2022

Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Adam Douglas Smeets

LOYOLA UNIVERSITY CHICAGO

CHANGES IN TEACHER PEDAGOGY AND
STUDENT ENGAGEMENT IN ELEMENTARY 1:1 CLASSROOMS

A DISSERTATION SUBMITTED TO

THE FACULTY OF THE GRADUATE SCHOOL OF EDUCATION

IN CANDIDACY FOR THE DEGREE OF

DOCTOR OF EDUCATION

PROGRAM IN CURRICULUM AND INSTRUCTION

BY

ADAM SMEETS

CHICAGO, ILLINOIS

MAY 2022

ACKNOWLEDGMENTS

To my Chair, Dr. David Ensminger, I cannot ever thank you enough for your undeniable patience, commitment, flexibility, insights, knowledge, and understanding through this journey of self-discovery and transformation. From my first class with Dr. Ensminger, I knew that he would be a transformational figure personally and professionally – little did I know that it would be at the scale of my Loyola experience. I am eternally grateful for him, this experience, and many other reasons that could take up a ream of paper.

To my Committee, Dr. Kate Marek and Dr. Kelly Ferguson, I value your dedication, feedback, professional advice, perspectives, and insights, each of which I will cherish throughout my professional journey. You both have a radiating and addictive passion for education that inspired me to press on and develop this study to its greatest potential.

Dr. Kathleen Castillo-Clark, my friend. Thank you for constantly pushing me to be the best version of myself through our time at Loyola, this process, and well beyond. While Starbucks is no longer at the corner of Pearson and State, I will forever hold close our coffee conversations, time in class, and our connection as we made it through the cohort experience and then some. I respect, admire, and love your brilliance, wit, perseverance, determination, wisdom, and valor.

To Justin, Mom, Dad, and Annie, as you know, this dissertation has been *many* years in the making. Each of you was instrumental in supporting my journey – bouncing off ideas and touring our kids on adventures to ensure I had the opportunity to “write Papa’s big paper” that the kids always took guesses trying to figure out the page count. Thank you for your support, continued encouragement, trust, and love as I pursued this dream and passion.

To Mrs. Peggy Hart, the best composition teacher <u>ever</u>, you taught me how to write and the valuable lesson of a solid backup plan in the face of a challenge. Most importantly, you valued my voice in an environment that was not always open to hearing from a small-town closeted student. Her lessons and activities fueled my passion for writing, education, and the service of others. (And *yes*, I did snap the rubber band at another student in the class and earned my only detention ever. Yes, it was worth it.)

Mrs. Debbie Hudolin, my first-grade teacher, taught me her appreciation and to value the individual word. (She also *may* or *may not* have secretly supplied me with worksheets for my at-home “classroom,” which would become my life’s calling in the service of education.) While she passed in 2020 before I completed this dissertation, her energy and spirit flow through the pages of this study and continue to reverberate through the halls of Elwood School. For her 40 years of service in education, I rejoice in knowing all the excited children learning to read and the teachers who celebrate that joy and exploration with fascination.

To my children, Collins, Emmett, and Harper, I dedicate this labor of love to you.

In the words of my favorite author, the profound Toni Morrison, who discusses parenthood as a fundamental and profound act of resistance with Andrea O'Reilly for her 2004 book, *Toni Morrison and Motherhood: A Politics of the Heart*:

> There was something so valuable about what happened when one became a mother. For me, it was the most liberating thing that ever happened to me. Liberating because the demands that children make are not the demands of a normal 'other.' The children's demands on me were things that nobody ever asked me to do. To be a good manager. To have a sense of humor. To deliver something that somebody could use, and they were not interested in all the things that other people were interested in, like what I was wearing or if I were sensual. Somehow all of the baggage that I had accumulated as a person about what was

valuable just fell away. I could not only be me—whatever that was—but somebody actually needed me to be that. If you listen to [your children], somehow you are able to free yourself from baggage and vanity and all sorts of things and deliver a better self, one that you like. The person that was in me that I liked best was the one my children seemed to want.

The secret to doing anything is believing that you can do it. Anything that you believe you can do strong enough, you can do. Anything. As long as you believe. […] Didn't you know you had that much power? You can move mountains. […] This is your world. You are the creator. Find freedom on this canvas. Believe that you can do it, 'Cuz, you can do it. You can do it.

— Bob Ross

TABLE OF CONTENTS

APPENDIX

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Technology advances at a pace that far exceeds the rate of change possible in education. Without adjustments to their pedagogy, teachers continue leveraging pedagogical practices that do not match the effective use of technology in classrooms. This qualitative, retrospective instrumental case study explores two areas of the connected elementary classroom: (1) how teachers adapt their instructional practices as a result of 1:1 device adoption at their school and (2) teacher perceptions of change to classroom communication and student engagement the adoption of 1:1 devices. The data for this study was collected through a questionnaire, three-part semi-structured interviews, and district document analysis. Pedagogical changes in 1:1 classrooms occurred through review and practice of TPK and TCK, the use of data to inform practice, and reflection on current practices. Teacher pedagogy was impacted by organizational and personal factors which impeded change. These findings illustrate the value of communities of practice, support structures for ongoing training and development, organizational partnership, and fostering a fail-forward culture.

CHAPTER I

INTRODUCTION

Overview

In the 1960s, Intel's co-founder Gordon Moore documented his observations on the technology industry. These insights included the pace, acceleration, and financial costs of innovation. Moore speculated that the speed and capability of technology would improve every two years while decreasing overall cost (1965). Today, technology is part of nearly every facet of our world: how we engage and communicate, record and store information, perform our daily work, find entertainment, and, most recently, how students attend school.

Technology tools and resources directly impact the classroom, instruction, and learning. In a 2019 Consortium for School Networking (CoSN) survey (N=335) on technology in K-12 schools, 88% of district leaders responded that they had a goal of providing a technology device to each student, with 60% having already implemented such a program (CoSN et al., 2019b). In addition to student devices, classrooms now have smartboards, interactive screens, projectors, artificial intelligence tools, and other technologies facilitating interactions with students and teachers.

Technology has a more profound influence in the classroom for students who grew up in an era of ubiquitous access to technology. The tools and resources available influence how students and teachers think, engage, and connect with their world. While students and teachers *may* have the technical skills, it is a false assumption that they are inherently tech-savvy multi-taskers who also want to use technology for learning; though they do expect technology to be part of their day-to-day lives for communication, engagement, and entertainment outside the classroom (Jones & Czerniewicz, 2010; Kirschner & De Bruyckere, 2017; Prensky, 2005).

With a wide variety of technologies available, acquiring up-to-date, relevant, and pedagogically aligned technology that reflects the pace of change and innovation is both a priority and challenge for schools (Calhoun Williams, 2019). Schools are like giant ships moving in the ocean, bobbing and attempting to stabilize when they enter rough waters. While they can change course, it is not often done quickly or with grace. This lack of nimbleness is especially true when developing standards and implementing technology beyond local, small-scale pilots. At scale, implementations require significant hidden resources, strategic planning, and stakeholder collaboration (CoSN et al., 2019a).

Even when students and teachers have experience working with their own technologies and those available in classrooms, there is no guarantee of positive learning or instructional outcomes for the student or teacher. With the increase in available educational technology resources, researchers and educators continue to explore a set of fundamental questions: is technology being used effectively by teachers, what are the pedagogical impacts of technology in the classroom, and are digital tools used appropriately (Cuban, 2001; Martorella, 1997; van der Laan, 2004)?

While research on 1:1 Chromebook programs, a laptop that runs Google's Chrome operating system, and other technology devices issued to students in K-12 education includes examinations of approaches to device implementations (Islam & Andersson, 2016; Islam & Grönlund, 2016), improvements to learning outcomes (Bebell & O'Dwyer, 2010), increased achievement (Gulek & Demirtas, 2004), recommendations for practice (Donovan et al., 2007; Donovan & Green, 2009) and engagement (Donovan et al., 2010), research is not as robust on the pedagogical changes resulting from technology devices in the elementary classroom. Mishra and Koehler (2006) argue that these pedagogical changes result from the new knowledge created, called technological pedagogical content knowledge (TPACK). A focus on this area can inform professional development approaches for elementary teachers with 1:1 classrooms, considerations for how curricular and pedagogical change occurs, and methods for evaluating technology's perceived value.

Statement of Problem

The adoption of classroom technology continues to expand (Gray et al., 2010). Without adjustments to their pedagogy, teachers may continue leveraging pedagogical practices that do not match the effective use of technology in their classrooms (Kelly et al., 2009). These adjustments are based on a foundation of Chickering and Gamson's (1987) seven principles of good educational practice[1] and align with the goals of the

[1] While Chickering and Gamson's (1987) article aligns with undergraduate education, their principles connect across all grade levels. These include encouraging communication, cooperation and reciprocity, active learning, prompt feedback, time on task, communicating high expectations and respecting diverse talents and ways of learning (p. 2).

study site: the planning and design of lessons, content aligned for authentic student engagement and interaction, educationally aligned methods for delivering information, and approaches for ongoing, holistic growth-focused assessment (Bloom, 1956; Dewey, 1916; Mager, 1962; Pellegrino et al., 2001; Tom, 1997). While there is a growing body of research on the impact of 1:1 initiatives that provide computers or tablets to students as a learning tool, research on pedagogical changes by elementary school teachers is limited. Additionally, while research is robust on student engagement outcomes, fewer studies examine classroom communication and engagement from the teacher's perspective after a 1:1 classroom implementation.

Statement of Purpose

The purpose of this study is to explore elementary teachers' pedagogical changes after a district adopts 1:1 Chromebooks – laptops designed to run Google's operating system and connected to the Google Apps platform. This qualitative retrospective instrumental case study will focus on how elementary school teachers changed their instructional practices due to 1:1 adoption. Additionally, this study will examine these teachers' perceptions of how classroom communication and student engagement changed after 1:1 adoption.

Research Questions

This study seeks to provide insight into the relationship between 1:1 devices in the classroom, a teacher's evolving pedagogy, and the influence of 1:1 technologies on student engagement and communication. The following research questions and sub-questions will guide this study:

1. How do teachers adjust pedagogical practices in 1:1 classrooms?

    1a. How do 1:1 devices in classrooms influence teacher pedagogical practices?

    - Planning and design of instruction
    - Selection of content
    - Delivery of instruction, instructional strategies, and techniques
    - Assessment strategies, techniques, and procedures

2. How do teachers describe shifts in their classrooms since implementing a 1:1 program?

    2a. How do teachers perceive student academic engagement in a 1:1 classroom?

    2b. How do 1:1 devices in classrooms influence communication for and between teachers and students?

    2c. How do 1:1 devices in classrooms influence communication for and between students?

Local Context

Bear Rapids School District[2] (BRSD) is a suburban midsized public school district that serves students from Pre-K to 12+. The District has a student enrollment of 27,000 and 3,000 employees working across 33 schools (Bear Rapids School District, 2019a). This study focuses on elementary schools, where PK-5 enrollments ebb and flow based on new property developments, student mobility, and family employment. Average class sizes for elementary schools range from 24 students in grades K-1 to 27 students in grades 2-5 (Illinois State Board of Education, 2019).

Looking at the District's elementary schools, the Illinois State Board of Education (2020b) assigned a summative designation of exemplary to nine schools and twelve as commendable. While there are several factors, the key to an exemplary status means that the schools performed in the top 10% of schools statewide, had a graduation rate above 67%, and did not have any subgroup performing below the level of "all students." Commendable means that the schools were not in the top 10% statewide and did not have any subgroup performing below the "all students" level (Illinois State Board of Education, 2020a).

District families expect their schools to be focused on student success and connected to the community. These expectations are drawn from BRSD's goals to achieve a 95% community satisfaction rating of A or B by 2020. As of 2019, 94.2% of

---

[2] Bear Rapids School District and Kodiak Creek Elementary School are fictitious names used to support the confidentiality of the participating district and school while examining each of the cases. Pseudonyms are used to represent the participants in this study due to the number of elementary schools and teaching staff in the District and school.

parents rated this in the Illinois 5Essentials survey (Buglio, 2020). A supporting element of student success involves the student graduation rate. At 96%, high schools have a large percentage of graduating students, with 86% enrolling in college within 12 months (Illinois State Board of Education, 2019).

1:1 Program Adoption

The District identified that "teachers and pedagogy are the key drivers of student achievement" and committed to focusing their efforts on a digital transformation initiative (Sullivan et al., 2017, p. 6). In 2011, the District sent a contingent of staff members to Forsyth County, Georgia, to understand the value and impact of a Bring Your Own Technology (BYOT) program for enhancing a student's educational experience and success (Gorbatkin, 2011). BYOT is a program where students bring their own devices to the classroom rather than school-issued devices. During the visits, the Technology Director identified several areas that needed resolutions to be successful: (1) addressing the digital equity gap for students that would not have their own device, (2) providing appropriate staff support in elementary and middle schools, (3) a robust infrastructure that could support the new wireless devices, and (4) consent from families to address the legal issues with students connecting to the internet (Gorbatkin, 2011).

Developing the Bring Your Own Technology Program

Over the next several months, teachers participated in a pilot program where students would bring a personal device or borrow a laptop from the mobile cart if they did not have access to one. The Technology Services department surveyed teachers shortly after the pilot began. When asked how often they use laptops or student personal devices as instructional tools, 40% of teachers (N=1,000) indicated that they never used the devices from the mobile carts. Another 40% shared that they used the devices as frequently as monthly. Interestingly, 59% of students (N=3,400) felt that their school encouraged them to use technology as a learning tool, while in the same group, 92% used technology at home to study or work on class assignments (Strang et al., 2011).

Starting in the 2012-2013 school year, the District made additional investments in mobile cart computers with the primary purpose of administering the State of Illinois mandated assessments, but also to lay the foundation for a more robust 1:1 program. It was not the goal of the original mobile cart program to provide a computer for every student since the device ratios for students through the mobile cart program were 5:1 for elementary students, 3:1 for middle school, and 4:1 for high school students (Strang et al., 2011).

1:1 Chromebook Pilot and Device Selection

With the success of the mobile cart deployment pilot, the District hosted a series of focus groups that included students, staff, parents, and community members to gather feedback and evaluate the next steps, including device options. Participants reviewed six devices that represented various form factors, weights, and feature sets during these sessions. Participants were asked to provide feedback in a Google Form that included questions about the physical characteristics, screen resolution, appearance of text and graphics, the keyboard and mouse, and overall impression of the device’s ease of use.

Feedback from the focus groups included the ease of use and portability of devices (Bear Rapids School District, 2013):

> It is a nice machine. Definitely a contender. I guess with all these devices, what would matter is durability. Kids and teachers are pretty tough on equipment. For such a substantial investment, durability is pretty important. (Grade 3-5 Teacher)

and concerns about the learning curve:

> It will require a definite learning curve. Manipulating and maneuvering are quite different (two fingers for right click) will take some getting used to but young students are fast learners. Teachers are another story. (K-12 Parent)

with overall feedback optimistic about Chromebooks:

> Wow...I am instantly impressed. Why am I drawn to this? Sleek, small, light, easy to use for kids K-5. (PK-12 Teacher)

These focus groups and feedback sessions led to selecting Chromebooks for a middle school pilot in August 2015. Like other districts over the past ten years, BRSD rallied around Chromebooks as the one-to-one (1:1) technology solution for students who wanted timely, relevant, and low-cost tools. At just below the cost of a paper textbook, Chromebooks support access to personalized learning tools at a low price point and deliver at scale. Based on Google's 2018 estimates, 30 million students and educators worldwide use a Chromebook in education and growing 275% year over year (Vamvakitis, 2019).

Leading up to the pilot, the team identified that for a "student to reach his or her greatest potential, we must set high expectations and believe that each student can achieve those expectations" (Davenport et al., 2015, p. 4). Further, they identified that teachers needed to implement effective instructional practices for all students to hone future-ready skills like creativity, collaboration, and communication (Davenport et al., 2015). Professional development sessions were offered for teachers in pilot classrooms on digital tools and best practices. As one example, the District leveraged Google Apps for Education for teachers and students. BRSD adopted Google Apps for Education in 2012, a collection of online applications (Docs, Slides, and Sheets) and cloud-based storage (Drive), which promotes communication and collaboration.

After the one-year pilot, 89% of students (N=367) indicated that having a Chromebook was beneficial to their learning, and 86% stated that they understood more about the lesson when using their device than without (Davenport et al., 2015). Teachers in the pilot program resoundingly indicated that the introduction of 1:1 computing changed their pedagogy related to technology integration. This feedback needs further evaluation since a survey was the only data collection method for evaluating success and outcomes. Further, the District did not conduct any focus groups or interviews. This study will serve as a vehicle for elevating District teachers' voices and further examine how 1:1 computing changed teacher pedagogy.

Current State

After the pilot programs, the District adopted the 1:1 program for implementation over three years. Table 1 provides the timeline for full-scale implementation in 2016-2017 with middle schools, followed by the high schools in 2017-2018, and elementary schools from 2018-2021.

Table 1

Implementation Timeline for 1:1 Chromebooks

Year	Staff device rollout	Student pilot	Student device deployment
2015-2016 *1st Semester*	Middle schools	6th grade, select teams	N/A
2015-2016 *2nd Semester*	N/A	Additional 6th & 7th grade teams	N/A
2016-2017	High schools	High school, select classes	Grades 6-8
2017-2018	Elementary schools	Elementary, grades 3-5	Grades 9-12
2018-2019	N/A	N/A	Grades 3-5
2019-2020	N/A	N/A	Grade 2
2020-2021※	N/A	N/A	Grades K-1

※ Devices were issued to K-1 students during COVID-19 remote learning.

Note. Reprinted from *Device Plan Recommendation: School board workshop presentation* (p. 18), by A. Davenport, S. Gorbaktin, K. Pease, and B. Hillman, 2015. Copyright 2015 by Bear Rapids School District.

During this time, the District changed its curriculum, enhanced its infrastructure, updated staff professional development to include technology pedagogy, and focused on the program’s evolution rather than rapid conversion (Davenport et al., 2015, p. 16). The program's growth included making configuration decisions and establishing requirements, policies, and handbooks. Comparisons of device configurations, settings, and links to program resources are provided in Table 2.

Table 2

Configuration of 1:1 Student Devices

	Grades			
	PK	K – 5	6 – 8	9 – 12+
Device	Apple iPad	HP Chromebook	HP Chromebook	HP Chromebook
Login	Student QR Code	Student QR Code (K-1) and Password (2-5)	Password	Password
Internet Access[3]	Most Restrictive	Aggressive	Moderate	Least Restrictive
Email	No Email Access	Request Only for K-2 & 3-5 To/From District Email Accounts	To/From District Email Accounts	Full Access
Applications	Pre-Selected by Curriculum & Instruction	Pre-Selected by Curriculum & Instruction *Students can add pre-approved Google Apps*		
Storage	Not Available	Google Drive and 16GB of Chromebook Storage		
1:1 Handbook	bit.ly/3ApseKM	bit.ly/3ApseKM	bit.ly/3tOkyyZ	bit.ly/39eGZE8
Student Agreement	bit.ly/3kjRn3T	bit.ly/3kjRn3T	bit.ly/3AkFvnA	bit.ly/3zi11Ig

The program was fully operational at the end of the 2018-2019 school year, with K-1 students receiving 1:1 device access in 2020 supporting COVID-19 remote learning.

[3] As provided by the BRSD Acceptable Use Policy, internet access is provided in accordance to the requirements of the Children’s Internet Protection Act (CIPA). Thise requires blocking or filtering access to visual depictions that are: (1) obscene, (2) pornographic, or (3) harmful or inappropriate for students.

Professional Development

During 1:1 device implementation for students and teachers, the District developed a repeatable training plan for supporting teachers (Bear Rapids School District, 2017a). This plan included whole group meetings, core and elective-focused content sessions, site visits, and library media center staff meetings. Schools also offered workshops during their institute and school improvement days, focusing on instructional approaches (Bear Rapids School District, 2017a, p. 6). Professional development experiences were available face-to-face, online, or blended environments and through professional learning communities and on-the-job mentoring (Sullivan et al., 2017, p. 25). Professional development efforts have moved to individual tool and service offerings more recently.

Evolution versus Rapid Conversion

When considering the 1:1 implementation at BRSD, time and culture are critical factors. The District culture at BRSD supported the organic development of projects rather than a rapid conversion approach (Sullivan et al., 2017, p. 17). This model meant that the pilot and implementation could stop and provide an opportunity to make changes and continue again. This approach also meant that the District could gather feedback from teachers about the best classroom device, approaches to instruction, and identify the resources needed to support students. One exception to this staged evolution was when access to devices became challenging for PK and Grade 1 students at the start of the COVID-19 pandemic. These students were not previously issued individual devices and were allocated to each classroom on a 4:1 basis. As a result of concerns regarding digital equity and access, the District purchased iPad devices for PK students and reused high school student devices for K-1 students to move to a 1:1 model during remote learning.

Approaches to Technology and Devices

Today, Bear Rapids supports 27,800 1:1 student devices. As listed on their Parent FAQ (Bear Rapids School District, 2016), BRSD defines the purpose of their 1:1 program to improve academic performance through the effective use of technology that will inform instruction and enhance student learning (Pease & Lee, 2018). Further, the District promotes that student outcomes of building life and work skills and curricular goals as the primary focus, rather than a device or specific technology to direct decision making (Bear Rapids School District, 2018a). In the Teachers Union contract, the Teachers Association and School District detail their expectations for the use of technology in the classroom:

> The Board and the Association recognize the potential inherent in the use of technology to aid in the learning process. To that end, teachers are expected to use technology resources to enhance classroom management, curriculum delivery, parent communication and in other areas of their professional responsibilities. (2018a, p. 18)

There are representations in District professional documents that technology may serve as support; however, one specific technology is not the sole driver of classroom practices and instructional delivery. For example, in the 1:1 pilot program training, facilitators circled the essential question of "What do I want my students to learn from this lesson?" With this mindset, regardless of the device or model for delivering instruction, educators should have a pedagogical understanding of the effective use of technology to support learning and instruction, rather than using technology because it is in the room or connected to a student (Merriam, 2009, p. 40).

