that at [redacted] integration is all about using technologies **effectively across the curriculum** to provide **unprecedented opportunities** for richer **choices** and **accessible**, **relevant**, and **high-quality** learning experiences.

Finally, collaboratively, we (faculty, administration, educational technologists and technology leaders) used the mission statement, the diversity statement, and the

Strategic Plan to develop a shared vision. Our shared vision will become the paddle to steer organizational decisions around technology integration.

Priorities identified in meeting:

- Global readiness
- **Communication & collaboration
- **Critical thinking
- **Digital literacy
- Inquiry-based learning
- *Professional ethics
- *Creativity and innovation

Vision statement: [redacted] seeks to give our students and faculty access to innovative technologies that promote learning through collaboration, creativity, communication, and critical thinking. Our students will become thoughtful, responsible, and ethical producers of information prepared to thrive in a global economy.

Next Steps:

- Design technology purchase plan to increase the number of student devices in Lower School:
    - Extend 1:1 through 2nd grade
    - 1:2 in pre-primary (PK, K, and 1)
- Explore more affordable alternatives for 1:1 devices in upper elementary grades and write a comparative analysis for review in budget decisions.
- Design a comprehensive professional development plan to support the integration of student devices in the classroom--aligning purpose of activities to appropriate use--with specialized support for one-to-one environments.
- Educational Technology will work closely with the Educational Design department to continue to support teaching and learning goals with technology integration in curriculum, instruction, and professional development.

For your reference:

- Google Slides presentation from the meeting
- EdSurge post on SAMR and Starbucks
- ISTE's Shared Vision - best practices in effectively leveraging technology for learning

On behalf of [redacted] please accept our sincere appreciation for your time and efforts. It is your work that continues to propel [redacted] forward. Thank you!

Sincerely,

[redacted]

Current Student Devices:

- PK - 3 Shared grade level set of iPads
- 4 - 5 1:1 iPads
- Ed Tech iPad cart
- Comp Sci iPad cart
- *Laptops/Desktops (varies depending on campus)
- Approximately 300 iPad 2s in grades PK - 3 require replacement for 2016-17

Device Comparative Analysis:

iPads		**Chromebooks**	
Apple iPad Air 2 Wifi 64 GB	$579	ASUS Chromebook Flip	$269
Protective Case	$49		
Keyboard	$54		
JAMF Management (3yr)	$21	Management (3yr)	$30
Subtotal Device	**$703**	**Subtotal Device**	**$299**
PowerSync Cable 1:5	$59		
PowerSync Cabinet 1:10	$599	Ergotron YES12 Cabinet 1:12	$650

iPads	**Chromebooks**
○ Touchscreen interactive	○ GAFE suite
○ Apps	○ Built-in keyboard
○ Creation device	○ Integrated security
○ Known device	○ Simple deployment & manageability

Option 1:

- iPads 1:2 grades PK - 3
- iPads 1:1 grades 4 - 5
- Purchase 500 iPads - approximate total cost of **$254,102**
- Note: Faculty in FTL requested grade level shared laptops in grades 1-5

Option 2:

- iPads 1:2 grades PK - 3
- Chromebooks grades 4 - 5
- Class set of iPads in grades 4 - 5
- Purchase 40 iPads; 328 Chromebooks - approximate total cost of **$158, 924**
- Note: Addresses FTL faculty request for shared laptops in grades 4-5

Option 3:

- iPads 1:2 grades PK - 1
- iPads 1:1 grades 2 - 5
- Chromebooks 1:1 grades 4 - 5
- Purchase 500 iPads - approximate total cost of **$387,350**
- Note: Faculty in FTL requested grade level shared laptops in grades 1-5

Option 4:

- iPads 1:2 grades PK - 1
- iPads 1:1 grades 2 - 3Class set of iPads in grades 4 - 5
- Purchase 212 iPads; 384 Chromebooks - approximate cost of **$292,172**

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