Research and Assessment

With a significant average investment of $10 million every three years, the District performed a limited evaluation of the 1:1 program after adopting Chromebooks. Recently, the District shared assessment reports which included student testing, state report cards, and other state-based metrics; however, organizational evaluations focused on informal questionnaires about perceived classroom experience improvements on a limited basis. For example, one of the first assessments included teachers' comments in a 2017 middle school-focused evaluation. Their feedback mirrored students' perceived improvements in problem-solving, critical thinking, collaboration, and digital literacy to their Chromebook use in the classroom (Bear Rapids School District, 2017b). Separately, the department asked middle school students how they communicated using their Chromebook, of which 79% of students indicated they used their device at least once to communicate with their teacher. In comparison, 99% used their devices for taking an assessment over the previous 30 days.

In the fifth year of their 1:1 program, Bear Rapids is interested in how these devices may influence each area. While the District indicates that "the type of device is far less important than an understanding of how it can be used to support instruction," program evaluation efforts have not focused on understanding changes in teacher pedagogical practices, student/teacher classroom engagement, or communication in a 1:1 classroom (Sullivan et al., 2017, p. 42). The lack of focus on pedagogical practice and engagement changes mirrors the limited emphasis on elementary classrooms and teachers in literature.

Positionality and Subjectivity Statement

At the age of four, my mother drove to our local bank to make an atypical withdrawal; the bank upgraded computer models and sold their older devices. To this day, I remember my excitement when she walked into the house with two large boxes full of parts: 5.25" floppy discs that loudly clicked when in use, a single-color, green cathode-ray tube monitor with a distinctive hum, and a massive all-in-one keyboard. After assembling the workstation, I started playing the games that came with it but quickly realized that I could make student tests for my pretend classroom and program applications.

I learned how technology functioned early in my childhood, from how Teddy Ruxpin[4] worked to later recording my own content. Later I would write computer applications that addressed school-wide issues. Fast forward 30 years, and I now consider

[4] Teddy Ruxpin, popular in the mid-1980s, was an animatronic toy who read stories to children using audio cassette tapes. This was a novel toy at the time based on the creative use of the cassette tracks. With stereo audio, both the left and right channels of the cassette tape are dedicated to audio. With Teddy Ruxpin-specific tapes, audio was only available on the right track, and control data was stored on the left track to control his eyes, mouth and gestures, creating an interactive experience for a child (New York Times News Service, 1985).

educational technology my calling. The former banker's computer served as a crucial platform and launching point for my professional future as a credentialed English teacher and technology leader in education.

From working in education for the past eighteen years, I have observed how technology is perceived, leveraged, and valued in K-12 and higher education. By default, technology should not serve as a single solution to institutional or curriculum issues. "Goals and outcomes first" is a critical mindset since it reminds educational leaders, students, and the community that educational technology is not the first decision when considering instructional approaches. Instead, educational technology has the potential to reinforce instructional objectives, goals, and individual learning styles. Further, we should understand how using a technology device, paired with pedagogical changes, results in an environment ripe with rich communication and encourages positive classroom engagement.

Educational technology is a blessing, and a curse, as the tools and resources alone cannot adequately fill our equity gaps. Since my time at Loyola University Chicago, I have been drawn to the critical nature of equity and social justice, most notably educational equity. Technology devices are sometimes argued to be the solution for educational equity and access (Mezzacappa & Hangley Jr, 2020; P. Stein, 2020; Wharton School of the University of Pennsylvania, 2008). While this is one piece of a complex puzzle, devices alone do not account for the growing digital divide impacting students.

Teachers must consider the trickle-down effects of their pedagogy related to technology; for example, assigning students homework that requires internet access at home without understanding the intricacies of the decision. These intricacies include (1) whether students have reliable access to the internet at home, (2) if a parent can provide technical support when needed, and (3) if their students have a foundation for digital citizenship when collaborating online. From this, equity must be a critical focus area when working through pedagogical changes, classroom innovation, and developing a curriculum that focuses on student engagement and collaboration.

Theoretical Framework

This study's theoretical framework is grounded in Koehler and Mishra's (2009) Technological Pedagogical and Content Knowledge (TPACK) conceptual framework, which examines the intersections of an educator's technical knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK). Each section comes together to form an individual's technological pedagogical content knowledge. This intersection is where Koehler and Mishra (2009) identify that technology can build on existing knowledge to develop new theories of knowledge or enhance existing.

Using TPACK as the framework will provide an approach to investigate and address the research questions by looking at teachers' instructional practices through the lens of TPACK. The framework influences the site selection, participants, research questions that guide and ground this study, and the data analysis. In-depth interviews, a questionnaire, and document analysis will be conducted to identify where TPACK behaviors are demonstrated during lesson construction, delivery, and instruction outcomes by teachers. It is essential to understand each of the following components as parts of the broader TPACK framework as they will also be used as guiding buckets later in data analysis.

TPACK represents the intersection of the three types of knowledge teachers need to succeed when integrating and working with educational technology: technological, pedagogical, and content knowledge (Koehler & Mishra, 2009). Through professional development and practitioner experience, teachers identify each area's sensitive nature that represents an evolving, not always transactional, relationship. Teachers can improve their awareness, competency, and self-efficacy toward technology (Ofsted, 2008; M. Swan, 2006). It is important to note that it is not merely about knowing each area independently but also how each area intersects. Each of these areas is reviewed below.

The Core Components of TPACK

Content Knowledge (CK)

CK is a teacher's knowledge of the subject area being taught. Shulman (1986) referred to this knowledge as the concepts, theories, ideas, organizational frameworks, knowledge of evidence and proof, and established practices and approaches toward developing such knowledge (Koehler & Mishra, 2009). Koehler and Mishra (2009) identify that teachers without a robust content knowledge base may deliver misguided or uninformed information, leading to students' misunderstanding.

For example, consider the content knowledge required to teach a high school algebra course. The course content would likely require the teacher to understand and teach linear equations, expressions, functions, and exponential functions. Suppose they do not have a firm grasp on these topics. In that case, their students will not acquire the skills necessary for future coursework or may misunderstand the approach to calculating these values, resulting in errors and re-teaching.

Pedagogical Knowledge (PK)

PK reflects a teacher's knowledge of teaching and learning methods, including the purpose of education, values, and goals (Koehler & Mishra, 2009). Thinking back to coursework, examples of PK include how to develop an effective assessment, understanding how students learn and acquire information, and classroom management. According to Koehler and Mishra (2009), teachers with deep PK "understand how students construct knowledge and acquire skills and how they develop habits of mind and positive dispositions toward learning" (p. 64).

Continuing with the previous example, when designing a curriculum for delivering quality instruction, the teacher must have the expertise to make algebra accessible for all students. While a teacher may have a firm grasp of their content area, this does not necessarily mean that they effectively know how to teach it at the same level of expertise. For teachers, this includes considering what practices and strategies would best support student learning, including classroom management techniques, developing lesson plans, and creating effective student assessments.

Math is not easy for all students. Based on the classroom conditions, a teacher with a base of PK may adopt a flipped classroom model to reach their emerging learners. The teacher creates small groups for intervention and follow-up in this model while other students complete independent work with developed online assignments and practice. Because of the increased level of support for differentiated instruction, students can explore topics individually in greater detail, all the while ensuring that students who are not grasping the material have an opportunity to re-engage with the content through a structured intervention.

Technological Knowledge (TK)

According to Koehler and Mishra (2009), TK is connected to the Committee of Information Technology Literacy of the National Research Council's recognition of teachers with high TK who:

> understand information technology broadly enough to apply it productively at work and in their everyday lives, to recognize when information technology can assist or impede the achievement of a goal, and to continually adapt to changes in information technology. (p. 64)

Given that technology knowledge changes more rapidly than CK and PK, Koehler and Mishra (2009) are cautious to acknowledge that TK's definition is likely to be outdated the minute it is published. TK does not reach an idle state or something that is achieved and remains constant. Instead, it grows and evolves along with a teacher's interactions with technology.

A teacher's technological knowledge will provide a base for applying pedagogical and content knowledge in the running example. For example, a teacher will need to consider the available resources and how well they know how to use the technology. The math teacher may want to use a resource to share the steps to evaluate an expression. One tool, Flipgrid™, provides an opportunity for students to share their responses through a video recording on teacher-defined topics. Without discussing the TCK and TPK implications of using Flipgrid, the math teacher needs to know how to create an account, create a course, invite their students to join using a code, moderate content, and record videos using their webcam.

While several other TK areas are required, this example shows how selecting a tool requires a base of technical knowledge that can later be applied and influences TCK, TPK, and TPACK. Again, TK grows and expands, so the teacher could review online help guides, videos, and other resources to understand better.

The TPACK Domains

Pedagogical Content Knowledge (PCK)

PCK is a type of knowledge that is unique to teaching and instruction. It is how teachers relate what they know about teaching and learning to their content area. Further, Koehler and Mishra (2009) indicate that PCK "covers the core business of teaching, learning, curriculum, assessment and reporting, such as the conditions that promote learning and the links among curriculum, assessment, and pedagogy" (p. 64). One area that helps promote a clearer understanding of PCK is that it considers context. For example, when teaching word problems, teachers with strong PCK would avoid shortcuts like searching for keywords instead of focusing on reading-comprehension strategies (Van de Wall et al., 2012; Van de Wall & Lovin, 2006). Consider this example story problem that is missing essential information:

There are 125 horses and 5 dogs living on the farm. How old is the farmhouse?

Rather than reading the whole problem to determine that they have insufficient information to answer the question, students may immediately see the two sets of numbers and divide to respond with an answer of 25. When students skim a word problem, they will look for action keywords and identify an operation to solve the problem rather than review the word problem. Van de Walle and Lovin (2006) remind that "mathematics is about reasoning and making sense of situations" for students, which will help them to identify the best solution, leading to math proficiency (p. 70).

PCK also represents an expansion of Lee Shulman's pedagogical content knowledge construct to include technology as a critical component of effective instruction. In his essay *Those Who Understand* (Shulman, 1986), Shulman argued that there were sharp divides between a focus on pedagogical or content knowledge as the premise for instruction over time in teacher preparation. In several examples from teacher assessments, he shines a light on regular "blind spot*s* […] where it is clear that central questions *were* unasked" about the content or pedagogical knowledge (Shulman, 1986). Instead, he argues that a teacher's pedagogical knowledge transforms subject matter knowledge. They are inextricably linked, introducing pedagogical content knowledge

(PCK) – highlighted in Figure 1 in green. Professional development for teachers and teacher education programs started encouraging the development of PCK since, according to Shulman, it is central to the "[…] understanding of what make*s* learning of specific topics easy or difficult" (Shulman, 1986).

Technological Content Knowledge (TCK)

TCK involves the interplay between technology and content. It is not enough to understand the content area as a teacher; they must also understand the capability of technologies to communicate, display and demonstrate concepts, constructs, and theories of their content (Koehler & Mishra, 2009). Technology choices can support and restrict the type and approach of instruction, specifically those that deepen student inquiry and support lasting learning. Likewise, specific content can limit the technology and approaches used in instruction.

For the running example, if a teacher wants to develop a lesson on mathematical functions, they may use Geometer's Sketchpad, mathematics visualization software, to display dependent and independent variables. These values and representations are static in a textbook, while the teacher can demonstrate various scenarios using the software. To do this, the teacher needs to know how to use the software application to connect to the content area and information presented.

Technological Pedagogical Knowledge (TPK)

When technology is integrated into the classroom, changes in teaching strategy often occur. TPK focuses on how teaching and learning are influenced or changed based on how technologies are used differently (Koehler & Mishra, 2009). Examples of this knowledge include the available technology tools, the capabilities and opportunities available in each resource, and how they can be used to support or detract from learning.

Teachers need to know which technologies best fit their individual students' learning needs to apply instructional strategies for engaging with technology in pedagogically appropriate ways. While the teacher used Geometer's Sketchpad in the previous example, TPK's focus would be on understanding the landscape of tools available to promote student understanding, with less emphasis on the content supporting the lesson. The teacher would also consider how they could use Sketchpad to demonstrate the interplay between dependent and independent variables so that students could interact and engage with their examples. For example, students could share the functions developed in their files and collaborate in a shared document on their findings.

Technological Pedagogical Content Knowledge (TPACK)

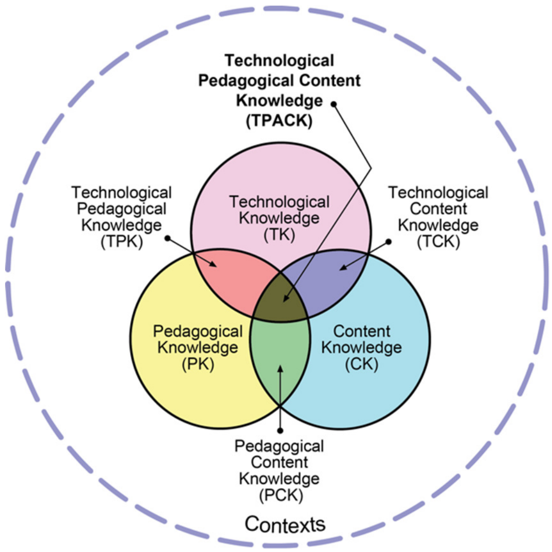
This study's theoretical framework is at the center of Figure 1 in the dark purple shaded area. Teachers need to intertwine their technology, pedagogy, and content knowledge in a single fiber for quality teaching supporting learning and technology integration. According to Mishra and Koehler (2006), TPACK and good teaching include:

> […] understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how

> technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones. (p. 1029)

In short, technology can not be placed on a shelf kept away from teaching and learning. When cohesively integrated, technology tools cannot be tacked on to an assignment but must thoughtfully and intentionally be included in the overall planning process. In tandem with the growth of an individual's knowledge in their content area, receiving professional development to learn new pedagogical strategies, or participating in technology training to increase understanding, an individual's TPACK is dynamic, changing as each focus area ebbs and flows.

Closing out the high school algebra example, a TPACK focus on the lesson would include using technology to represent and support knowledge creation about functions. In this case, the teacher could use a Geometer's Sketchpad as a guiding factor in the lesson, rather than a technology add-on. Students would explore the software first to support creativity, engagement, and open dialogue about their findings. The teacher would then model the software and an example function, then open the application for student use and further exploration. Students would complete a series of activities through peer work to connect with the concepts and further student engagement more deeply in the classroom. Using Geometer's Sketchpad to identify similarities and differences, students will investigate critical properties in each function. As the assessment for this activity, the students would complete a series of questions as part of a digital “exit ticket” to demonstrate their understanding of the key concepts.



Note. The figure represents the intersections of an individual’s technical knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK). The image is reproduced by permission of the publisher, ©2012 by tpack.org.

Figure 1. *Koehler and Mishra’s (2009) TPACK Framework*

Assumptions

Based on my information technology and education work experiences, this study is being conducted based on a series of researcher assumptions with the research process and the 1:1 technology environment. First, this is a post-implementation study and is not the first year of engagement with Chromebooks for district students and staff. Students at the site school have used 1:1 devices in the classroom for the past two years. Having access for two years assumes that teachers will recall their initial feedback on the program they actively participated in, including growth and ongoing changes in their classroom, beliefs, and overall perceptions. In addition to their professional feedback, it is assumed that teachers' answers will be open, honest, and are recalled based on their experiences in their 1:1 classroom. Further, it is assumed that participants' attitudes, perceptions, and experiences represented the staff at the site. The study uses semi-structured, open-ended questions to reduce bias and not guide the participants' answers in the questionnaire and interviews.

I will also assume that my interpretations and definitions of classroom technology will likely differ from that of participant teachers. This will be the case among the participants and the pedagogical decisions made through their definition of technology. TPACK may also not be a term or definition commonly used by teachers in the study. In the document review, questionnaire, and interviews, I will be looking for evidence of each teacher's technological, pedagogical, and content-related choices. Further, in the research questions, "influence" is not used for implying or referring to direct causation. For example, 1:1 devices in classrooms do not solely cause a change in teacher pedagogical practices, nor should it be assumed that the study implies they are the sole driver of the change before data collection.

Limitations

This study has a series of limitations in its methodology that cannot be controlled for and thus potentially may impact the findings (Price & Murnan, 2004). First, site-based restrictions will affect data collection and the research process. As a result of COVID-19 limits in the county and school district, interviews will occur remotely and will not include classroom or student observations. With remote interviewing and no observations, self-reported data will be leveraged along with other data collection efforts. Since participants provide self-declared responses and analysis of changes, the study assumes that participants can reflect and recall experiences over the past three years.

While this study describes a phenomenon and reports its findings, readers may develop naturalistic generalizations from the participants' unique perspectives and experiences. Stake and Trumbull (1982) explained that as readers connect to the details of a study and align them with their own experiences, they make a personal determination that the generalizations made are warranted to gain further insights (Mills et al., 2013).

Additionally, research on the district's 1:1 program is being performed post-implementation along with the inquiry on teacher pedagogical changes. While BRSD is currently in its fourth year of using student 1:1 devices, they completed their first year with K-1 elementary students using Chromebooks remotely during COVID-19 remote learning. As a researcher in this study and a former staff member at BRSD, I may have worked with staff where the study is based; however, I did not work directly with any participants on Chromebooks or 1:1 technology projects.

Delimitations

Delimitations for this study include elements that will limit the scope of the study and define specific boundaries. For this study's context, I will not evaluate or observe any of BRSD's middle or high school classrooms or staff, nor will I evaluate other area school districts. To further limit the study's scope and context, I will select one of the district's 21 elementary schools to focus the findings, specifically to examine the comparisons between device adoption and integration at elementary schools. With the impact of COVID-19 on teaching pedagogy and direct instruction outside the physical classroom, this study will focus on the time before remote instruction and after their return to schools.

While BRSD's classrooms have other technologies in the space, including smartboards, televisions, and projectors, the primary focus will be on the teacher's laptop and a student's 1:1 Chromebook device. When evaluating the research questions, this study will focus on engagement, communication, and a teacher's pedagogical decisions but will not address the links between engagement and individual student achievement. The current research abounds with support and concerns regarding student achievement and social learning, so this study will focus on areas with limited scope and reach in contemporary literature. As a result, no student artifacts will be collected or evaluated. Lastly, this study will not evaluate the curricular value, quality, content, or strength of instruction provided by any educator.

Definition of Key Terms

The following is a list of key terms explicitly related to this case study on 1:1 programs in K-12 schools:

1:1 (One-To-One) Program: 1:1 program refers to students using technologies in conjunction with their education, most commonly with a computer or tablet issued to each student. The student is ultimately responsible for the device's contents and safety (Penuel, 2006). Students use the device inside and outside the classroom, carrying the device back and forth from school to home for classwork and homework.

1:1 School: A 1:1 school refers to a school or district providing personal technologies to each student. The student is ultimately responsible for the device's contents and safety (Penuel, 2006).

21st Century Skills: The American Association of School Librarians (AASL) provides domains and competencies for 21st-century learners, including the ability to (a) inquire, think critically, and gain knowledge; (b) draw conclusions, make informed decisions, apply knowledge to new situations, and create new knowledge; (c) share knowledge and participate ethically and productively as members of our democratic society; and (d) pursue personal and aesthetic growth (2009, p. 24). The AASL's definition is extended and validated when overlaying the context and needs of the modern and future workplace, which includes (a) digital-age literacy, including visual and information literacy; (b) inventive thinking, including curiosity, risk-taking, and creativity; (c) effective communication, including teaming, collaboration, and interpersonal skills; and (d) high productivity, including effective use of real-world tools (Lemke et al., 2003).

Adaptation: A change or adjustment based on a new situation, context, or circumstance.

Adoption: The acceptance or agreement with a new situation, context, or circumstance. In this study, adoption is used to understand the level of acceptance of technology in teachers' daily practices and pedagogy.

Chromebook: A laptop with a Google Chrome operating system. This Linux-based device is a Google-centric product that connects to the essential functions of Google's web-connected applications (Docs, Slides, and Sheets), cloud-based storage (Drive), applications available from the Google Play store, and a web browser with installable extension.

Code-switch: While more commonly used when alternating between languages in a single conversation or context, in the context of this study, code-switching is being applied when students rotate between classrooms and approach different instructional technology strategies across teachers. This experience is a more typical narrative in classrooms where teachers need to find entry opportunities for student learning, engagement, and collaboration (Fiester & Green, 2016; Rekimoto et al., 1998).

Digital Divide: Originally defined by Llyod Morrisett (Hoffman & Novak, 1998), the economic, educational, and social discrepancies and inequalities between socioeconomic groups with computers and online access and those who do not (Merriam-Webster Online, n.d.)

Educational Technology: The study, design, and ethical practice of facilitating learning through reflective pedagogy to improve performance and the holistic development of a 21st-century learner. Improvements are achieved by creating, collaborating, and fostering personalized engagement with technology.

Mid-size Suburban School: Based on the National Center for Education Statistics (Snyder et al., 2007), suburban schools are close to major cities and urban areas. Mid-size suburban schools are outside of a principal city but in a metropolitan area less than 250,000 but greater than 100,000 residents.

Hidden Curriculum: Lessons or knowledge learned but not outwardly defined or expressed as part of the outcome. This curriculum includes beliefs, values, social norms, gender, language, and behavior communicated and not necessarily directly stated. A hidden curriculum may represent characters, images, history, and morals.

Instrumental Case Study: The study of a person, specific group, or organization (a case) to provide insights into and understanding of a particular issue, redraw generalizations, or build theory (Mills, 2013a).

Retrospective Case Study: This longitudinal approach collects all data, including first-person recall, after the fact. The events and activities have already occurred, and the outcomes are also known by participants and/or the researcher. A timeline of events and variables that change over time may also be reconstructed after the events have occurred (Mills, 2013b).

Specials: Elective courses taken in elementary and middle school that specialized teachers teach. At BRSD, these classes are in addition to classroom studies like math, social studies, and English Language Arts. Specials offerings include physical education, art, music, and Library Media Center (LMC).

Technological Pedagogical Content Knowledge (TPACK): TPACK is the new knowledge created when combined: technical knowledge, pedagogical knowledge, content knowledge, technical pedagogical knowledge, and technical content knowledge. TPACK is necessary when using technology to teach content in pedagogically significant ways (Koehler & Mishra, 2009).

Summary

The purpose of this study is to explore a district's adoption of 1:1 Chromebooks in elementary classrooms. A qualitative retrospective instrumental case study design will analyze how teachers changed their instructional practices because of the 1:1 adoption. Each case will be analyzed separately, and additional analysis will be made across cases. This will develop a rich description of teachers' pedagogical changes and perceptions of how classroom communication and student engagement shifted after 1:1 adoption.

Chapter 2 presents a review of the related literature, providing a review of 1:1 technologies, the impact on teacher pedagogy, and the opportunities for research in this study. Chapter 3 delineates the literature-grounded research design and overall methodology of this study, including the sampling methods, data collection, data analysis, and the ethical considerations of data collection in a public K-12 school district. The findings of this research will be presented in Chapter 4 with participant introductions and each interview question. This chapter will also provide a comparative case study analysis across studies. Chapter 5 discusses the study's implications, addresses the research questions, and makes recommendations for further research. Lastly, Chapter 6 presents a reflection of my Loyola and dissertation experience.

CHAPTER II

REVIEW OF RELATED LITERATURE

Overview

Technology is not new. Instruction is not new. What is new and changing is the relationship between technology and instructional practices in the classroom in 2021 and beyond. In alignment with this study's research questions, this chapter will provide a sketch of educational technology's roots and the emergence of pedagogical advancements and challenges that came with the growth of 1:1 programs. This layout will support the investigation of changes in pedagogical practice in the 1:1 elementary classroom.

Defining Educational Technology

Educational technology has been defined and interpreted in many ways. There is common ground when comparing the following three interpretations, yet they emerge with a set of explicit values. Notably, these definitions include one's philosophy and ethics when applying technology in the classroom. The first is from the Association of Educational Communications and Technology's (AECT) field definitions that posit a foundation in the study and ethical practice:

> Educational technology is the **study and ethical practice** of **facilitating learning** and **improving performance** by creating, using, and managing appropriate technological processes and resources. (Richey et al., 2008, pp. 24–25)

The second definition provided by Hap Aziz (2010), Director of the School of Technology and Design at Rasmussen College, does not include ethical practice as referenced in the AECT definition but focuses more directly on enhancing teacher pedagogy:

> Educational technology is the considered **implementation of appropriate tools, techniques, or processes** that facilitate **the application of senses, memory, and cognition** to **enhance teaching practices** and **improve learning outcomes**. (p. 1)

Like the AECT definition, Aziz focuses on improving student performance but adds a broader picture of student development beyond just understanding. This definition also introduces a teacher's pedagogical practice to improve outcomes. The third definition from Song and Kidd (2009) provides a base for the three areas for improving the teaching and learning process through technology with an emphasis on mind, body, and spirit:

> *[Educational technology involves the…]* includes **analysis, design, development, evaluation, and implementation** and management of instructional systems and other learning environments that **contribute to learning** and **the development of the mind, body, and spirit**. (p. xxiii)

Comparing the two previous definitions to Song and Kidd, implementing educational technology's professionalism and craft expands the running definition. Instead of applying "senses, memory, and cognition," Song and Kidd (2009) introduce that when appropriately applied, educational technology can further the growth of a student beyond only the facts of a lesson.

For this study, educational technology will be defined as the study, design, and ethical practice of facilitating learning through reflexive pedagogy to improve the performance and holistic development of a 21st-century learner. Improvements can be achieved by creating, collaborating, and fostering personalized engagement with technology.

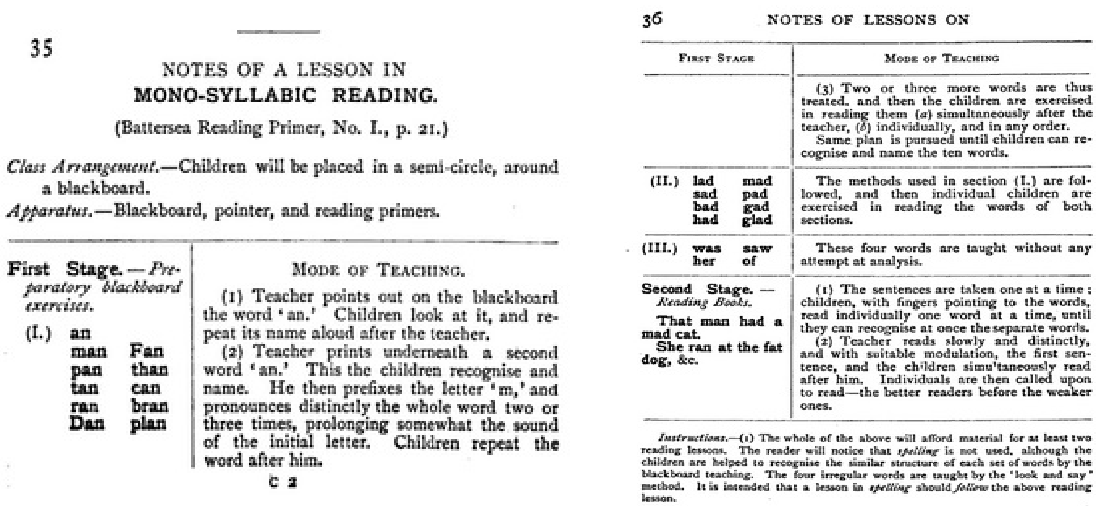
Brief History of Classroom Technologies

Educational technologies have a history best defined by a repeating pattern where new technology makes difficult knowledge easier to attain (Provenzo & Cuban, 1986). This pattern will be explored through six key classroom technologies: chalkboards, textbooks, film, television, computers, and mobile devices. This review is not intended to cover all technologies but instead provide a high-level overview of technology's role in education and pedagogical changes.

Slate Tablets to Chalkboards

Looking back to the American schools in the 1800s, teachers and students would work out of one-room buildings to develop literate and ethical citizens (Valente, 2012). As communities established larger populations and increased student enrollments, educational technologies were introduced to help students learn. While not the smartboard or interactive touchscreens we know today, chalkboards were one of the earliest advances that moved students from individual slate tablets to the use of a chalkboard. Shade (2001) explained that as technology changed, so too did the evolution of teachers' technology pedagogy as chalkboards in classrooms "went unused for many years until teachers realized that it could be used for whole group instruction. They had to change their thinking from individual slates to classroom slates” (p. 2).

In the late 1800s, teaching manuals included chalkboard instructions for each subject. In Figure 2, pedagogy is connected to chalkboard instruction as reflected through rote memorization, demonstrated through skills and drills at the chalkboard (Wylie, 2012). The chalkboard in this example primarily acts as a presentation space indicated in the lesson instructions.



35

NOTES OF A LESSON IN
MONO-SYLLABIC READING.

(Battersea Reading Primer, No. I., p. 21.)

Class Arrangement.—Children will be placed in a semi-circle, around a blackboard.
Apparatus.—Blackboard, pointer, and reading primers.

First Stage. —*Preparatory blackboard exercises.*	MODE OF TEACHING.
(I.) **an** **man Fan** **pan than** **tan can** **ran bran** **Dan plan**	(1) Teacher points out on the blackboard the word ‘an.’ Children look at it, and repeat its name aloud after the teacher. (2) Teacher prints underneath a second word ‘an.’ This the children recognise and name. He then prefixes the letter ‘m,’ and pronounces distinctly the whole word two or three times, prolonging somewhat the sound of the initial letter. Children repeat the word after him.

C 2

36 NOTES OF LESSONS ON

FIRST STAGE	MODE OF TEACHING
	(3) Two or three more words are thus treated, and then the children are exercised in reading them (*a*) simultaneously after the teacher, (*b*) individually, and in any order. Same plan is pursued until children can recognise and name the ten words.
(II.) **lad mad** **sad pad** **bad gad** **had glad**	The methods used in section (I.) are followed, and then individual children are exercised in reading the words of both sections.
(III.) **was saw** **her of**	These four words are taught without any attempt at analysis.
Second Stage. — *Reading Books.* **That man had a mad cat.** **She ran at the fat dog, &c.**	(1) The sentences are taken one at a time; children, with fingers pointing to the words, read individually one word at a time, until they can recognise at once the separate words. (2) Teacher reads slowly and distinctly, and with suitable modulation, the first sentence, and the children simu'taneously read after him. Individuals are then called upon to read—the better readers before the weaker ones.

Instructions.—(1) The whole of the above will afford material for at least two reading lessons. The reader will notice that *spelling* is not used, although the children are helped to recognise the similar structure of each set of words by the blackboard teaching. The four irregular words are taught by the ‘look and say’ method. It is intended that a lesson in *spelling* should *follow* the above reading lesson.

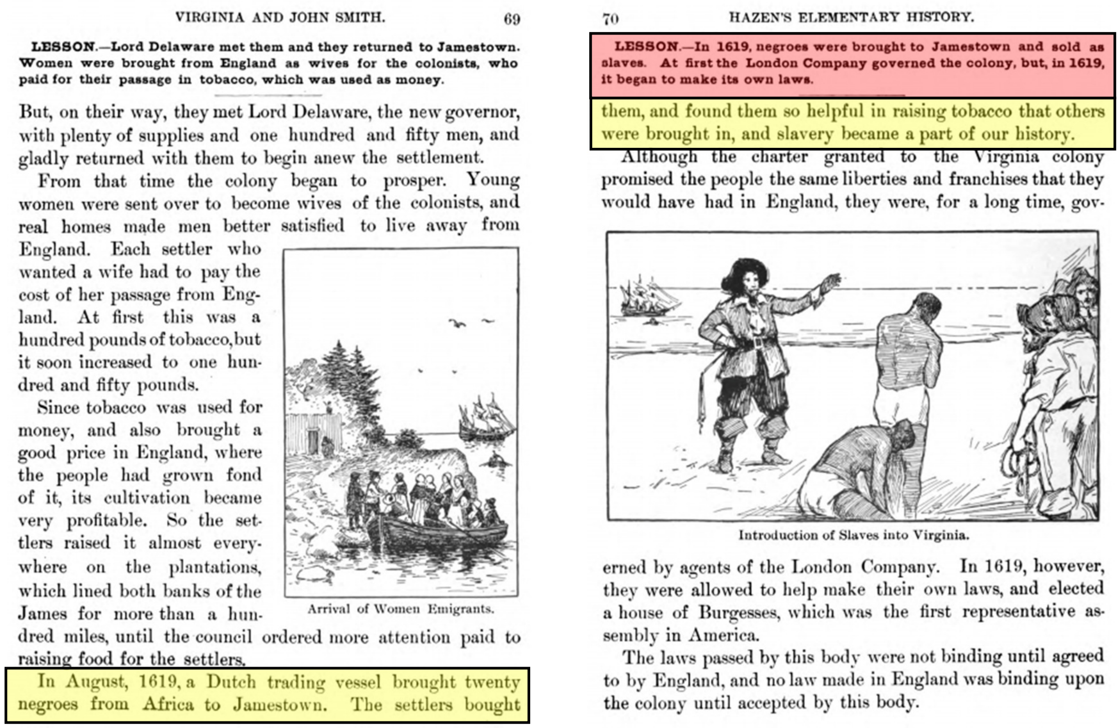
Figure 2. *Lesson instructions for mono-syllabic reading*

Limited only by their drawing or writing abilities, chalkboards provided teachers with an opportunity to modify their presentation of content on-demand rather than move each of the students from one topic to another on their slate tablets (Barker, 1992). Aside from the chalkboard dust, adaptation at the chalkboard is reminiscent of teachers’ experiences with whiteboards in today’s classrooms with the ability to change a lesson’s direction with a quick erase of the board.

Textbooks

In the early 1900s, as teachers adapted to slate tablets and chalkboards, the cost of paper needed to produce textbooks fell to historically low levels (Tucker et al., 1999). With paper prices so low, teachers and schools moved away from individual slates for students because it was now possible to provide books to each student cost-effectively (F. J. Smith, 1913). This meant that teachers were no longer the single source of information available to students and could continue their learning outside of the classroom. Students could also continue their learning outside of the classroom since textbooks were portable and did not require a teacher or guide.

While textbooks provided teachers with access to new content that could extend their CK, there was a side-effect of this new information source in the classroom – the expansion of the hidden curriculum. While teachers were often a primary source of a hidden curriculum, textbooks and other forms of technology simultaneously extended this reach. One example includes slavery in the United States as represented in *Hazen's Elementary History of the United States: A Story and a Lesson*. In Figure 3, the yellow highlighted boxes indicate that slavery was purely a labor element in the supply and demand equation, with no mention of the inflicted violence and abuse. The red box provides talking points and outcomes for the lesson. The key takeaway of the lessons was the introduction of Africans and the first formal legislation in the American colonies. Nevertheless, just a few inches away from that box is an image of two half-naked individuals standing on a beach before a group of on-lookers and a Dutch colonial sailor, labeled “Introduction of Slaves into Virginia.” The text omits the roots and definition of slavery, whitewashing slavery as merely a group of individuals who helped support trade.



VIRGINIA AND JOHN SMITH. 69

LESSON.—Lord Delaware met them and they returned to Jamestown. Women were brought from England as wives for the colonists, who paid for their passage in tobacco, which was used as money.

But, on their way, they met Lord Delaware, the new governor, with plenty of supplies and one hundred and fifty men, and gladly returned with them to begin anew the settlement.

From that time the colony began to prosper. Young women were sent over to become wives of the colonists, and real homes made men better satisfied to live away from England. Each settler who wanted a wife had to pay the cost of her passage from England. At first this was a hundred pounds of tobacco, but it soon increased to one hundred and fifty pounds.

Since tobacco was used for money, and also brought a good price in England, where the people had grown fond of it, its cultivation became very profitable. So the settlers raised it almost everywhere on the plantations, which lined both banks of the James for more than a hundred miles, until the council ordered more attention paid to raising food for the settlers.

Arrival of Women Emigrants.

In August, 1619, a Dutch trading vessel brought twenty negroes from Africa to Jamestown. The settlers bought

70 HAZEN'S ELEMENTARY HISTORY.

LESSON.—In 1619, negroes were brought to Jamestown and sold as slaves. At first the London Company governed the colony, but, in 1619, it began to make its own laws.

them, and found them so helpful in raising tobacco that others were brought in, and slavery became a part of our history.

Although the charter granted to the Virginia colony promised the people the same liberties and franchises that they would have had in England, they were, for a long time, governed by agents of the London Company. In 1619, however, they were allowed to help make their own laws, and elected a house of Burgesses, which was the first representative assembly in America.

Introduction of Slaves into Virginia.

The laws passed by this body were not binding until agreed to by England, and no law made in England was binding upon the colony until accepted by this body.

Note. This text represents a “validation” of slavery to support tobacco collection. Reprinted from *Hazen’s Elementary History of the United States: A Story and a Lesson*, by Marshman Hazen, 1903 (http://hdl.handle.net/2027/nyp.33433012110429). In the public domain.

Figure 3. *Hazen’s Elementary History and explaining slavery*

Hazen’s Elementary History and the many others that followed are important because they expose the limited, and often intentionally restricted, information available to teachers and students about our history and other subject areas. While textbooks provided opportunities for expanding access to information, provided options to extend learning time, and supported independent student work, they also highlighted the teacher’s critical role in shaping the lessons and informing the students’ instruction. The impact of classroom technologies, the critical nature of pedagogy, and content selection will be discussed later in this chapter.

Film

With an increase in the number of schools and students attending, there was a need to provide lessons to many students in a single setting (Mondale, 2001). Thomas Edison claimed that textbooks "[…] would soon be obsolete in schools. Scholars will soon be instructed through the eye, […] touch[*ing*] every branch of human knowledge with the motion picture" (F. J. Smith, 1913). The first board of education to adopt silent educational films for use in the classroom was in Rochester, New York. Within 20 years, "twenty-five states […*had*…] units in their departments of education devoted to films and related media" (Provenzo & Cuban, 1986, p. 12). Foreshadowing Edison's future, the market of educational films snowballed over this time, but not without compromise. The expansive reach of educational films led to tensions resulting from competing priorities for movie production companies, either increasing commercial value or maintaining educational quality (Saettler, 2004). In the end, companies prioritized theatre over the content.

Commercial film prioritization was due to external factors at critical historical points, like the military during World War I and II. From 1942 until three years after World War II, American films were used to "transform the social, political, and military attitudes of an embattled nation, while promoting the aims and goals of the war effort" (Jacobs, 1967). Beyond use for the public, the military used films with sound for training to target an audience of military recruits who may have been “illiterate, but of sufficient intelligence to be of use to the army with further remedial training” (Fry, 2015, p. 3). As represented in Figure 4, training adaptations of more than 400 films were created between 1943 and 1945 represented a way to deliver instruction to large groups of recruits with varying competency levels, education, and achievement standards (Reiser, 2001).

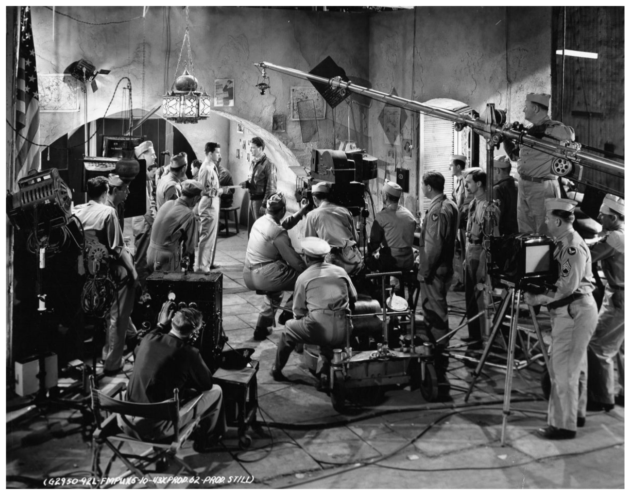
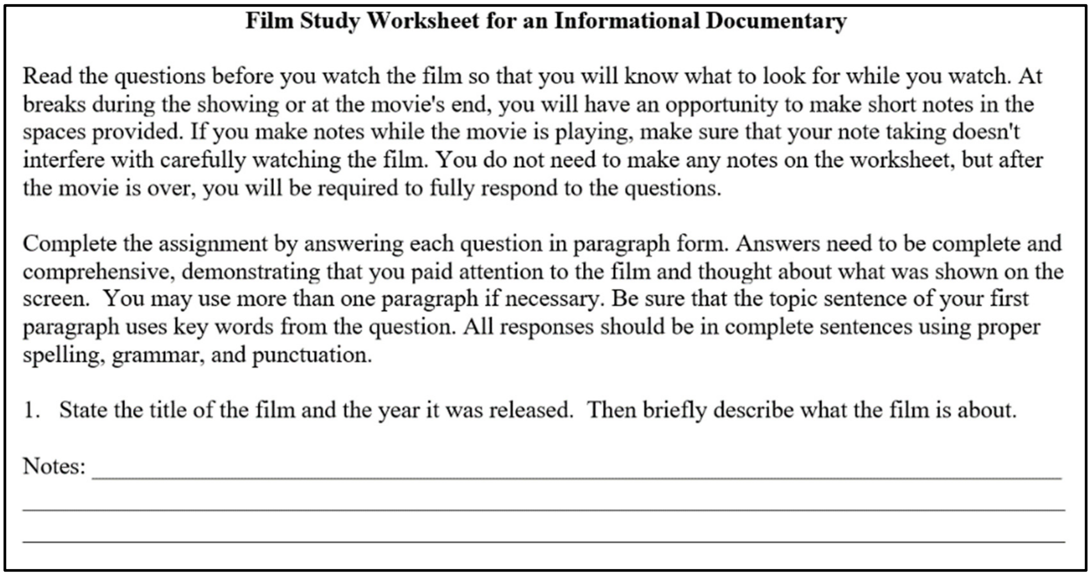


Figure 4. *First Motion Picture Unit Creating Field Training Films with Commercial Sets*

Even with new films featuring sound, the classroom use of film has already plateaued in teacher adoption (M Russell, 2006). Since “film took up a bare fraction of the instructional day,” according to Cuban, “teachers used […films] hardly at all” (Provenzo & Cuban, 1986, p. 17). Reasons for their lack of film use included their “lack of skills in using equipment and film, cost of films, equipment and upkeep, inaccessibility of equipment when it is needed and finding and fitting the right film to the class” (Provenzo & Cuban, 1986, p. 18).

A district or school often adopted textbooks emphasizing sticking to the text. Films represented an opportunity for teachers to introduce a new medium in the classroom. Teachers needed to evaluate a film resource and know how it fits and provides quality to the assignment since not all films were classroom ready or pedagogically appropriate. In turn, teachers needed to apply their technological pedagogical knowledge to best use film to guide students through the lesson.

One example includes using guided questions to facilitate a film study for a documentary. Lawson et al. (2006) identified that students with guided questions scored significantly higher on an assessment than the control group when viewing a film shown in a psychology course. The student resource in Figure 5 shows that questions guide students to follow along, encourage engagement with the film, and stimulate critical thinking (Frieden & Elliott, 2019). Further, the guides often include lesson plans, connections to standards, example projects, activities, and additional background information for instruction. For teachers, this opens opportunities for discussion topics, new assessment opportunities, and creative ways of using media in the classroom.



Film Study Worksheet for an Informational Documentary

Read the questions before you watch the film so that you will know what to look for while you watch. At breaks during the showing or at the movie's end, you will have an opportunity to make short notes in the spaces provided. If you make notes while the movie is playing, make sure that your note taking doesn't interfere with carefully watching the film. You do not need to make any notes on the worksheet, but after the movie is over, you will be required to fully respond to the questions.

Complete the assignment by answering each question in paragraph form. Answers need to be complete and comprehensive, demonstrating that you paid attention to the film and thought about what was shown on the screen. You may use more than one paragraph if necessary. Be sure that the topic sentence of your first paragraph uses key words from the question. All responses should be in complete sentences using proper spelling, grammar, and punctuation.

1. State the title of the film and the year it was released. Then briefly describe what the film is about.

Notes: ____
____
____

Note. This excerpt is from a Cesar Chavez documentary in Frieden and Elliott's (2019) *TeachWithMovies.org* resources for teachers.

Figure 5. *Film Study Worksheet from "TeachWithMovies.org"*

Radio

Just seven years after the first board of education adopted educational films, the first radio broadcasting locations were established in Detroit and Pittsburgh (Ackerman, 1945, p. 2). In just two years, broadcasting sites expanded to 30 additional cities (Ackerman, 1945, p. 2). Radio was not only viewed as the "indispensable and indisputable part of American life" but allowed for the development of specific programs geared to K-12 and university education (Reid, 1942). Students could participate in the classroom or at home if they had a transceiver and could pick up the signal (Haworth & Hopkins, 2009).

The first educational radio broadcasts were reminiscent of many of the first attempts at delivering online courses. Professors repeated their lectures through the microphone and did not account that a strong lecturer does not necessarily result in effective broadcasting – or vice versa (Hokanson & Hooper, 2000, p. 542). Delivering an effective broadcast meant that the lecturer could not merely copy the format and content of their in-person lectures to radio broadcasting without accounting for the pedagogical changes required to address the remote learner's needs. Fundamental pedagogical changes, like asynchronous student and teacher responses, resulted from radio-based education's one-way nature. This directly impacted the ability to perform formative assessments and understand learner progress (Reid & Day, 1942).

While there are varying opinions, radio-based education aimed to supplement existing classes and not replace the classroom (Provenzo and Cuban, 1986). Edison's forecast for replacing in-person instruction was in opposition to Dewey's educational theory that active engagement would result in learning environment success (Dewey, 1986). Nevertheless, when used in connection to existing in-person instruction, the model of radio-based education was successful reinforcement for students (Haworth & Hopkins, 2009).

Fast-forwarding to March 2020, UNICEF provides radio-based education support to Zimbabwe and other countries to reduce the impact on student learning resulting from COVID-19 school closures where in-person learning is impossible. While the internet has become a more common way to access and participate in distance learning, the radio provides a way to connect to students in rural and potentially less established areas with limited access to schools (COMOSAConnect, 2018). In Figure 6, for example, Irasubiza Uwayo works with her mother after listening to a radio lesson together.

Note. Radio-based lessons are designed so students like Irasubiza can participate independently. Parents and caregivers are encouraged to listen in and support learning at home (Ministry of Primary and Secondary Education, 2020, p. 1). Reproduced with permission, © UNICEF/UNI319823/Kanobana.

Figure 6. *Radio-based lessons supporting at-home learning*

In the broadcasting schedule included in Figure 7, the Ministry of Primary and Secondary Education in Zimbabwe developed set schedules for each grade level, including content areas broadcast on radio stations[1]. Of note, students receive up to one hour of instruction daily in a rotating A/B model, with time dedicated for cultural and Specials courses.

[1] Lessons from Zimbabwe's radio-based education program are available on Radio Garden© at http://radio.garden/visit/zimbabwe/mCeJbzo5 and by selecting the respective channel.

MINISTRY OF PRIMARY AND SECONDARY EDUCATION

ZBC Radio Lessons Programme Schedule Eight

Primary School (ECD-Grade 6)

The Ministry of Primary and Secondary Education in conjunction with ZBC, UNICEF and UNFPA will be rolling out the **Eighth Phase** of radio lessons as part of alternative learning platform. Lessons for this eighth schedule will be aired from **28 September to 9 October 2020**. Thereafter, another schedule will be released. Parents/guardians are advised to familiarise themselves with the schedule so that they may assist their children as much as possible.

Week 15 (28 September to 2 October 2020)

Day	ECD	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6
Monday 28 September		9:00-9:15am Maths and Science NFM	9:30-10:00am Maths and Science NFM	3:00-3:30am English Classic 263		10:00-10:30am Mathematics Classic 263	9:00-9:30am Agriculture NFM
	11:00-11:15am Maths and Science NFM					2:00-2:30pm English Power FM	11:00-11:30am Science and Technology - Power FM
Tuesday 29 September			2:00-2:15pm Family and Heritage Studies NFM	9:30-10:00am Agriculture Power FM	9:00-9:30am FAREME Classic 263	10:00-10:30am Social Studies and Heritage Studies NFM	2:00-2:30pm Guidance and Counselling Classic 263
					10:30-11:00am Mathematics Classic 263	11:30-12:00noon Science and Technology Classic 263	
Wednesday 30 September	9:00-9:15am English NFM	11:45-12:00noon Family and Heritage Studies NFM	2:00-2:15pm English Classic 263		11:30-12:00noon Science and Technology Classic 263	10:00-10:30am Guidance and Counselling NFM	2:30-3:00pm Science and Technology NFM

Note. The weekly schedule is an example of radio-based instruction provided by Zimbabwe's Primary and Secondary Education Ministry. (2020, p. 1).

Figure 7. *Weekly radio-based instruction schedule*

Television

On October 4, 1957, a giant magnifying glass was focused on the United States regarding a perceived education crisis. At the time, a growing public "fear [...*developed*...] that the United States was falling behind in developing new technologies and underscored the importance of education to national security" (McGuinn, 2006, p. 28). This concern was experienced by Americans every 98 minutes as Sputnik circled the Earth and would hear beeping on their radios when the signal interfered with frequencies (NASA, 2007). These concerns and developments triggered the National Defense of Education Act (NDEA) development, which increased funding for education at all levels, focusing on scientific and technical education (McGuinn, 2006, p. 28). Instructional television was part of advancing students' knowledge of science and technology. The funding for these efforts came from the NDEA and outside stakeholders like the Ford Foundation, who "expended more than $300 million for the educational television movement" (Saettler, 2004, p. 372).

Making these investments, similar to radio and film, government leaders and education administrators thought students could receive a better education through television (Provenzo & Cuban, 1986). Expansion of television occurred more commonly in small rural classrooms where qualified teachers were scarce. As with 1:1 implementation in some schools, television was not successful in other venues, as early programming was not based on consultation with teacher needs or views. Instead, television was "hurled at teachers" as the magic solution for instruction (Provenzo & Cuban, 1986).

Channel One's programming accelerated the expansion of television in schools and classrooms (Assessment., 1995). Apple (2014) introduced Whittle Communications' plans to decrease the literary crisis in the early 1990s, coined Channel One. In exchange for students watching for a 12-minute segment for 90% of the days that school was in session, a school would receive free equipment, including a satellite dish, two central VCRs, and one color television per classroom (Apple, 2014, p. 102). The primary argument for this program, according to Apple (2014), was that "students do not know enough about the world around them to participate effectively in a democratic society" (p. 104). Schools were quick to jump on the Channel One bandwagon. With costs for a

19" television at roughly $650, it was difficult to argue with the proposed support for addressing literacy challenges and a free opportunity. By 1993 and three years into the program, 12,000 schools participated in the Channel One offering (Assessment., 1995).

Like the outcomes with film in the classroom where tensions arose between commercial and education needs, Channel One was a controversial offering because of its programming's commercial nature. Occupying six days of school year instruction, students were forced to watch two minutes of advertisements per day, often exceeding the two-minute agreement with schools (Fox News, 2012). Executives argued that ads were vital revenue needed to provide technology to schools; however, Saettler (2004) posited that "the classroom should not be another market to exploit" (p. 534). In Figure 8, Sheneman (2013) satirically captures the essence of Saettler and the push-and-pull between the classroom and Channel One by showing how advertising and commercialism seeped into the classroom.

Note. This political cartoon, "*Schools are tasked with filling our future generations' heads with knowledge. What is the harm in stuffing in a little crass commercialism, too?*" is drawn by Drew Sheneman (2013) of The Star-Ledger, reproduced with permission from the artist.

Figure 8. *Channel One Political Cartoon*

Unfortunately for schools, the American Academy of Pediatrics found that students who viewed Channel One could remember the commercials more than the news, raising a critical concern regarding television in the classroom (Miller, 2007). As historically represented by films, teachers are a crucial component in learning – television is not a set-it-and-forget-it instructional tool. Goodman (1990) supported that Channel One and no other television service would be successful unless a teacher followed up and discussed beyond the stories. By the end of 2012, the owners of Channel One ceased to provide in-school distributed news broadcasts, citing that Houghton Mifflin Harcourt is "constantly evaluating its product portfolio for strategic coherence and return on investment, and as a result […] made the difficult decision to close the Channel One News business" (Channel One News, 2012).

Computers

Computers and tablets in education have deep roots in the 1983 federal report, *A Nation at Risk*. The report published by the National Commission on Excellence in Education (1983) included an update to high school students' graduation requirements to include computer science. Paul Hurd concluded in his findings from a study on student achievement that in 1983 the United States was "raising a new generation of Americans that [were] scientifically and technologically illiterate" (National Commission on Excellence in Education, 1983, p. 4). The state of education and training sounded alarm bells and flashbacks for the education community reminiscent of the Sputnik launch (Ansary, 2007). The warnings included that:

> Our nation is at risk. Our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world […] If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might well have viewed it as an act of war. (p. 1)

In addition to government and community pressure, the dependency on technology multiplied in the early 1980s, which defined the need to teach children job-related skills. Advocates contended that computers would streamline the education process, reduce class sizes, reduce instructional time by a teacher, and reduce the number of teachers needed (Kirst, 1983; Mondale, 2001; Oppenheimer, 1997; Saettler, 2004; Solomon, 2015). Regardless of the validity of the opinions, the number of computers in schools soared in the early 1980s. Based on survey findings, Provenzo and Cuban (1986) noted that there were 100,000 computers in schools by 1982, with that number growing by three times in four years. In 1988, the estimated number of computers in schools ballooned by 1,000% (Saettler, 2004, p. 457).

After this explosive school computer growth, the implementation of one-to-one (1:1) student device programs started on a large scale in 1985 with Apple's *Classrooms of Tomorrow*. In this first program at scale, the computers remained on-site (Sandholtz et al., 1997). Students like Jake Anderson in Figure 9 were the first classes to participate in this new program. They attended school two weeks earlier than their peers to learn to keyboard and were immersed in using a computer as much as possible. This included

Office™-like and specialty applications like LOGO turtle – a program that responded to commands to make a turtle cross the screen while teaching programming fundamentals (Microsoft, 2006).

Note. Jacob Anderson, pictured with the United States Senator Dave Durenberger at an Apple //e computer in the Apple's Classrooms of Tomorrow initiative. This image is reproduced with permission from Jacob Anderson.

Figure 9. *Apple's Classrooms of Tomorrow initiative*

In 1996, Microsoft's *Anytime, Anywhere Learning* program expanded the 1:1 offering, which provided schools and districts the opportunity for their students to lease or buy a portable computer with the expectation for use in the classroom (Rockman et al., 2000). A new era of dialogue for research and inquiry lines regarding technology and classroom use by teachers and students was opened by making computers accessible to all students.

Apple and Microsoft's programs kickstarted the re-evaluation and transformation of existing boundaries in education and how the United States would educate students (Barker, 1992). The Department of Education proposed changes to remain competitive in the world labor and industry markets. However, as with many changes, they were profoundly political and involved a process for sustaining and maintaining efforts, not just a one-time event (Fullan, 1993). As the concept of providing individual technologies to every student grew in popularity, so did the beliefs on student learning and factors considered when delivering a 1:1 program.

By 1994, nearly all states recommended that public schools integrate computers or information technology into their curriculum, with only 25% mandating integration (Walther et al., 1994). While recommendations were still progressing, they came when, on average, 14 students shared a single workstation. Many schools opted to install computer labs rather than a workstation for each student (Means & Olson, 1995). Thinking back to my grade school experience, visiting the computer lab was a once-a-week activity with groups scheduled back-to-back throughout the day. Even though labs are still used today and achieve short-term goals, teachers need to increase weekly visits to remain effective (Kozma, 1991). 1:1 programs became more critical to education in environments with limited access to computer labs and financial constraints.

Adoption of 1:1 Programs in Education

Several research studies evaluated the school computer lab's effectiveness, determining that personal technologies needed to be regularly available for students (Abell Foundation, 2008; Belanger, 2002). Based on this and various other reasons that will be addressed more fully, school districts have implemented 1:1 programs for students. The most frequently cited reasons include addressing digital equity, cost-cutting measures from expensive textbooks, and community outcomes.

The first adoption reason, student performance, is one of the critical drivers used when validating the adoption of student devices; however, the research is mixed on the outcomes (Gulek & Demirtas, 2004; Severin & Capota, 2011; K. Swan et al., 2005; Zucker & Hug, 2007). Gulek and Demirtas (2004) evaluated the impact of 1:1 devices on GPAs, end-of-course grades, and a local writing assessment to determine the effect of a one-year laptop immersion program. At the end of the first year, student grade point averages were higher than those of non-laptop students, grades were substantially higher than non-laptop students, and writing proficiency was more advanced than non-laptop participants.

However, not all 1:1 initiatives result in positive outcomes. In 2002, Maine was the first state to launch a statewide effort that provided middle school teachers and students with Apple iBook computers. After spending $41 million on middle school students and teachers, the Maine Education Policy Research Institute (MEPRI) determined that there was “no appreciable change in Maine Education Assessment MEA) scores” since starting the 1:1 program (Abell Foundation, 2008, pp. 3–4). The program's goals were to make Maine a premier state for using technology; however, the program's goals were ill-defined, and devices did not result in any overall improvements.

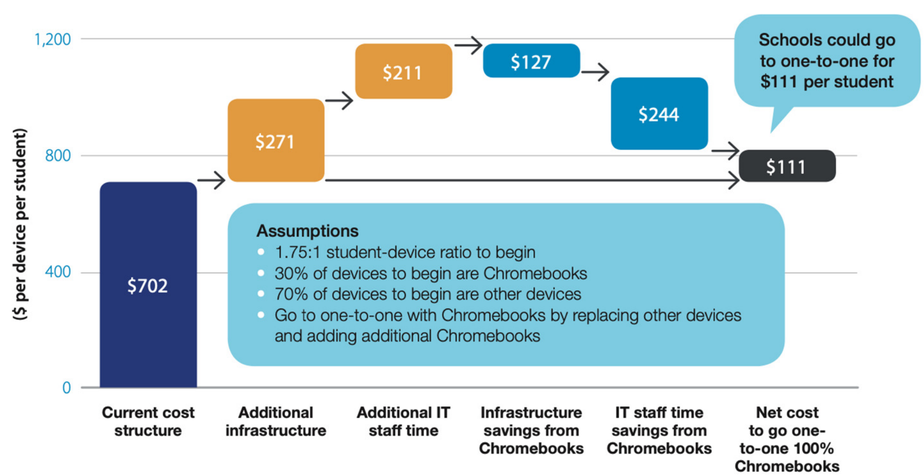
In the same year as Maine’s 1:1 launch, the State of Michigan started a device initiative that targeted second-grade students to develop “self-sustaining, self-directed learners" at the cost of $7.5 million (Ross, 2005). With 15 schools participating, they let each school design its initiative. Two years later, program sponsors determined that laptops would be the only option. The initial report from the Center for Research in Educational Policy (CREP) did not analyze student learning or achievement, and they did not anticipate improvements (Ross, 2005):

> […] We are not necessarily expecting noticeable achievement gains on the Michigan Educational Assessment Program (MEAP). The latter, like all state tests, is a high stakes multiple-choice assessment that seemingly has little direct connection with the real-world skills that laptop students are acquiring. The higher student engagement and effective teaching associated with the laptops might produce some carryover effect on MEAP, but it may also be that the latter is not sufficiently sensitive to detect such impacts. (p. 6)

Over the next three years, they continued the program but did not find any additional evidence that supported computer usage as a driver for increasing student achievement on standardized tests. While the goals were not targeting improving student achievement, students and teachers reported added interest in learning, more accessibility to complete schoolwork using devices, and student-centered practices focused in classrooms.

In addition to academic performance, schools focus on the financial impacts of purchasing 1:1 devices. On average, states purchase a new textbook program every 7 to 10 years (Partelow, 2018). Simply put, the information contained in a textbook purchased today will likely be used by a student in 2027. Suppose that students today were to look at their ten-year-old print textbooks. They would read that President Barack Obama was just elected to office and that YouTube is starting to take off as a venture-capital project.

Accessing up-to-date and timely information is where 1:1 programs shine. Before device initiatives, teachers were limited to technologies available in their school or classroom, often limited to a classroom set of photocopies. With quick, inexpensive, and easy-to-use services, teachers can augment or replace a district-assigned course textbook with their own new and refreshed instructional materials to provide a deeper understanding. For District administrators, this means that the device and even digital textbooks in "a 500-student school can save between $35 and $250 per student per year by switching to digital textbooks" (Tomassini, 2012).



Note: Reprinted from IDC Document #258440: The Economic Value of Chromebooks for Educational Institutions, 2015.

Figure 10. *Cost Analysis of Going to a One-to-One Student-Device Environment*

While there are undoubtedly other costs associated with launching a 1:1 program, this is a significant saving when considering the textbook costs (see Figure 10).

Evolution of Technology and Pedagogy – Did We Get "IT" Right?

From the *A Nation at Risk* report, schools and districts developed and adopted more rigorous and measurable classroom learning standards; however, very little changed due to assumptions that all levels of the education system had the capacity, agency, and willingness to do so change (National Commission on Excellence in Education, 1983). Referenced in Table 3, examples of these attempts at classroom learning standard changes included teachers' guidelines when using computers in their classrooms between 1982 and 1994.

Table 3

Timeline of Changes in Guidance on How Teachers Should Use Computers in Schools

	1982
Teachers are told to:	Teach students to program in BASIC[2].
Rationale:	"It is the language that comes with your computer."
	1984
Teachers are told to:	Teach students to program in Logo[3].
Rationale:	"Teach students to think, not just program."
	1986
Teachers are told to:	Teach with an integrated drill and practice system.
Rationale:	"Individualize instruction and increase test scores."

[2] Beginners' All-Purpose Symbolic Instruction Code, also known as BASIC, is a programming language focused on ease of use. Developed by John Kemeny and Thomas Kurtz in 1964, this language served as the foundation for Visual Basic, developed by Microsoft in 1991, which introduced opportunities for macros in Microsoft Excel and integrations with other programming languages (Kemeny & Kurtz, 1964).

[3] Logo is a programming language designed in 1967 by Wally Feurzeig, Seymour Papert, and Cynthia Solomon. Originating from the Greek logos, meaning word or thought, LOGO is most known for the "turtle" or an on-screen cursor that responded for commands. This provided the foundation for educational programming and a literacy model for approaching coding for non-technical users (Abelson et al., 1974).

1988	
Teachers are told to:	Teach word processing.
Rationale:	"Use computers as tools, as adults do."
1990	
Teachers are told to:	Teach with curriculum-specific tools (history databases, science simulators, data probes).
Rationale:	"Integrate the computers with the existing curriculum."
1992	
Teachers are told to:	Teach multimedia hypertext programming.
Rationale:	"Change the curriculum – students learn best by creating products for an audience."
1994	
Teachers are told to:	Teach with internet telecommunications.
Rationale:	"Let students be part of the real world."

Note. Reprinted from *Teachers and Technology: Making the Connection* (p. 104), by U.S. Congress, Office of Technology Assessment, 1995. In the public domain.

It is important to note how between 1982 and 1990, teachers were to focus students on the technology, and it was not until 1994 that there was a glimmer of student learning that was not molded around the device, a test, or norms. Technology drove the decisions made for teachers rather than their pedagogy and their approach to implementation. This is important because it reflects the tradition of incorporating technology rather than actual integration. When interviewed for an article on the increase in teacher's technical skills, Michael Hines, assistant professor at Stanford University, indicated that even today, "generations of reformers and policymakers, we've seen new tools [… *that* …] have each been incorporated in traditional ways of teaching and learning, instead of fundamentally altering them" (Schwartz, 2020).

In 2017, the U.S. Department of Education published the National Educational Plan Update that lays out recommendations and research-based approaches to education with technology. Specific to preparing future-ready students, the plan emphasizes the need for providing not only 21st-century competencies but also a growth mindset across content areas:

> To remain globally competitive and develop engaged citizens, our schools should weave 21st-century competencies and expertise throughout the learning experience. These include the development of critical thinking, complex problem solving, collaboration, and adding multimedia communication into the teaching of traditional academic subjects. In addition, learners should have the opportunity to develop a sense of agency in their learning and the belief that they are capable of succeeding in school. (*National Education Technology Plan Update*, 2017, p. 10)

To prepare students for future-ready careers and education, teachers use technology as a tool for student learning and to support the development of 21st-century skills. The use of tools manifests in the classroom as further adjustments to classroom practices are needed (Silvernail & Buffington, 2009), such as moving to a student-centered and inquiry-based model (Fairman, 2004; Klieger et al., 2010) for instruction where the teacher is a facilitator and not a sage on the stage.

Student as Digital Native?

The availability of, and access to technology, for children at an early age has led to a belief that students are more connected and technologically engaged than any other generation (Goos, 2005; Kivunja, 2014; Prensky, 2001). First-year college students are assigned the label of generation C for actively producing consumer-generated content (Duncan-Howell & Lee, 2007), generation Y for being technology-connected and more segmented (Perillo, 2007), and digital natives for spending their entire lives with access to advanced technology. Digital natives are the “speakers of the digital language of computers, video games and the Internet,” who are considered bilingual in terms of embracing technology along with the discipline (Prensky, 2001, p. 1).

When analyzing strategies for how students learn, Prensky (2001) identifies that students are more aligned with the expansion and explicit use of learning strategies that more closely align and integrate with technology, such as “parallel processing and multitasking” independently (p. 2). While often connected to computer processors and operating systems, this means that students were akin to multitasking and working on multiple tasks at the same time. Other studies found that students prefer a more interactive, relationship-building approach than receiving broadcast information (Ang, 2005; Hamre & Pianta, 2001; Tapscott, 1999).

Prensky’s theory comparing students to processors has been argued. While natives *may* have tech skills, it is a false assumption that they inherently are tech-savvy multi-taskers and want to use technology for learning (Kirschner & De Bruyckere, 2017).

While studies have found that students do not require technology for learning, they expect technology to be part of their day-to-day lives for communication and engagement (Brenoff, 2017; Frawley, 2017).

Teacher as Digital Native?

Each study and strategy explains that students can be expert educational technology users but are not inherently predisposed. If we follow Prensky's theory of digital natives, all newly arriving teachers are digital natives and can fully engage with technology. How do we know that teachers are prepared to engage with their TPACK knowledge in the classroom?

Voogt and McKenney (2017) identified that both new incoming teachers and their teacher educators struggled to effectively use technology in their courses. Teachers who do not have the opportunity to engage with technology due to non-existent hands-on training during their academic preparation or at their school through professional development are disadvantaged. Without professional development programs and training on educational technology, schools are not supporting teachers who may have insufficient technological knowledge, skills, or a pedagogical understanding of technology in the classroom (Ruggiero & Mong, 2013; Stobaugh & Tassell, 2011).

This leads to the risk of a teacher applying old methodologies, outdated pedagogy, or insufficient technical knowledge to reach and teach students whose hierarchy of learning modalities has evolved beyond approach (Kelly et al., 2009; Kivunja, 2014). According to Brand (1997), "if students are going to be prepared for a technological society, they must be taught by confident and competent teachers. This can only be done by adequate training and development of teachers" (p. 13).

In a 2019 survey conducted by Bear Rapids School District, 7% of parents/guardians felt technology was not critical to student learning. The direct instruction staff called into question if "technology" is essential to student learning (21.06%). In an interesting juxtaposition, there was reinforcement from direct instruction staff that while technology does prepare our students for their future (96.06%), we need to explore a diverse representation of staff's comments about implementing technology even with increased professional development opportunities. From this, pedagogical and fundamental changes require teachers and administrators to improve their technology competencies through self-evaluation, assessment, ongoing professional development, and shared commitment (Adelsberger et al., 2008; Collis, 1996; Yildirim, 2000).

Teachers and schools require a new learning approach and carefully curated technology-based pedagogy training to deliver these opportunities. Such relationships and technology competencies support what Kelly et al. (2009) reference in using old methodologies and pedagogy to teach students with evolved learning requirements. Sticking with the old teaching strategies is referred to by Kivunja (2014) as the "That is the way we've always done it" (p. 9) approach. Further, Gates (2005) references that America's high schools were obsolete in that:

> […] even when they are working exactly as designed, [schools] cannot teach our kids what they need to know today. Training the workforce of tomorrow with the

> high school of today is like trying to teach kids about today's computers on a 50-year-old mainframe. It is the wrong tool for the times. (p. 2)

This stems from teachers who repeat the pattern they were taught or from an assessment lens that says instruction must be performed this way (Norton, 2011).

Teachers may require an updated set of guiding principles that consider their classroom's requirements, assessments, and curriculum needs to advance pedagogical change (Norton, 2011). This is critical while still acknowledging that technology use is not innately and automatically at the student's level because of their perceived expert status nor always a positive association. Tapscott (2010) acknowledged this through analysis of a "NetGen mind" and an identification of the changing workforce through the learning approaches preferred by students:

> The reason many students are deserting school is because schools today still use a model of education that was designed for the Industrial Age. That model revolved around the teacher who delivered a one-size-fits-all, one-way lecture. The student, working alone, is expected to absorb the content delivered by the teacher. This might have been good for the mass production economy, but it does not deliver for the challenges of the digital economy, or for the Net Gen mind. (p. 122)

In education advocate Sheryl Nussbaum-Beach's 2011 interview, she calls to action that a new student-centric approach was needed but would require a transformation in the ways educators teach today (Norton, 2011).

By identifying technology skills, coupled with principles and appropriate integration, application, and classroom evaluation, we can prepare our students for a world where needs are changing rather than reflecting present-day or ingrained social needs and expectations. This was supported by ISTE, who indicated that “traditional educational practices no longer provide students with all the necessary skills for economic survival in today’s world” (International Society for Technology in Education, 2020b).

Along with new technologies, tools, online resources, and teaching for a 21st-century learner, there was a need for highly skilled teachers. This results from educators' redefined roles stemming from teachers' “required” pedagogy changes and continues through to pre-service teaching programs. While pre-service education is not the primary focus of this literature review, it does provide additional support for the legitimacy and trends identified in new incoming teachers. As curriculum develops in response to social needs, emerging educational theories, and technological advances, pre-service teacher education programs have historically struggled to support pedagogical enhancements to teaching and education (Goktas et al., 2008). Along with the hiring trends changing toward teachers with 21st-century skills and providing ongoing training, there is also a shift in pre-service teacher education programs to meet these needs. This focus on technology pedagogy in hiring new teachers and pre-service teachers' training in university programs further supports ongoing teacher professional development for successful 1:1 classrooms (Lambert & Gong, 2010; Urbani et al., 2017).

Teacher as Reflective Practitioner

Beyond the lens of professional development and considerations for technology-based competencies, reflection as a craft and practice influences a complete view of personal development (Sumsion, 1997). Schön (1983, 1987) and Gibbs (1988) are most notably referenced for popularizing the concept of a reflective practitioner. A reflective practitioner is an individual who evaluates themself, parts of a task, the context of their environment, and their practice situated in the past, present, and future.

Schön (1983) presents three approaches to modeling this practice: follow me, joint experimentation, and hall of mirrors. Beginning with Follow Me, educators share and demonstrate their PK to other teachers. The Follow Me approach results in teachers imitating the behaviors they observed. The next stage, Joint Experimentation, suggests that teachers take the reins with experienced practitioners following the teacher's line of inquiry. Along the way, the practitioners will coach, advise and provide alternatives as teachers question the issue being reviewed. Lastly and most applicable to this study, Schön best describes the participant's recursive, systematic, and reflective process as "working within a Hall of Mirrors." This model looks at both teachers and experienced practitioners to understand how to develop in their practice. Through this model, participants experience being a "learner" in a practice scenario while supporting their reflection later in their professional practices (Loughran, 1996).

Considering the strategies for self-reflection, Schön (1983) defined two approaches depending on when the act occurs. Reflection "*on*" action is the process of reviewing how a teacher's method can be further developed, improved, or changed *after* an event has occurred. For example, after completing a curricular unit, the teacher reflects on the tools and strategies used to determine their effectiveness and any needed changes to support student learning. Reflection "*in*" action, on the other hand, involves the process of making changes in real-time that can still impact the outcome (Schön, 1983). Reflection in action means that the teacher does not wait until an activity is over to complete the review and self-assessment process. For example, a teacher completes a lesson in class and identifies that students cannot keep up with the pace and content presented. Rather than continuing and using exit slips to determine if the lesson was successful and any changes, the teacher takes an informal survey in the classroom and course corrects during the lesson, noting in their log that the approach needs to be reconsidered.

Following Schön's instrumental work, reflection has been studied as a critical approach to teacher knowledge development (Hatton & Smith, 1995). A component of this knowledge development is a teacher's ability to integrate technology. Recently, there has been a more in-depth focus on moving away from adapting the need for technology by offering technology-centered methods courses. This shift in pedagogy aligned with TPACK (Mishra & Koehler, 2006) attempts to narrow the gap between future classroom expectations, the technical competencies needed to meet them, and a movement toward facilitating educational technology integration (J. Voogt et al., 2013). Further, project-based, learner-centered instructional models are approaches that support teachers who are looking to develop their TPACK (Koehler & Mishra, 2005a, 2005b) since they promote the development and facilitation of their ideas, can receive critical feedback, share their rationale, refine their approach and connect to prior experiences to solve classroom issues (Kolodner et al., 2003).

Facilitating Educational Technology Integration

Teachers who leverage technology in their classrooms are akin to culinary chefs who need to find and assemble the ingredients that develop the best recipe and provide a fantastic meal. Along with pre-service teachers, in-service teachers must consider the impact each "ingredient" has not only on their unit lesson outcomes but on each other, too. With additional context to follow, teachers have many factors to consider in their planning for technology integration beyond which tool or utility will be used. This section will focus on the factors that shape and impact technology integration, conditions that will promote technology integration in education, and discuss the pedagogical impacts of 1:1 technologies in classrooms.

Factors Impacting and Shaping Technology Integration

Along with this and the growing use of technology in schools supporting 1:1 devices, examining the key factors shaping and impacting learning technology integration is essential. A teacher's decision to leverage technology for instruction will depend on their beliefs and expectations of technology itself (Bitner & Bitner, 2002; P. A. Ertmer, 2005). In a seminal piece that examines the barriers to technology integration, Brickner (1995) classifies the roadblocks mathematics teachers encounter when integrating educational technology in two ways. These roadblocks are categorized as external barriers such as lack of training or professional development (first-order barriers) and internal barriers, including more personally connected elements such as beliefs in an educational system or competence (second-order barriers). Since both barriers often coincide, each of the barriers and essential conditions for addressing them will be explored more fully below (P. A. Ertmer & Hruskocy, 1999).

First-Order Barriers

First-order barriers are closely tied to resources, including unreliable technology, lack of available training, limited time to learn the technology, or a lack of base technical and pedagogical knowledge for using and applying it (Brickner & Russell, 1995; P. A. Ertmer & Hruskocy, 1999; Means & Olson, 1997). First-order barriers are often easier to overcome because they are often easy to measure and address when funding or other resources can be provided. While there are many first-order barriers to technology integration, this section will explore several occurring outside the classroom and occur due to education politics.

Technology Hype. Hedman and Gimpel's (2010) research on consumer technologies and the research void on hyped technologies identifies that the least considered value is functionality when making a technology decision based on hype. Instead, emotion, curiosity, social values, and desire are the contributing and deciding factors. The newness of technology was a consistent fiber of concern across 1:1 program evaluations that calls into question the frenzy of 1:1 devices and the pace of their implementation, ultimately asking, "Was it worth all the excitement" (Crichton et al., 2012; Grundmeyer, 2013)? When decisions are made based on the consumer hype with quick purchases, teachers and students will experience noticeable lags where the technology is not fully developed or effectively used in the classroom (Grundmeyer, 2013). Fumbled implementations can lead to teachers who attempt to integrate the technology and students who would rather pause until the issues are resolved or another solution can be identified.

Buy-In from Key Stakeholders. Stemming from technology hype, another challenge with school technology integration involves stakeholder buy-in, like teachers and students. One example of the impact of not considering buy-in from stakeholders is Crichton et al.'s (2012) profiling of a two-phase iPod Touch and iPad device implementation in a large, urban Canadian school district. While teachers integrated devices into the curriculum, they found that elementary students showed more openness to a 1:1 iPad in their classroom than their high school peers. This opposition was likely connected to the "…persistent challenge*s* for teachers and students [… *on* …] how to submit assignments from their devices and how to work collaboratively on projects hosted on multiple devices" (Crichton et al., 2012, p. 29). With increased electronic assignments and complex instructions to submit their work, students instead emailed assignments in various file formats, making it challenging for teachers new to the technology to provide feedback. One additional element not addressed in the article was the likelihood for disagreement between how different stakeholders like technology leadership, teachers, and administration viewed the use of the technology in the classroom and how it was integrated into daily practice.

Lack of Sufficient, Effective Professional Development. As technology continues to evolve, so too does the need for professional development opportunities for teachers. Providing teachers with professional development concerning technology does not correlate with increased classroom integration (Papanastasiou et al., 2003). Further, teachers responsible for the day-to-day management and troubleshooting of 1:1 devices in their classroom may find this time-intensive and overwhelming responsibility if proper training is not available (Crichton et al., 2012).

Researchers have emphasized the critical nature of professional development that goes further than spreadsheets, word processing, how to turn on the device, or projecting onto a screen (Brush et al., 2003; Dawson et al., 2003; P. Ertmer, 2003; Ware & Stein, 2014). Further, teachers need support in risk-taking activities with technology (Harrell & Bynum, 2018; Howard, 2011, 2013; Le Fevre, 2014). However, there is little understanding of what teachers experience in a technology-integrated professional development session (Wilkerson et al., 2016). Knowledge gaps in technology pedagogy are created or exposed when a teacher is provided instructions for new technology. A false assumption is made that they will intrinsically know how to use the technology in a pedagogically sound way. Teachers need knowledge of and exposure to technology to develop pedagogy. More fundamentally, they need to work in a supportive and resource-rich environment to affect teaching and learning (Papanastasiou et al., 2003).

Poor Infrastructure and Inadequate Technology. K-12 school districts are moving toward adopting future-ready classrooms based on 21st-century skillsets, including mobile learning and individualized technology-integrated lessons. To succeed, they must be undergirded by a robust technology infrastructure and tools needed to support students and teachers (CoSN et al., 2017, 2019a). With a focus on solid infrastructure and security, the classroom can begin focusing on students' needs today and tomorrow. Fractures can occur in the classroom experience when infrastructure is not factored into the planning process for 1:1 initiatives or new technologies.

With the purchase of Chromebook devices for grades K-12+, Bear Rapids School District found internet consumption on their network exponentially increasing year-over-year, even though the number of devices was not increasing across schools (Smeets, 2020). This increased bandwidth resulted from the teacher and student use of interactive online tools and multimedia to support the District's curriculum and instruction goals and the move to online learning in 2020. With this growth, internet speed to devices and the responsiveness of the network were reduced. In response, the District expanded access points for increased coverage and network speed each year (Smeets, 2018, 2019).

Digital Divide. As personal and classroom technologies expand, so too does the expansion of the digital divide. This divide results from those who have and do not have access to: a computer/mobile device, the internet, training on technology, or services (Munkittrick, n.d.). In some cases, having these devices still constitutes a gap when students are disadvantaged by lower-performing devices, lower-cost and speed connections with data caps, difficulty obtaining technical assistance, technical skillset, and access to subscription-based contents (Bowles, 2018). Further, low-SES students and their serving schools may be less prepared to take full advantage of device and resource capabilities due to limited literacy skills or prior experience working with computers (Warschauer, 2008).

By working towards bridging the divide in providing a device, schools should also take steps toward providing education on available resources, which is critical for supporting students' needs in our classrooms and reducing inequalities for students and families (Ferrer et al., 2011; Martino, 2009; Mouza, 2008). Zucker and McGhee (2005) identified increases in parent involvement at school and their technology literacy when student devices were introduced. However, Vigdor and Ladd (2010) identified that providing students with home access to technology that did not have access previously decreased academic outcomes since students were inclined to use them for noneducational activities. Teachers and parents are a critical bridge for students who need this systematic focused instruction to use their devices effectively.

Second-Order Barriers

Unlike first-order barriers, second-order barriers block change, are not always easy to overcome, are less identifiable, and are intrinsic to the teacher (P. A. Ertmer, 1999). Second-order barriers are connected to the beliefs or perceptions of an individual. This section will review teacher self-efficacy as a second-order barrier connected to the impact of change on 1:1 pedagogy like first-order barriers.

Self-Efficacy. A key pillar of social cognitive theory is the premise of self-efficacy. Bandura (1986) illustrated that self-efficacy is referenced as an individual's "judgments of their capabilities to organize and execute […a…] course of action required to attain designated types of performances" (p. 391). Separate from a teacher's attitude toward technology, individual factors like self-efficacy, needs, and motivation are more important when integrating or developing educational technologies (Paraskeva et al., 2008). Teachers' perceived risk-taking with innovative technologies is much less than other mediums (Goldsmith & Foxall, 2003; Vannatta & Nancy, 2004). With tried-and-true methods and a component of educational change, a teacher tendencies toward risk-taking with technology are directly related to the instructional strategies they prefer, perception and attitude toward change, emotions upon the tools they may attempt (Harrell & Bynum, 2018; Howard, 2011, 2013; Le Fevre, 2014).

In a study about secondary-education teacher self-efficacy and classroom technologies, Iscioglu (2011) made several claims regarding self-efficacy, most notably that ~85% of teachers avoided computers[4]. While access to a computer was easy to find, teachers in the study did incorporate computers as part of their daily work. While Iscioglu's study is now ten years old, and one might question this study's connection, teachers have more access to technology today. Nevertheless, the same hesitance for using technology played out in our remote learning environments.

[4] Iscioglu's study included secondary education teachers (N=98) from two schools located in North Cyprus; however, it does not provide the confidence intervals, classification information about sampling, assignment, or information regarding the population's assumptions.

As entire school districts engaged remotely over three-quarters of the 2020-2021 school year, teachers did not take as many risks and leaned back on traditional instructional pedagogy. The Yale Center for Emotional Intelligence and the Collaborative for Social-Emotional and Academic Learning (CASEL) surveyed 5,000 teachers' experiences during remote learning. On top of needing to move their classrooms to a completely online environment, teachers responded that some of their top feelings were anxious, fearful, worried, and overwhelmed (Cipriano & Brackett, 2020). When surveying how teachers (N=328) experienced the transition to remote instruction due to COVID-19, Marshall et al. (2020) found that nearly 50% of teachers were at least somewhat unprepared for delivering instruction remotely. While the study's responses were justifiably impacted by the COVID-19 pandemic and possibly due to juggling family with full-time employment, there were also connections to quickly moving classes online instruction. More than 90% of participants indicated that they did not have any online teaching experience before emergency closures.

Essential Conditions for Technology Integration

To reduce the barriers discussed and others identified by Brickner, Ertmer, and Hruskocy (1999) extended this work by examining several critical questions connected to a university-school partnership: the impact of a teacher’s attitudes toward and the use of technology, a student’s confidence with technology, and the school’s approach to technology implementation. Their research developed areas that shaped future research and recommendations that would facilitate changes to educational technology integration.

The International Society for Technology in Education (ISTE) developed the Essential Conditions for Technology Integration as an outcome that influenced future guidance. The conditions were created out of the 2008 National Educational Technology Standards for Teachers (NETS-T), representing a fundamental shift in how teachers used technology.

At the time, teachers were focused on the “what” technology rather than “how” technology would support student learning and instructional goals (Maloy et al., 2010). The Essential Conditions were developed from educational leaders and teacher feedback about the barriers each group encountered when integrating technology in the classroom and their approaches to managing change to fostering a meaningful technology integration for learning (International Society for Technology in Education, 2020a). As a foundation for the ISTE Standards for Educators, the conditions are a framework for teachers' reflection on readiness to shift their thinking and practice for integrating technology across the curriculum. Each of the conditions and indicators listed in Table 4 will also be evaluated in further detail in Chapter 4. These conditions are included in the discussion of findings and their link to 1:1 classrooms, technology integration, and the impact on teacher pedagogical changes.

Table 4

Essential Conditions for Technology Integration

Essential condition	Sample indicator(s)
Assessment and Evaluation. The use and application of technology are regularly reviewed and evaluated to determine effectiveness.	• Reflexivity exercises are encouraged and completed by staff and teachers. • Teachers and administrators are assessed. When possible, please complete this step by visiting the online scheduling site in their use of technology using an assessment tool determined by the school.
Consistent and Adequate Funding. Beyond an initial investment, financial resources are available and committed to supporting resources, staff, and technology infrastructure initiatives.	• Budgets are developed and funded to support technology and curriculum departments' technology initiatives. • Schools are engaged and apply for the E-Rate funding programs. • Funding is provisioned for professional development from the same budget. • A per-student technology fee is implemented or considered.
Curriculum Frameworks. 21st-century learners are supported with resources that are aligned to content standards and digital curriculum frameworks.	• Instruction in technology skills and communication technologies (ICT) is fused into curriculum activities is not a separate instructional path. • Frameworks are reviewed regularly to ensure that they are aligned with 21st-century skill sets and expectations.
Empowered Learners. All members of the organization are empowered to lead change.	• Job descriptions provide avenues for partnership on key committees and initiatives. • Expectations are clearly stated for all positions in the school and district. • Teachers have easy and digital access to the curriculum connected to technology frameworks and standards.
Engaged Communities. Community members are connected and partner with the organization to both fund and support digital learning initiatives.	• Parents and the community can access a website for the school/district that provides up-to-date information and ways to engage. • Parents and the community participate and connect with groups, committees, and associations.

Essential condition	Sample indicator(s)
Implementation Planning. Integration is connected to an overall shared vision for how technology will support school effectiveness and learning.	• Teachers and staff are aware of roll-out plans and how they are involved in the process. • Key dates and deliverables are communicated widely to the community.
Equitable Access. Connectivity and resources (i.e., software and hardware) support all learners and teachers in learning.	• Where 1:1 programs are not available, students have before and after-school access to classroom technology or labs. • Partnerships are established with local libraries and other student-focused groups to ensure access to computers and other technology outside school hours. • Internet access is provided to students who do not have access, including unreliable access, at home.
Ongoing Professional Learning. Beyond implementation, there are plans, committed time, and action related to the development of staff.	• Dedicated opportunities are ongoing, inclusive, and comprehensive for teachers to share ideas about practical applications and engage in training development. • Sessions include topics beyond curriculum integration, such as personal goals and professional efficiencies.
Shared Vision. A strategic direction developed collaboratively, understood universally, and supported by all stakeholders and roles. The development process can include teachers, staff, students, parents, and administrators.	• Leadership will coordinate school and district-wide planning while involving staff at all levels. • Proactive and engaged leadership collaboratively solves problems. • Stakeholders can identify and share practical experiences in connection to the vision.
Skilled Personnel. Staff and teachers can select tools and resources that effectively and appropriately use technology resources.	• Input is gathered from staff, teachers, and other school leaders in selecting and using technology resources. • Educators and staff are trained and can use the instructional technology available in the school (i.e., projectors, printers, smartboards, document cameras.) Sessions are provided over time. • Programs are implemented that support coaching, mentoring, and modeling opportunities.

Essential condition	Sample indicator(s)
Student-Centered Learning. Student needs and abilities are at the center of all planning, instruction, and resources.	• 21st-century skills are developed to accomplish specific tasks. • Curricular tasks are connected to technology and industry competencies.
Support Policies. Policies and protocols are defined to support digital learning's curricular and instructional needs in all organization areas.	• Teachers and staff are aware of, agree to adhere to, and accountability practices for technology and copyright policies. • Internet use, acceptable use, and legal/ethical use policies are established and well understood across the organization.
Supportive External Context. Guided by standards, local, regional, national, and international policies and initiatives support technology implementation. Teacher preparation and pre-service programs also support these efforts.	• Connected and regularly reviewed the policies and governance locally and nationally that influence technology standards and resources. • Partnerships are established with area universities and colleges to understand and support the curriculum needs at primary, secondary, and post-secondary schools.
Technical Support. Reliable and dedicated resources are available to provide ongoing maintenance, iterative replacements, and how to use technology resources.	• Staff is available to support teachers and students during instructional hours. • Upgrade and replacement plans are in place for the refresh of outdated equipment. • Records are maintained for warranties, repairs, licensing, and support requests.

Note. Adapted from *Essential Conditions*, International Society for Technology (ISTE) in Education, 2020. Copyright 2021 by ISTE. Permitted for educational use to inform graduate and academic work as defined on the ISTE website.

Pedagogical Changes in 1:1 Classrooms

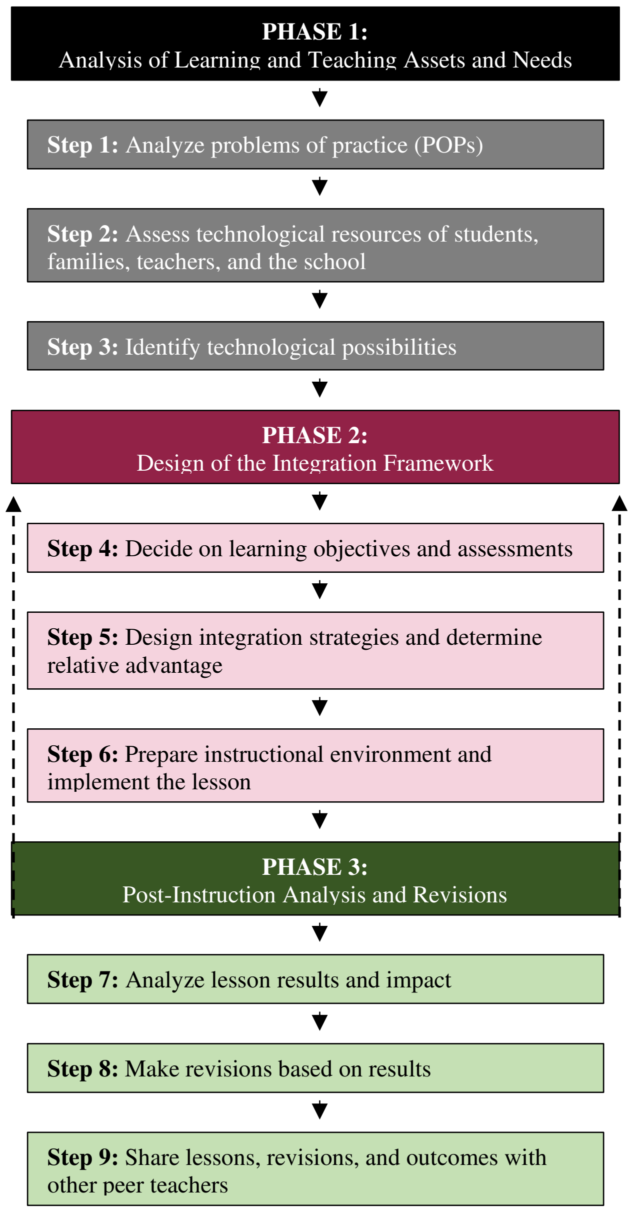
The boundaries of classrooms have rapidly changed over the past 30 years. With technology increasingly added to classrooms, changes are also occurring to develop and deliver instruction and foster student learning. Bebell and Kay (2010), in their analysis of the Berkshire Wireless Learning Initiative (1:1 program), found that 80% of the participating teachers changed their teaching as a result of the initiative. This result was related to an increase in the frequency of using technology in the curriculum, but it is evident that technology impacts teacher pedagogy for Berkshire. As these changes and new approaches for instruction in the classroom unfold for a teacher, Kerr (1996) warns that teachers may experience or need to go through a:

> […] radical shift in both teaching style and […] vision of what classroom life is all about … This new vision is one that changes the teacher's role in basic ways, reducing the importance of 'chalk and talk,' increasing the need for sensitivity to individual students' problems and achievements, shifting how classrooms are laid out, how evaluation is conducted, how teachers relate to their colleagues, and a hundred other particulars of daily life in schools. (p. 24)

Measuring any technology's impact depends on how it is used, in what context, and for what specific purpose (Burbules & Callister, 2018; Lei & Zhao, 2008; McFarlane, 2003). It is essential that we study and further consider teachers' changing pedagogy in 1:1 classrooms during implementation and integration to more fully understand the impact of technology on the classroom as a system. While many factors undoubtedly influence pedagogical practices in classrooms, this section will focus on six areas of effective teaching as a foundation to explore pedagogical changes as they relate to the research questions for this study: the planning and design of instruction, content selection, delivery of instruction, assessment strategies, and decisions about student engagement and communication (Bloom, 1956; Dewey, 1916; Mager, 1962; Pellegrino et al., 2001; Tom, 1997).

To further guide the review of these areas, I will apply this study's theoretical framework and the Turn-around Technology Integration Pedagogy Planning (TTIPP) approach to decisions in a 1:1 classroom. Roblyer and Hughes (2019) introduce the TTIPP model as a framework for teachers as they consider how technology fits into their teaching and learning - or are required by administrators to do so. This model is based on research from a three-year study by Kamler and Comber (2005), which found that students had a renewed interest and were more engaged in learning when turning toward students to gain a deeper understanding of their background and interests. In turn, students were viewed for their assets rather than their deficit areas (Kamler & Comber, 2005; Roblyer & Hughes, 2019).

By reviewing each of the steps detailed in Figure 11, teachers can move toward identification and integration of "technology […] *that* will be meaningful and successful in meeting learning needs through the process of building a revitalized curriculum that engages all students" (Roblyer & Hughes, 2019, p. 59). Further, teachers "will be able to identify exactly how the technology contributes to specific aspects of instruction, learning and/or curriculum" (Kamler & Comber, 2005, p. 37). These will be reviewed more fully throughout the Review of Related Literature and Chapters 4 and 5.



Note. Adapted from Roblyer and Hughes (2019, p. 59).

Figure 11. *Turn-Around Technology Integration Planning (TTIPP) Model*

Planning and Design of Instruction

In addition to providing a framework of focus areas on technology integration, TPACK supports a teacher's pedagogical autonomy in instructional design choices.

According to Mishra and Koehler (2006), integration is specific to the content and classroom setting (context) in which it is considered. When thinking about the planning process for instruction with technology, teachers consider what and how they will teach and set the lesson's outcomes and expectations (Algozzine et al., 2009; Fang, 1996; Pithers & Soden, 2000). It is not solely about planning a lesson because of the bells and whistles of a specific technology. Instead, they consider how a lesson is designed using engaging approaches with collaborative methods.

While there are many areas for exploration, four key areas will be reviewed to examine the impact of technology on designing and instruction planning in a 1:1 classroom. The following sections will then serve as a reminder that technology needs to provide an advantage over the current instruction approaches that do not include technology. Once determined that there is an advantage, the section will explore the changes in the world of work that drive student-required skillsets and directly impact classroom pedagogy and instructional delivery. Lastly, this section will address how problem-based learning has supported developing instruction with technology to steer toward objectives and away from primary tool adoption.

Determining Relative Advantage and Meaningful Instruction

A quick search on the relative advantage of technology to support and enhance instruction will return a robust number of results; however, which content areas would provide the most authentic, engaging, and relevant experiences for students? Technology tools have impacted all content areas and can benefit from integration strategies and potential pedagogical changes.

Effectively planned/designed 1:1 instruction requires considerations for how technology applies in the classroom and self-awareness for the necessary changes to pedagogical practices. Gustafson and Branch (2002) indicated that instructional design's essential components should be learner-centered, goal-oriented, and empirical in their text on instructional development models. They should focus on real-world performance with outcomes that are measured reliably and with validity. One additional component involves considering technology as an additional factor that requires planning and careful design considerations.

The International Society of Technology in Education (International Society for Technology in Education, 2020b) references that technology, when used with students, should improve achievement, promote learning, and provide students with skills needed in future education or other work. Further, there needs to be a determination of the relative advantage of technology in the classroom to ensure that all curricula are engaging, relevant, and authentic. By determining a relative advantage, technology integration shifts from an isolated goal for teachers to an approach to planning for students to engage in meaningful work in cross-content areas (P. A. Ertmer & Ottenbreit-Leftwich, 2013; Herrington & Kervin, 2007; Painter, 2001).

Meaningful Instruction and a Constructivist Approach

Pink (2006) discusses the shifts and changes that occur during workplace changes, including "senses" that result in success during economic prosperity – these include design, story, symphony, empathy, play, and meaning. During the times when access to information is high and a changing economy, Pink presents an argument that in his self-described Age of Abundance, "It is no longer sufficient to create a service, an experience, or a lifestyle that is merely functional. Today it is economically crucial and personally rewarding to create something that is also beautiful, whimsical, or emotionally engaging" (p. 65). While Pink references an economic model and the need to look beyond pure function to develop more meaningfully designed goods and experiences, this concept translates to education and the classroom. Beyond producers and consumers, teachers and students need to build meaningful instruction and experiences.

Even when it is determined that there is a relative advantage and all essential conditions are met, it is not a guarantee that just because of technology, a teacher's pedagogy is changing, making improvements, or a positive experience for teachers and students. While technology does not directly result in changes to pedagogy, teachers with 1:1 technologies in their classroom implemented research-based best practices more often and regularly than their counterparts without technology (Lowther et al., 2012).

As teachers adjust to devices in the classroom, they develop a more social constructivist approach to instruction (Gulek & Demirtas, 2004; Maninger & Holden, 2009). The most successful found that these teaching principles were critical in ensuring student outcomes. The process of learning from the social constructivist perspective involves three key assumptions relating to the knowledge: (1) knowledge is a product of human interaction, (2) knowledge is socially and culturally constructed, as well as influenced by the group and their environment, and (3) learning is a social activity (Kim, 2001). Social constructivism also focuses on learning because of social interactions with a group.

In their approach to constructivism as implemented in Malaysian schools, Sultan et al. (2011) found that learners construct their knowledge based on their understanding and interpretation of events and previous experiences. In their study of Kindergarten teachers using devices in the classroom, Katz and Kratcoski (2005) noted that while developing their role as "facilitator, trying to provide opportunities and resources for students to discover or construct knowledge" (p. 52), a teacher was also expanding their TPK. This provided support for a more student and technology-connected learning environment.

Changes in the World of Work and Pedagogical Impacts

In 2017, Bear Rapids School District gathered families, alumni, business owners, community members, the Board of Education, and other District staff as part of their community engagement efforts to guide their district. On January 29, 2018, a session was dedicated to understanding the climate of academics, instruction, and learning in district classrooms (Pease & Lee, 2018). BRSD administrators regularly communicated a finding from the World Economic Forum's *Future of Jobs Report* (2016) that "65% of children entering primary schools today will ultimately work in new job types and functions that currently do not yet exist" (p. 32). These jobs included functions that have not been created yet, tools that have not been invented yet, and solving problems that have not been thought of yet. Though just four years later, with the "future of work already arrived for a large majority of the online white-collar workforce," the outlook for students in the *Future of Jobs Report* was bleaker without a course correction:

> Automation, in tandem with the COVID-19 recession, is creating a 'double-disruption' scenario for workers. […] Forty-three percent of businesses surveyed indicate that they are set to reduce their workforce due to technology integration, 41% plan to expand their use of contractors for task-specialized work, and 34% plan to expand their workforce due to technology integration. […] By 2025, 85 million jobs may be displaced by a shift in the division of labour between humans and machines, while 97 million new roles may emerge that are more adapted to the new division of labour between humans, machines, and algorithms. (2020, p. 5)

Nevertheless, even with the changes in 2025, disruptive changes due to industry and the economy are not new. Traditional learning environments do not prepare students for the 21st-century workplace (Hannon, 2012; Saavedra & Opfer, 2012). Education historically is driven by the social needs and innovations as described earlier in this chapter. Early schools were designed around an industrial model to transition students to one of three places: factory, farm, or university (Toffler, 1984). For example, in describing industrial era schools, Toffler (1984) discusses how to pre-adapt students for a new world that included factory whistle and clock regulation:

> The whole idea of assembling masses of students (raw material) to be processed by teachers (workers) in a centrally located school (factory) was a stroke of industrial genius. The whole administrative hierarchy of education, as it grew up, followed the model of industrial bureaucracy. (p. 204)

Today, changes in the world of work are driving forces for the 21st-century skillsets required from students. The skills that employees want from students have changed. By 2025, employers will expect value-added soft skills in addition to technical expertise such as "active learning, analytical thinking, creativity, leadership and social influence, emotional intelligence, critical analysis, problem-solving, resilience, stress tolerance, and flexibility" (World Economic Forum, 2020, p. 71). Recognizing the changing skillsets for students, the American Association of School Librarians developed learning standards for information literacy. These standards include an intentional lens to "multiple literacies, including digital, visual, textual, and technological, that are crucial for all learners to acquire to [*succeed*] in our information-rich society" (American Association of School Librarians, 2009, p. 8). The four standards include:

1. Inquiring, thinking critically, and gaining knowledge.
2. Drawing conclusions, making informed decisions, applying knowledge to new situations, and creating new knowledge.

3. Sharing knowledge and participating ethically and productively as members of our democratic society.
4. Pursuing personal and aesthetic growth.

These critical skillsets and associated technologies are essential for preparing students for 21st-century careers. Further, they align with national educational policies and reforms like the Race to the Top and STEM (science, technology, engineering, and mathematics) initiatives. As a result, a district's responsibility is to integrate each skill set into instruction design and their overall teaching and learning outcomes (Cakir, 2012; Luterbach & Brown, 2011). A technology-rich and student-centered environment must be created to support these outcomes (Groff, 2013; Hannafin & Land, 1997).

Portrait of a Graduate. In 2018, Bear Rapids School District engaged with Battelle for Kids to begin the design process for infusing 21st-century skillsets into their students' academic experience. The District gathered stakeholders to identify collective goals for their youngest learners to their high school graduates. The group included parents, teachers, students, business leaders, representatives from higher education, and area non-profits. These fundamental questions are at the center of their engagement:

1. What are the hopes, aspirations, and dreams that our community has for our young people?
2. What skills and mindsets do our children need for success in this rapidly changing and complex world?

3. What are the implications for designing the learning experiences—and equitable access to those experiences—we provide in our school systems?

They identified core competencies that students need to succeed, regardless of their path – career, college, or gig work (Bear Rapids School District, 2018b). Referred to as "Portrait of a Graduate," these competencies are visually represented around three development areas: heart, will, and mind (see Figure 12).

Note. Bear Rapids School District produced this Portrait of a Graduate graphical organizer to provide an "at a glance" view of the initiative for the community. The graphic is reproduced with permission from the District.

Figure 12. *Portrait of a Graduate Graphic*

- **Resilience**. Students will overcome obstacles, learn through missteps, adapt in the face of challenges, and persist toward and exceed goals despite setbacks.
- **Flexibility and Adaptability**. Students will adjust to new conditions, different roles, unpredictable situations, and shifting contexts. They will manage ambiguity

and adjust to changing priorities. Further, they will recognize that there are often several paths to the desired outcome.

- **Communication**. Students will express their thoughts and ideas collaboratively using oral, written, and non-verbal communication skills in various forms and contexts. They will also listen with empathy to make meaning and build understanding. Lastly, they will communicate effectively in diverse environments.
- **Citizenship**. Students will understand civic processes and service obligations at local, state, national, and global levels. They will use empathy when collaborating with others to guide their civic participation.
- **Critical Thinking and Problem Solving**. Students will collect, assess, and analyze relevant and reliable information to reason effectively. They will collaborate with others to consider different perspectives, test ideas, and evaluate solutions.
- **Creativity and Innovation**. Students will use idea creation techniques to improve, analyze, and evaluate ways to grow creative efforts. They will empathize with others to gain new perspectives and recognize that originality may challenge constraints. Lastly, they will understand that creating a collaborative process requires risk-taking and learning from mistakes.

Each Portrait of a Graduate competency will be reviewed since research and interviews were not conducted at BRSD. Specifically, this study will address how 1:1 teachers integrate and model technology in classroom instruction. These competencies have connections to student engagement and are explicitly identified to focus on communication. As a result, the change in teacher pedagogy to emphasize support for student development in each area is an essential factor.

A change in competencies and expectations supports leveraging instructional approaches like problem and project-based learning, emphasizing collaboration through individualized learning experiences. While the objectives of project-based learning and individualized learning experiences may at times be at odds, they share a common goal of developing meaningful instructional experiences for students. Since three frameworks are referenced in the Review of Literature, a crosswalk is introduced to provide connections across the AASL Shared Foundations for Students, ISTE Standards for Students, and the BRSD Portrait of a Graduate initiative (see Table 5).

Table 5

21st Century Student Skillset Crosswalk (AASL, ISTE, and BRSD)

	AASL ***Shared Foundations for Students***	**ISTE** ***Standards for Students***	**BRSD** ***Portrait of a Graduate***
Domain	*A1/3: Think – Inquire & Collaborate*	*Standard 7: Global Collaborator*	*Critical Thinking & Problem Solving*
Learner Competencies	A1] Learners display curiosity and initiative by: • Formulating questions about a personal interest or a curricular topic. • Recalling prior and background knowledge as context for new meaning A3] Learners identify collaborative opportunities by: • Demonstrating their desire to broaden and deepen their understandings. • Developing new understandings through engagement in a learning group. • Deciding to solve problems informed by group interaction	• Students use digital tools to connect with learners from various backgrounds and cultures, engaging with them in ways that broaden mutual understanding and learning. • Students use collaborative technologies to work with peers, experts, or community members, to examine issues and problems from multiple viewpoints. • Students contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal. • Students explore local and global issues and use collaborative technologies to work with others to investigate solutions.	• Collect, assess, and analyze relevant and reliable information to reason effectively. • Collaborate with others to consider different perspectives, test ideas, and evaluate solutions.
Domain	*B2/C3: Create/Share – Include*	*Standard 6: Creative Communicator*	*Communication*
Learner Competencies	B2] Learners adjust their awareness of the global learning community by: • Interacting with learners who reflect a range of perspectives. • Evaluating a variety of perspectives during learning activities. • Representing diverse perspectives during learning activities. C3] Learners exhibit empathy with and tolerance for diverse ideas by: • Engaging in informed conversation and active debate. • Contributing to discussions in which multiple viewpoints on a topic are expressed.	• Students choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication. • Students create original works or responsibly repurpose or remix digital resources into new creations. • Students communicate complex ideas clearly and effectively by creating or using various digital objects such as visualizations, models, or simulations. • Students publish or present content that customizes the message and medium for their intended audiences.	• Express thoughts and ideas collaboratively using oral, written, and non-verbal communication skills in various forms and contexts. • Listen with empathy to make meaning and build understanding. • Communicate effectively in diverse environments.

Domain	*A2/D1: Think & Grow – Include & Inquire*	*Standard 1: Empowered Learner*	*Flexibility & Adaptability*
Learner Competencies	A2] Learners contribute a balanced perspective when participating in a learning community by: • Articulating an awareness of the contributions of a range of learners. • Adopting a discerning stance toward points of view and opinions expressed in information resources and learning products. • Describing their understanding of cultural relevancy and placement within the global learning community. D1] Learners participate in an ongoing inquiry-based process by: • Continually seeking knowledge. • Engaging in sustained inquiry. • Enacting new understanding through real-world connections. • Using reflection to guide informed decisions.	• Students articulate and set personal learning goals, develop strategies leveraging technology to achieve them, and reflect on the learning process itself to improve learning outcomes. • Students build networks and customize their learning environments in ways that support the learning process. • Students use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways. • Students understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies, and are able to transfer their knowledge to explore emerging technologies.	• Adjust to new conditions, different roles, unpredictable situations, and shifting contexts. • Manage ambiguity and adjust to changing priorities. • Recognize there are often several paths to the desired outcome.
Domain	*C5/D4: Share & Grow – Explore & Curate*	*Standard 4: Innovative Designer*	*Creativity & Innovation*
Learner Competencies	C5] Learners engage with the learning community by: • Expressing curiosity about a topic of personal interest or curricular relevance. • Co-constructing innovative means of investigation. • Collaboratively identifying innovative solutions to a challenge or problem D4] Learners select and organize information for a variety of audiences by: • Performing ongoing analysis of and reflection on the quality, usefulness, and accuracy of curated resources. • Integrating and depicting in a conceptual knowledge network their understanding gained from resources. • Openly communicating curation processes for others to use, interpret and validate.	• Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems. • Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks. • Students develop, test, and refine prototypes as part of a cyclical design process. • Students exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems.	• Use idea creation techniques to improve, analyze, and evaluate ways to grow creative efforts. • Empathize with others to gain new perspectives. • Recognize that originality may challenge constraints. • Understand that creation in a collaborative process requires risk-taking and learning from mistakes

Domain	*B/D5*: Create and Grow – Explore	*Standard 5: Computational Thinker*	*Resilience*
Learner Competencies	B5] Learners construct new knowledge by: • Problem-solving through cycles of design, implementation, and reflection. • Persisting through self-directed pursuits by tinkering and making. D5] Learners develop through experience and reflection by: • Iteratively responding to challenges. • Recognizing capabilities and skills that can be developed, improved, and expanded. • Open-mindedly accepting feedback for positive and constructive growth.	• Students formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models, and algorithmic thinking in exploring and finding solutions. • Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making. • Students break problems into component parts, extract essential information, and develop descriptive models to understand complex systems or facilitate problem-solving. • Students understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.	• Overcome obstacles, learn through missteps, adapt in the face of challenges, and persist toward and exceed goals despite setbacks.

Domain	*D2/3: Grow – Include & Collaborate*	*Standard 2: Digital Citizen*	*Citizenship*
Learner Competencies	D2] Learners demonstrate empathy and equity in knowledge building within the global learning community by: • Seeking interactions with a range of learners. • Demonstrating interest in other perspectives during learning activities. • Reflecting on their own place within the global learning community. D3] Learners actively participate with others in learning situations by: • Actively contributing to group discussions. • Recognizing learning as a social responsibility.	• Students cultivate and manage their digital identity and reputation and are aware of the permanence of their actions in the digital world. • Students engage in positive, safe, legal, and ethical behavior when using technology, including social interactions online or when using networked devices. • Students demonstrate an understanding of and respect for the rights and obligations of using and sharing intellectual property. • Students manage their personal data to maintain digital privacy and security and are aware of data-collection technology used to track their navigation online.	• Understand and be informed of civic processes and obligations to be of service to others at a local, state, national, and global level. • Use empathy when collaborating with others to guide civic participation.

Project and Problem-Based Learning in 1:1 Classrooms

When designing instructional lessons, a teacher aims to create learning experiences that acquire and apply new knowledge and skills. With student devices in 1:1 classrooms, technology can become a central planning factor for instruction and requires planning and design considerations. Rosen and Beck-Hill (2012), in their study in fourth and fifth-grade 1:1 classrooms, found increased differentiation practices when students used devices. Similarly, teachers created more personalized environments when designing curricula using the same or similar devices (Hutchison et al., 2012).

Reiser and Dempsey (2001) identified that all instructional design's essential components should be learner-centered, goal-oriented, empirical, and focused on real-world performance when working on these curriculum forms. These outcomes should be measured reliably and with validity, but to do so is a team effort. Technology Integration Matrix (TIM) and the Integrating Technology for Inquiry (NTeQ) are two approaches when designing instruction in a 1:1 classroom. These models emphasize educational technology for delivering a quality learning experience that includes supporting tangible evidence. These highlight the critical nature of interactive learning for teachers and various instructional strategies rather than only drill and practice.

iNtegrating Technology for inQuiry (NTeQ). Founded by Morrison and Lowther (2005), NTeQ is a 10-step instructional model where students actively participate in their learning rather than waiting for the teacher to transmit information. Figure 13 provides a sample NTeQ lesson plan which emphasizes the student, the lesson, the environment, and the computer. Traditional roles are altered where teachers are facilitators and designers of learning who take backstage to technology as a tool, and students who are empowered to take on a researcher role. A student's primary goal is to gain knowledge through complex problem solving (Flake, 2017; G. Morrison & Lowther, 2005). They need to be connected and actively engaged in the lessons to explore and solve problems.

The example lesson is integrated with technology to provide a pathway for the lesson, with the computer supporting the teaching process. Lastly, the environment is student-centered and rich with available technology and is at the center of student learning (G. Morrison & Lowther, 2005). The student-centered environment means that instead of being responsible for gathering information and driving students through a lesson, students are accountable for exploring and discovering information using their 1:1 device based on the teacher's problems. Moving to a "student as explorer" model includes transitioning power and responsibility from teacher to student. Morrison and Lowther (2005) further indicated that teachers "need to go beyond computer literacy to become technologically competent" (p. 12).

Specify Objectives

- <u>**What learning objectives will students achieve by completing this lesson?**</u>
  - By the end of this lesson, students will be able to format a personal business letter and envelope.
  - Organize a body of a letter with transition and flow.
  - Conduct research to form an opinion to prepare a persuasive letter.
  - Prepare and share a presentation or movie discussing the issue.

Match Objectives to Function

- <u>**The objective is matched to various computer functions by comparing the learning tasks required by the objective with the functions of the computer.**</u>
  - Computer Function: Internet searches, visiting websites, using Microsoft Word/PowerPoint/Movie Maker (optional) and a Projector
  - Computer Application: Research, Reading and Surfing, Creating a letter, Creating a Presentation, Creating a Video/Movie, Giving a Presentation

Specify the Problem to Investigate and Solve

- <u>**What problem will students be solving? The problem statement should be written in the language used with students.**</u>
  - We'll watch videos of people that have spoken out in different ways to make a difference on human rights issues.
  - You will use the internet to research issues, I will provide you with some very helpful websites for you to visit.
  - You will have a think sheet to help you organize your thoughts and there will also be a graphic organizer available to help outline the contents of your letter.

Planning for Data Manipulation

- <u>**Determine how students will use the computer functions to solve the problem. How will data need to be modified to find a solution?**</u>
  - Determine effective searches and keywords for your topic.
  - Evaluate how valid a website is for the data provided.
  - Review the functions available in PowerPoint in relationship to your project; or, add and edit audio to produce your short video.

Planning the Presentation of Results

- <u>**How will students present their results or solutions to the problem?**</u>
  - Students will give a PowerPoint presentation or show a video with background information/context about their chosen issue.
  - Students will read their letter to other groups, along with a class discussion on the solutions that were chosen.

Activities During Computer Use

- <u>**What will students do while using the computer? Directions should be clear, time is adequate and resources are suitable.**</u>
  - Visit designated websites, read pages and view the links/vidoes.
  - Type a first draft of the business letter.
  - Submit a draft letter to your teacher for edits and comments.
  - Prepare the PowerPoint presentation on the issue that was discussed.

Activities Before Computer Use

- <u>**What activities will prepare students for their computer work? This can be one or more activities.**</u>
  - Watch a video as a class and discuss teh key points.
  - Choose a person or compant to write to.
  - Makes nots or use the graphic organizer to arrange your ideas.
  - Assemble in groups and check for group understanding of the PowerPoint rubric.

Activities After Computer Use

- <u>**These activities will guide students in reaching a solution. Key guiding questions, aka Think Sheets, will ask inquire, lead to student predictions and provide an opportunity to make cross-disciplinary links.**</u>
  - Engage in small group discussions using the provided Think Sheet.
  - Review comments and discuss modifications needed to your letter.
  - Discuss how each member of the team will participate in the presentation.

Planned Supporting Activities

- <u>**The computer is only one of the tools that assist students. Not replacing technology, but these acitivies support the resources.**</u>
  - Read and be ready to discuss the declration of human rights.
  - Think about other times that you have written a letter. Why are business letters written?
  - Discuss the best formats for PowerPoints (i.e. timing, bullets, design, pages)

Assessment

- <u>**Rubrics provide a support for assessing productivity on standards based on performance expectations.**</u>
  - A rubric that includes format, content, language/mechanics, think sheet, and the PowerPoint presentation.

Figure 13. *Morrison and Lowther's NteQ Lesson Plan Ten-Step Approach*

Technology Integration Matrix (TIM). Developed by the Florida Center for Instructional Technology (FCIT), TIM is a framework for defining and evaluating technology integration. It focuses on five components key to meaningful instruction in learning environments: active, collaborative, constructive, authentic, and goal-directed (Welsh, n.d.). Each area is aligned against five technology integration levels: entry, adoption, adaptation, infusion, and transformation. Through the resulting 25 cells, teachers self-assess their technology integration level for a lesson or instructional unit. As referenced in Table 6**.** teachers move from left to right across each row. As they do so, they increase their use of TPK and TCK and spend less time focusing on TP, TK, or CK independently; however, this mobility is fluid and not linear.

Unlike the NTeQ model, in alignment with TPACK, the TIM approach does not prescribe that a computer or specific technology is the primary resource that all teachers must use. Further, TIM does not require the use of technology at all. Instead, there is a balance between available technology, student needs, and curriculum demands. With NTeQ as a framework example, self-evaluation strategies like the TIM, and other available frameworks, which techniques do BRSD teachers find to be the most impactful when working in their 1:1 classrooms? How do they describe their change in practices compared to before 1:1 devices?

Table 6

Levels of Technology Integration in the Classroom

	Entry	Adoption	Adaptation	Infusion	Transformation
Active	Information passively received	Conventional, procedure use of tools	Conventional independent use of tools; some student choice and exploration	Choice of tools and regular self-directed use	Extensive and unconventional use of tools
Collaborative	Individual student use of tools	Collaborative use of tools in conventional ways	Collaborative use of tools; some student choice and exploration	Choice of tools and regular use for collaboration	Collaboration with peers and outside resources in ways not possible without technology
Constructive	Information delivered to students	Guided, conventional use for building knowledge	Independent use for building knowledge; some student choice and exploration	Choice and regular use for building knowledge	Extensive and unconventional use of technology tools to build knowledge
Authentic	Use unrelated to the world outside of the instructional setting	Guided use in activities with some meaningful context	Independent use in activities connected to students' lives; some student choice and exploration	Choice of tools and regular use in meaningful activities	Innovative use for higher-order learning activities in a local or global context
Goal-Directed	Directions are given, step-by-step task monitoring	Conventional and procedural use of tools to plan or monitor	Purposeful use of tools to plan and monitor; some student choice and exploration	Flexible and seamless use of tools to plan and monitor	Extensive and higher-order use of tools to plan and monitor

Note. Reproduced from the Florida Center for Instructional Technology, 2019

Selection of Content

The availability of quality, accurate, standards-connected, and pedagogically informed resources directly impacts content selection for the classroom (Livingston, 2017; Polikoff & Dean, 2019; Michael Russell et al., 2004). Over time, resources have improved, but the quality, accuracy, trustworthiness, and pedagogical relevancy have become challenging to discern with many options available (Polikoff & Dean, 2019). With so many of these online services available like Teachers Pay Teachers© (TPT), ReadWriteThink©, and textbook publishers providing more e-resources than ever, it may be viewed that finding content online for a classroom is as easy as a few clicks online. For example, on the TPT site, teachers will upload curricular resources for use by other teachers. The resources are categorized by grade level, content area, type, and price. As robust of resources as the site may have, in their study focusing on the abundance, quality, and value of supplemental curriculum resources, Polikoff and Dean (2019) discovered that on a 0-3 scale, 72% of reviewers identified TPT materials as mediocre at best[9]. More concerning, 70% of reviewers felt that the content was weakly aligned to standards.

Information Literacy: Credible and Trustworthy?

Other literacy areas are recognized beyond traditional writing and reading focus areas. These include multimedia literacy, the function of interpreting and producing

---

[9] According to the study, the responses provided for the value of resources available on three different resource websites used a 4-point Likert scale: 0 = very unclear or no guidance offered; 1 = some lack of clarity or limited guidance offered; 2 = adequate clarity and guidance offered; and 3 = exceptionally clear, complete guidance offered. The mean value for TPT was 1.18.

knowledge in different media formats, and information literacy, or the ability to access, evaluate, manage, and use information (Seay, 2014). Multimedia and information literacy are critical TPACK-based skills for teachers (and students), which provide a lens for filtering information. Andresen (2016), in a review of 1:1 classrooms in Denmark, evaluated how digital technologies in the classroom can be used to improve digital and information literacy skills. In the study, Andresen (2016) identifies a loop that includes teacher analytics to reinforce content selection around long-term high-level goals and monitoring student learning. Through this process, teachers plan instruction around the support required for student learning and expectations for using tools and content. This planning and analysis are the sense of iteration needed when reviewing content for the classroom, precisely how a resource will best fit my learners' needs? Is it a credible and trustworthy source?

Teachers' pedagogical changes may be needed when introducing multimedia and information literacy in the classroom landscape. With literacy discussions occurring in the classroom, teachers will need to consider the impact of devices on processes, sources, and products. In addition to the pedagogical effects and changes, several studies noted that increased exposure to technology in the classroom results in teachers with improved skills in connecting to educational technology resources (Dunleavy et al., 2007; Ingram et al., 2008; Maine & Project, 2004; Zucker & McGhee, 2005). Warschauer (2008), in his multi-site case study, evaluated the impact of media integration into the curriculum. As Maine's most economically, culturally, and linguistically diverse school, Castle Middle

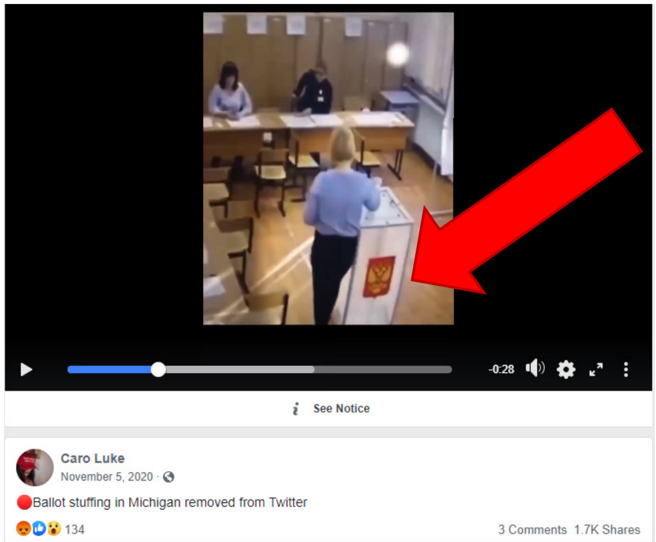
School is a 1:1 laptop school. Students with 1:1 devices had more opportunities to exhibit autonomous control in their literacy processes, were more collaborative, and supported iterative processes than their peers who did not have devices in the classroom (Warschauer, 2008). The most notable involved the access and application of literary sources. This section reviews the credibility and trustworthiness when selecting content; non-device students used textbooks and other school-based resources. At the same time, laptop-based classrooms had access to the same resources in addition to supplemental online materials.

While there is a utility in applying multimedia literacy in social, economic, and intellectual exchanges, decoding whether digital resources are trustworthy and credible is gravely underdeveloped for students. Consider the video created during the 2016 Democratic primary elections targeting Illinois, Pennsylvania, and Arizona. In Figure 14, the video shows individuals purported to be Democrats stuffing ballot boxes and moving papers to plastic bins in Pennsylvania. In a Stanford History Education Group study (N=3,000), students were asked if this clip demonstrated voter fraud in the United States. The study attempted to understand student ability in evaluating digital resources on the internet. Upon seeing the clip, only 52% of students were able to identify that this was not voter fraud (Breakstone et al., 2019). These students could not identify that the date and time stamp was embedded as September 18, 2016; however, the primaries ended by June 7, 2016. Second, they did not perform an internet search to see this video was posted to YouTube to demonstrate Russian Parliament election fraud during their elections.

Note. The screenshot is from a video campaign shared on Facebook to spread false information about election fraud during the 2016 Democratic primary.

Figure 14. *False information video campaign during 2016 Democratic primary*

Five years later, the same concerns about information literacy exist today when factoring in a recent video clip spread on social media about ballot-stuffing during the 2021 elections in Michigan. The video in Figure 15 was shared 1,700 times by this individual user; however, the video was shared by countless others. There were glaring indications that this video was fake in this second video. In the screenshot, a Russian flag is displayed on the ballot box. None of the voter protections match those found at all polling places. There is also a notice below the video indicating that the video contains false information. The video is still widely circulated on the internet with all these indications.



Note. The screenshot is from a video campaign shared on Facebook to spread false information about election fraud during the 2021 election.

Figure 15. *False information video campaign during 2021 elections*

Given that multimedia and information literacy represent a component of the 21st-century soft skills students need, compounded by the increased difficulty in discerning content, how do teachers in 1:1 classrooms modify their pedagogy to integrate these critical lessons? This study seeks to understand how teachers evaluate and select content from digital literacy perspectives for their classrooms. Further, what resources are the most successful in their classrooms? What recommendations would they provide a colleague when selecting content for a 1:1 classroom? What messaging and objectives are the most essential for students?

Technology Tools Aligned to Pedagogical Purposes

As identified earlier in Table 3, after many years of teachers being directed on how to use technology, there is a shift from prescribing how teachers should be replaced by technology to thinking about how technology can support, reinforce the profession and empower teachers (Brandon, 1988; Dogan et al., 2021; Niederhauser & Stoddart, 2001; Nisanci & Nisanci, 2000). When considering technology tools and their function in the classroom, six primary categories of tools are available for teachers and students. These tools require teachers to have a basic TK level to address issues, prepare materials or collaborate on ideas (Fernandes et al., 2020; G. Morrison & Lowther, 2005). They include tools that generate classroom materials, gather and analyze data, create graphics, support reference, research, organize planning and sorting materials, and content-area specific tools (Roblyer & Hughes, 2019).

Compared to technology tools, instructional software is a core technology based on using a device and context-dependent code to serve one of five instructional functions: problem-solving, instructional gaming, simulation, drill and practice, or tutorials. As new software applications are developed, teachers need to consider that not all applications have a one-to-one relationship with an instructional purpose. Teachers will need to consider whether the application areas are appropriate for their class use. Consider a mobile and web-based application, Duolingo, which supports learning new languages in just 30 minutes per day. In the application, learners will work through the instructional functions. Duolingo will be used to introduce classroom instructional software to provide a thumbnail review in connection to drill and practice activities. This software will also be used later in the chapter to discuss opportunities for assessment.

Drill and Practice. Yes. No. Try Again. Correct. Drill and practice exercises date back to the 1940s and provide students with a question followed by feedback on the accuracy of their response (Lim et al., 2012). These are very similar to rogue memorization activities, which require perfection in a skill or activity. In selecting drill and skill practice software, teachers should identify resources that provide clear and appropriate feedback for responses and allow control over the pace at which questions are asked (Roblyer & Hughes, 2019). Upon reviewing Figure 16 from Duolingo, students are presented with a question with no time limit, emphasizing accuracy and practice. If students answer correctly, they can continue to the next question, report it for review, or discuss it with other users. If the answer is incorrect, they can try again with staggering support. They will receive another similar question to check for understanding. By receiving immediate feedback, students can make quick corrections and are motivated to continue to the next question. This feedback also saves teachers time since they are not grading formal evaluations or facilitating individual activities.

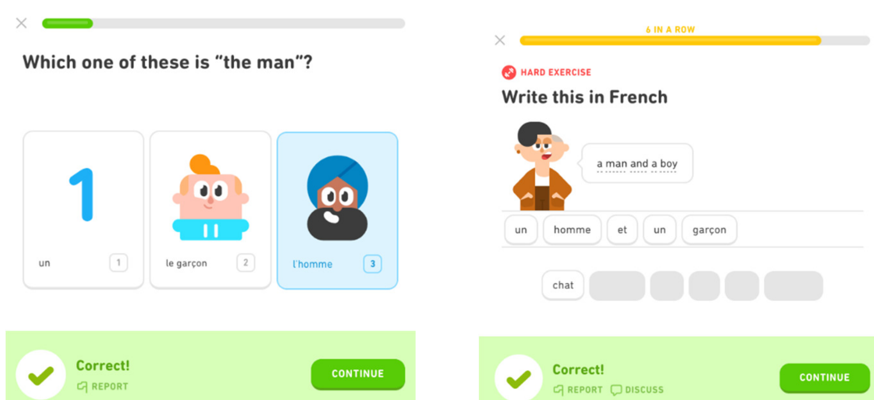


Figure 16. *Duolingo screenshots exhibiting “Drill and Practice” activities*

Schoppek and Tulis (2010) identified that students who practiced a moderate amount with drill and practice software improved significantly in problem-solving and arithmetic skills in their study of third-grade math students. For example, students need to understand basic math operations to work on algebraic equations. Defined by Gagné (1983) and Bloom (1968), practicing using drill and practice software builds up automaticity - the ability to recall lower-order prerequisite skills to accomplish higher-level learning tasks. Nevertheless, there are perceived misuses of instructional software where teachers may use the applications for an extended time. For example, teachers should not use drills and practice for new concepts but instead reinforce existing topics for reinforcement.

Copyright and Fair Use ≠ Free for All

In addition to finding an appropriate tool or resources for the classroom, teachers need to factor fair use and identify any legal implications. One of the more challenging areas when selecting content for the classroom is understanding copyright and fair use. There is a litmus test for using a resource and being able to classify it as covered under fair use[10], all of which must be considered as a whole (U.S. Copyright Office, 1990):

1) Purpose and Character of Use
    - Is the resource used for criticism, comment, news reporting, teaching, scholarship, or research?

---

[10] A resource that meets all conditions may be used without getting the express permission of the author; however, it is best practice to acquire permission prior to the use of copyrighted materials prior to use.

- Is the resource being used for “transformative” work and not just a reproduction?

2) Nature of the Original/Copyright Protected Work
   - Would using this resource impact the creative expression of the work protected by copyright?
   - Is this work a fact-based resource or more creative/imaginative?
3) Amount and Substantiality of the Work Used (Quantity and Quality)
   - Is the selection a small amount of the overall resource?
   - Is the selection being considered the “heart of the work?”
4) Value of the Work in a Potential Market
   - Does your new work present any financial risk to the copyright-protected work, or would the work present a significant income loss, such as commercial use?

The American Library Association (ALA) and American School Librarian Association (AASL) align their recommendations and refer to 17 U.S. Code § 107 – *Limitations on exclusive rights: Fair use* when guiding librarians and educators on fair use. Both include guidance that the ALA nor AASL can provide legal advice regarding fair use.

As an educator, I have heard time-and-time again, “I am using this video in the classroom, so there is not a copyright issue because it is covered by fair use,” or a student says, “It is for a class project, so I can use this song in my YouTube video.” A teacher understanding the substance of copyright and fair use is essential because modeling appropriate use for their students encourages them to cultivate their own academically responsible resources.

Copyright and fair use are increasingly challenging given the reduced hurdles to accessing others' online materials and works. Bear Rapids School District, for example, indicates that it is a staff member's responsibility to adhere to the law and guidelines; however, the District is not responsible for any copyright violations made by a teacher (BRSD Board of Education, 2019). A district policy is a good practice; however, other school districts have succumbed to copyright violations due to staff actions. In May 2019, a lawsuit filed by DynaStudy against the Houston School District alleged that staff was manipulating and intentionally violating copyright to copy and distribute a study guide to students rather than purchasing the study guides (DynaStudy, Inc. v. Hous. Indep. Sch. Dist., 325 F. Supp. 3d 767). The case's outcome was that the District was ordered to pay a $9.2 million fine due to the loss of income from study guide sales and violating DynaStudy’s copyright. After the verdict was announced, the owner of DynaStudy made a statement indicating that the outcome “affirms copyright law and enables DynaStudy to reimagine the best possible business model to accomplish its mission” (Carpenter, 2019).

Delivery of Instruction Strategies and Techniques

When factoring in using 1:1 devices in the classroom and delivering instruction, problem-based learning, and collaboration, standard rows of chairs and tables may be too limiting when delivering lessons and experiences. Further, changing the classroom seating and layout may positively resonate with students and support pedagogical decisions (Freeman et al., 2014; Walker et al., 2011). By rearranging the classroom layout, using self-assembly furniture, and picking up swap meet finds, teachers can designate learning zones and support student choice of where in the classroom best fits their needs. Wesley Imms, associate professor at the University of Melbourne, reviewed the impact of classroom design on Australian schools. In the initial findings, Bryerset al. (2014) find that flexible seating helps students be more collaborative and creative. School districts and administration support teachers in launching these initiatives, including completing flipped, problem-based, and personalized learning spaces.

In 2018, Bear Rapids School District launched a spin-off of the HGTV television show, *Flea Market Flip*, creating “Flea Market: Flip Your Classroom” (Bear Rapids School District, 2019b). Teachers were selected to participate in the challenge and asked to use donated furniture, items purchased from resale shops, or Goodwill. In Figure 17, the classroom teacher featured multiple seating options, with all furniture being easy to relocate based on the lesson needs. This flexible seating allows the teacher and students to change the layout of the space quickly and easily for any activity. The furniture also supports diverse learners with disabilities by easily connecting seating options with their specific needs.

Note. In the photo, a classroom in Bear Rapids School District completed the “Flea Market: Flip Your Classroom Challenge” using different furniture and spaces for engagement (Bear Rapids School District, 2019b).

Figure 17. *Classroom exhibiting flexible seating and learning zones*

Installing a couch and adding a rocking chair is not a magic wand for adoption and integration. Like the technology in a classroom, having a flexible seating layout does not guarantee that teachers will change their instructional approach or that students will experience a different form of learning. When interviewed in *Education Week*, Imms stated that:

> These spaces by themselves do not necessarily guarantee a different type of teaching, a different type of learning. It has to come from an educational vision. But we cannot expect the space to do all the work. Because it will not. You can put a teacher in a brand-new innovative space, and that teacher may teach the way they’ve always taught, and therefore, the kids will probably learn much the way they’ve always learned. (Klein, 2020)

Teachers participating in the BRSD program were encouraged to have an open mind and to consider the changes they may need to make in approaches and lesson design. After completing the activities, teachers encouraged other teachers to consider these changes. Since the catalyst for these changes was 1:1 integration needs and district efforts toward innovative learning design, this study will ask further questions about the pedagogical changes in the redesigning of classroom spaces. For example, how have participants changed their instructional practices due to a reconfiguration and new furniture?

Classroom Management and Engagement

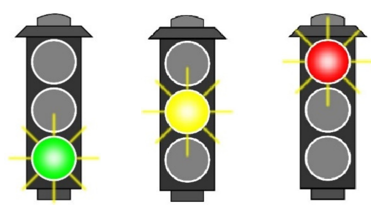
When 1:1 devices are included in a classroom environment, there are essential classroom management issues to consider when identifying, applying, and reforming protocols. The use of a 1:1 device does not guarantee that students will be more engaged or connected to the classroom environment (Bielefeldt, 2005). The most common theme across studies involved students exhibiting off-task behaviors (Donovan et al., 2010; Lei & Zhao, 2008; Maine & Project, 2004). Hu (2007), in an article on the use of 1:1 devices at Liverpool High School just outside of Syracuse, NY, reported that students were using devices during class to exchange tests, download inappropriate materials, and perform potentially illegal activities. Liverpool was in the process of phasing out student devices, with the school board president stating that, “After seven years, there was literally no evidence it had any impact on student achievement — none” (Hu, 2007, p. 1), yet there was a red herring which was not being addressed and likely a source of these issues:

> […] school officials here and in several other places said laptops had been abused by students, did not fit into lesson plans, and showed little, if any, measurable effect on grades and test scores at a time of increased pressure to meet state standards. Districts have dropped laptop programs after resistance from teachers, logistical and technical problems, and escalating maintenance costs.

While quick to highlight students' device misuse, the central source of these issues was the lack of implementation planning and resulting impacts on teachers' integration and classroom management efforts. As mentioned earlier, technology resources need to be reliable and aligned with intentional practices to support their use. In this case, students and staff experienced regular outages and configuration issues. Of note, though, the school district did return to 1:1 device programs ten years later, Issuing Chromebook devices for students in grades 4 – 12 with a more formal launch plan and change in administration (Farsaci, 2021; Zuber & Anderson, 2013).

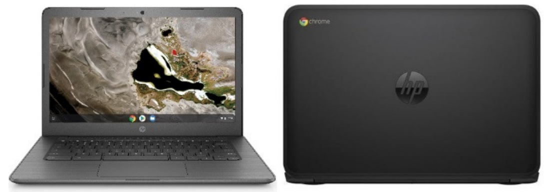
This example may be more extreme than in many schools; however, it highlights the opportunity to discuss classroom management strategies in a 1:1 classroom. In classrooms, teachers may find themselves in a monitoring mode where they feel like the enforcement police – ensuring that all students are on the right screen, adhering to policy, and remaining on task (Andersson et al., 2014; Hill et al., 2002). Several strategies support student autonomy and collaboration while ensuring that the classroom is safe, thriving, and operating effectively. This section will explore active monitoring, the use of consistent vocabulary, setting group roles and expectations, and the need for identifying the offline equivalent for a technology-based lesson.

Consistent Vocabulary. First, teachers should have clear expectations and methods to ensure that students know when technology should and should not be used in the classroom. Teachers can include visual indicators and consistent vocabulary in setting expectations, making students more comfortable with new pedagogical styles or environments (Sufka & George, 2000). From practical experience, students may constantly be on their devices or use them when the teacher does not want them used without clear expectations and indicators. To reduce any conflict, teachers can use a visual indicator like in Figure 18 which shows a traffic light indicating that it is time to use devices or time to put them away. In Figure 19,an alternative is a more literal representation, indicating the same message. Similar to a study on visual feedback for noise levels, these indicators are a non-invasive way to provide feedback to students and positively influence classroom behavior (Van Tonder et al., 2016).



Note. These lights represent when devices can be on a desk (green), when time is running out (yellow), and when it is time to put away devices (red).

Figure 18. *Stoplight indicators*



Note. This classroom indicator uses a two-sided image for students when devices can be used or should be in the closed position.

Figure 19. *Alternative Visual Indicators*

Group Roles and Expectations. To ensure accountability, support positive group dynamics, and encourage all students to make contributions to their learning, setting group roles and expectations for in-class work and out-of-class projects is highly beneficial (Barkley et al., 2014; Johnson et al., 1991; Millis & Cottell Jr., 1997; K. A. Smith, 1996). Consider a class project that involves developing a video presentation about another school in the district. Without group roles and student-developed expectations, team members may likely have an imbalance in tasks and functions. In this example project, the group may determine that each team member will have one role for the project's duration or rotate responsibilities (see Table 7).

Table 7

Roles and Responsibilities in a Project Supporting Engagement and Self-Management

Role	Example responsibilities
Recorder / Blogger	Separate from the "Backchannel Writer," this role ensures accurate notes of the group's progress. This role also organizes and provides copies/digital access to each resource.
Information Engineer	This role is responsible for researching any data questions discussed during in-person meetings. The student also researches any questionable information to ensure that facts are used.
Reflector	This role ensures that the group considers and documents their progress, successes, and improvement opportunities. The student is also responsible for clarifying any unclear areas or requiring action at the end of each meeting.
Leader / Editor	This student, or students, is responsible for the final organization of the project. This person is not solely responsible for the project but ensures it meets the rubric and group expectations.
Spokesperson	This role is responsible for understanding the technical details of the overall project. This student should summarize the group's progress and outcomes to the teachers and any other group.
Facilitator	This student ensures that all discussions are productive and stay on track. The role will ask questions for clarification where there may be misunderstandings.
Backchannel Writer	This role will document any conversations, questions, and answers during project meetings and include them in a chat. The writer should also document any classroom activities to follow up later or throughout the engagement.

Note. Adapted from Barkley et al., 2005; Johnson et al., 1991; Millis & Jr. Cottell, 1998; K. A. Smith, 1996.

Monitoring the Classroom. In her dissertation, Amy Marie Neaves (Marie Neaves, 2015) investigates the impacts of 1:1 implementations on teaching and learning. In this pedagogical study, teachers disclosed the challenges of continuous monitoring to ensure students use their devices as intended. As Neaves found, teachers assumed "initially that they could give them the iPads and that the students would make good choices and be responsible with them" (Marie Neaves, 2015, p. 180). However, students (and adults) do not *always* make positive choices with or without technology. Using an active monitoring role in the 1:1 classroom provides teachers an opportunity to add PK elements to their lessons and ensure students remain on-task and engaged. Historically, classroom management might include circulating the classroom, pointing out areas to redirect a student to the right path, reinforcing good behavior and correcting off-task behaviors.

Additional components must be considered in the 1:1 classroom with students driving their learning. Michigan's Kingston Community Schools developed a presentation on a 1:1 classroom management strategy for their staff. One of their key recommendations is not to place students' desks in rows but instead cluster students in groups or pods (Kingston Community Schools, 2019). This layout mirrors the flexible seating information provided previously. By placing students in clusters, as in Figure 20, teachers can navigate the classroom to ensure students are on task and ask about what students are learning, doing, or creating.

Note. This image was included in the District's Device Plan Recommendation presentation to the Board of Education. Students are collaborating on a project with defined roles and expectations.

Figure 20. *Students Collaborating in Pods*

An additional unique element is that the school asks students to hold each other accountable. For example, if a peer is not collaborating or working on the task, they should discuss the issue with their colleagues. If this does not work, they should notify the teacher as soon as possible. Like in team-based learning, they work in teams, and setting accountability expectations supports classroom improvements in classroom behavior and learning promotion (R. E. Stein et al., 2016).

Assessment Strategies, Techniques, and Procedures

Assessments in the classroom can move away from bubble sheet multiple-choice quantitative-based tests to assessments that support student demonstration of knowledge and online assessments. Paper tests and written assignments do not always allow students to learn or exhibit their understanding based on Gardner's (Gardner, 1999) 21st-century multiple intelligences. 1:1 programs can connect students to alternative learning and assessment environments where teachers can "challenge an educational system that assumes that everyone can learn the same materials in the same way and that a uniform, universal measure suffices to test student learning" (Gardner, 1983, p. 3). This section focuses on the role of teachers as data analysts who can respond and pivot based on information gathered and evaluated.

Each assessment goal and strategy is connected to a teacher's role as a data analyst. This role has continued evolving because of personalized instruction goals, state goals, and increased emphasis on data-informed instruction (J. Morrison, 2008). With access to data, teachers and administrators need to access, generate, manage, interpret the data and act on their findings (Knapp et al., 2006). Educational technology can assist; however, as a U.S. Department of Education study found, a teacher's pre-disposition to data use in decision-making is primarily based on their confidence about data analysis and interpretation (Means et al., 2011).

Teachers use multiple data sources like homework assignments, class tests, and in-class performance to support their analysis of student strengths and areas of opportunity. They have also used direct observation as an approach to monitor student progress, including a checklist or notes to record their observations (Algozzine et al., 2009). These strategies only highlight student performance on a case-by-case basis (Leung, 2004). Limiting these data sources does not account for class-to-class, year-to-year, or overall student growth (Confrey et al., 2004; Hammerman & Rubin, 2004; Knapp et al., 2006). These limitations expose the potential data gap for teachers who may not have the TK, PK, or TPK that would support knowing where to find relevant data, understanding what the data represents, identifying hidden or misleading data, or interpreting the available data to make decisions.

When examining trends and gaps in performance, teachers need the training and support for leveraging short-range data from formative assessments and long-range data from projects, state assessments, and grade-by-grade work to target outcomes to reduce gaps (Hamilton et al., 2009). This data can also inform which tools may be appropriate to close the gaps at varying levels. What was nearly impossible to efficiently query ten years ago using classroom technologies and school-wide student information systems is now available in seconds with a mouse click and strong TPACK to discern the data to actionable information.

Student Academic Engagement and Communication in 1:1 Classrooms

A large body of research identifies improved communications and collaboration opportunities between teacher-student and student-student with 1:1 devices in the classroom (Fairman, 2004; Dunleavy et al., 2007; Mouza, 2008; Ardito, 2011; Haselhorst, 2017). For example, Storz and Hoffman (2013) found that in their 1:1 initiative research, students communicated more frequently and intentionally with their teachers than students without a device. For this study, I will be focusing on teacher-student interactions and how 1:1 programs can impact teacher pedagogy and result in schoolwide improvements.

Teachers are rethinking how we conceptualize the teacher-student relationship in their consideration for space planning. This change reflects viewing students not merely as instruction objects but as partners, collaborators, providers of fresh perspectives, and creators of knowledge. Students can identify when teachers are attempting to make relationships with their classes. Responses in Sufka and George's survey found that students described such teachers as 'caring about them as a person or 'is energetic about the subject and how it connects to my life.'

In connection to these relationships, Maninger and Holden (2009) identified that teachers had more meaningful and remarkable moments with students when using their devices in a study on laptops in a fifth to eighth-grade laptop program. Teachers were most successful in developing these relationships and a climate of open communication when they established a community of learners through collaborative work in their classrooms (Fairman, 2004).

By introducing collaborative work across groups, student-student communication was five times more frequent than former teacher-student interactions (Fairman, 2004; Rockman, 2004; Ardito, 2011). Shapley et al. (2009) evaluated Texas' immersion pilot and found that students with 1:1 devices communicated more often and effectively. Today, teachers have access to many tools and resources for communicating with students. This study will seek to understand what methods and approaches for communicating with students do teachers find successful? How do teachers support collaborative discussions in the online environment?

Summary

In this Review of Related Literature, a brief history of the select advances in educational technology and practices was reviewed from a discussion beginning with slate tablets and ending with computers in today's classrooms. Across this history, instructional pedagogy has also evolved – at times begrudgingly, with ease or out of necessity. Each of these significant milestones represents a pivotal era in the transformation of teaching, the classroom, and student experience. While a volume of research is available on middle and high school technological pedagogical content knowledge and changes in pedagogy, limited research is present on the elementary teaching experience. As a result of this gap and literature review, a methodology was developed to examine the elementary teaching experience. In Chapter 3, the methodology, research design, sampling, and data collection strategies for this study are provided in further detail.

CHAPTER III

METHODOLOGY

Overview

This study applied a qualitative retrospective instrumental case study design model to address the research questions. Chapter 3 provides an overview of why the case study model was the most appropriate selection for this study, an examination of the researcher's role, population identification, and the process of identifying and selecting the sample. After exploring the background and decision-making that framed the study, the data collection and analysis procedures will be reviewed. Since this was a retrospective instrumental case study with convenience sampling, a portion of the chapter will also be dedicated to reviewing trustworthiness and ethical concerns. As discussed more fully in this chapter, case study provided the best avenue to understand how a set of elementary teachers changed their instructional practices resulting from a 1:1 technology adoption. The study also examined how these teachers perceived classroom communication and student engagement changed after 1:1 adoption.

Research Methodology

The research method used in this study was qualitative. Qualitative research is "an inquiry process of understanding based on […] traditions of inquiry to solve a human problem" (Creswell, 2013, p. 300). The study's research questions, problem, and purpose did not support quantitative research. While this study had established research questions, they did not aim to test a hypothesis but rather to discover ideas with a general research objective.

The study's research methodology was based on the foundations of case study research. A case study is defined as "an in-depth description and analysis of a bounded system, [*which is*] a single entity, a unit around which there are boundaries" (Merriam, 2009). As a check and balance, Yin (2017) identifies three conditions when considering a case study as a methodology: (1) the purpose must be to answer "how" or "why" questions; (2) the researcher must have little control over the events; and (3) the focus of the research must be on a contemporary phenomenon within a real-life context, even when the boundaries may not be clearly defined. A case study involves developing a holistic picture of a sample population's perceptions and views, including supporting documents, resources, and variables (Creswell, 2013).

In addition to being bounded, particularistic, descriptive, and heuristic, the case study approach supports the use of multiple methods supporting multiple sources of information to triangulate findings (Yin, 2017). While case studies tend to be more time-consuming, their results-rich nature and holistic approach are suited to allow participants' voices to emerge. Such studies' concrete and contextual nature also ensures participants' voices are rooted in a specific setting.

Research Design

At the start of the 2018-2019 school year, Kodiak Creek Elementary School (KCES) provided 1:1 Chromebooks to their second through fifth-grade students. Located in the center of BRSD and the site school for this study, KCES students in grades K-1 accessed Chromebooks using a shared cart model, supporting students and technology at a ratio of 4:1. Some Title-I funded schools invested funds to support a more closely tied 1:1 model; however, that is not the reality for all elementary schools. Since launching the Chromebook project three years ago, teachers have changed their pedagogical practices, and students engage in the classroom in new ways.

This study's primary focus was to understand how teacher pedagogy changed due to 1:1 devices in the classroom. Considering the research questions and the detailed phenomenon, a case study was the most aligned methodology for several reasons. First, this study involved a bounded system: a specific program at a specific school with specific participants and focus areas. By investigating this program and sample, this study examined a "unit of analysis, not the topic of investigation" (Merriam, 2009, p. 41). One way to determine whether this case was intrinsically bounded was to determine if a finite number of participants could be involved. Merriam further indicates that "if there is no end…then the phenomenon is not bounded enough to qualify as a case" (p. 28). The 1:1 program is not specific to BRSD because such programs also exist in other districts and environments. The classroom, teachers, and the school's specific bounded system also have finite participation limits in the study.

Why Case Study?

Case study was selected because of the research goals and alignment with the methodology's key characteristics: particularistic, descriptive, and heuristic (Yin, 2017).

This case study offers readers an understanding of teachers' experiences and pedagogical changes in elementary 1:1 classrooms. The study is heuristic since it will "bring about the discovery of new meaning, extend the reader's experience, or confirm what is known" (Merriam, 2009, p. 44). The study is also pluralistic because it focused on a specific program and a group of teachers. With the research questions and purpose identified, the case is "important for what it reveals about the phenomenon and for what it might represent," which includes understanding the pedagogical changes in 1:1 elementary classrooms (Merriam, 2009).

Addressing the first condition presented by Yin (2017) about the purpose of answering "how" questions, this study sought to answer two key "how" questions and three "how" sub-questions:

1. How do teachers adjust pedagogical practices in 1:1 classrooms?
    - 1a. How do 1:1 devices in classrooms influence teacher pedagogical practices?
2. How do teachers describe shifts in their classrooms since implementing a 1:1 program?
    - 2a. How do teachers perceive student academic engagement in a 1:1 classroom?
    - 2b. How do 1:1 devices in classrooms influence communication for and between teachers and students?

2c. How do 1:1 devices in classrooms influence communication for and between students?

For Yin's second condition about researcher control, I was not connected to BRSD or any schools when the 1:1 program was implemented; however, I did join the District in their third year during the elementary program expansion. By the fifth year of the program, based on position, I did not have the authority to make any instructional changes, adjust classrooms, appraisals, or assessments of teachers or schools. I did have the authority to influence the selection of replacement devices and the configuration of the 1:1 devices. During my tenure, no foundational changes were made to the devices or their structure that impacted this study's outcomes. Lastly, this research focused on a modern phenomenon with a real-life setting: teachers in a K-5 school making pedagogical changes due to 1:1 devices in their classroom.

In support of the research goals, a key target was to provide a thick description of a teacher's pedagogical changes, illuminate teachers' and students' experiences, and reveal classroom engagement and communication information. Merriam (2009) defines thick description as "the complete, literal description of the incident or entity being investigated" (p. 43).

Role of the Researcher and Bias

As a former administrator responsible for the District's technical operations, including the 1:1 program, I know that participants may have thought I was attempting to seek positive results regardless of the data gathered and information provided. To address this, I reviewed the informed consent process with participants. I also shared that the purpose of this study is not to validate the success or failure of the 1:1 program but to understand how and why pedagogical changes occur in 1:1 elementary classrooms.

In this study, I served as the researcher performing the interviews and engaging in evidence analysis. I was responsible for accessing participants' thoughts and feelings, even though it may have been challenging given the teacher's personal and professional nature. I kept notes during data collection and analysis to mitigate researcher bias and reflect on my engagement with the data. This ensured that I focused specifically on the data and evidence support and not my historical or personal influences. Also, I committed to considering all the data as presented, doing my best to set existing assumptions to the side. By reviewing documents and resources created by the teacher and their questionnaire and interview responses, I followed up on gaps between questionnaire scores, TPACK representation in the documents, and responses during the interview.

Study Participants and Setting

Population

This study's population was elementary teachers who work in schools with 1:1 device initiatives. As discussed above, the program at Kodiak Creek was purposefully chosen because it represented an established 1:1 program at a district with a history of focus on pedagogy and instruction. Serving Kindergarten through 5th grade, Kodiak Creek has four teachers for each grade level, two physical education teachers, and one art and music teacher. Students are also supported by six special education teachers, nine support staff, and five teaching assistants.

In alignment with the study's research questions and purpose, the sampling frame for this study included elementary grade-level teachers at KCES. Teachers at the school have a wide range of years of service, from some teachers in their first year of teaching to over 25 years in education. This represented the population at BRSD as the teacher service field extends from the first year to retiring teachers in elementary classrooms.

Sampling Method

Initially, I planned a purposeful case sampling approach by doing initial classroom visits to identify possible teacher participants using 1:1 devices in their classrooms. Teachers would be identified based on who demonstrated a balance in using the student's technology device in their lessons and modeled connections to a potential for strong TPACK. Examples would have included alternative assessments to check for understanding, like using the Chromebook to capture evidence in a science experiment or collaborating on a wiki to create an interactive reading summary. Negative cases would have been identified in classrooms where technology is ineffective for instruction and student learning. Through this process, I hoped to gain a richer and more in-depth understanding of the pedagogical changes in 1:1 classrooms.

As a result of the COVID-19 pandemic, classroom visits were not permitted, making purposeful case sampling impossible. Instead, I pivoted to use a convenience sampling model given the school conditions. This approach supported the recruitment of participants at KCES if they were elementary classroom grade-level teachers, used 1:1 devices in their classroom, and had at least three years of consecutive service at the school. Three years of service at the site school was critical because the date marked the beginning of the 1:1 program. All other respondents were not eligible for the study since they would have started as teachers at the site after the program was implemented or did not ever use Chromebooks in their classrooms—this sample best-supported providing insights into the research questions. Based on staffing limitations at the site, this study's sample size was limited to five to eight teachers in the school. The larger goal was to arrive at data saturation where responses are "[to the point that I begin] to see or hear the same things over and over again" (Merriam, 2009, p. 219).

After adding compensation, extending the study timeline, and following up with the potential participants using different outreach approaches, I could not recruit further teachers for the study. Of note, seven teachers did complete the informed consent process. However, they opted not to participate despite my best efforts to pare down the requirements to gather as much information as possible from potential participants. Seventeen respondents opted not to participate and provided feedback indicating that: (a) they were "exhausted from the school year and […they…] need*ed* a break," (b) this "was one more thing they would have to do," (c) they were unsure "… if the District would be able to identify [teachers] in the study" and (d) they were resolved that "no one would listen to what [*they*] have to say."

Recruitment

Before collecting data for this study, BRSD's Superintendent provided a signed Letter of Cooperation to allow for the recruitment of District teachers (See Appendix C). Once approved for data collection through Loyola's Institutional Review Board, I reached out to Kodiak Creek's building principal to introduce myself and the study (See Appendix D). The email introduction reiterated that the District supported this study based on a Letter of Cooperation and voluntary teacher participation. At no time did the principal receive a list of any participants, nor was participant data ever shared with the District.

After my introduction email, I sent an e-mail from my Loyola University Chicago email account to all teachers at the site (See Appendix E). This recruitment e-mail included information about the study and a link to review the Informed Consent document. Upon reviewing the Consent, participants could join the study and receive a Participant PIN used later. Among the participants were one 4th grade teacher, two 5th grade teachers, and two "Specials" teachers –who teaches Physical Education and another who teaches Art (see Table 8). Each teacher was coded and represented with a four-digit code to keep participant identities confidential. Each teacher provided a pseudonym to protect their identity further. All participants taught for more than three years at the site school and used Chromebooks in their classrooms in a 1:1 capacity for at least the past three years.

Table 8

Participant Summary

Name	Age	Gender	Average class size	Grades taught	Years at KCES	Years at BRSD
"Sally"	57-63	Female	28	5th	7 Years	27 Years
"Poppy"	50-56	Female	26	K – 5th	22 Years	27 Years
"Amy"	43-49	Female	25	K – 5th	9 Years	24 Years
"Terry"	57-63	Female	28	4th	7 Years	22 Years
"David"	29-35	Male	25	5th	4 Years	4 Years

All participants signed a Consent to Participate in Research (See Appendix F), which included the purpose of the study, anticipated commitment, and the risks/benefits to participating. The Consent also reviewed participant confidentiality and processes to ensure secure storage and retention guidelines for their data. A review of the Consent, especially the sections for privacy and security of related documents, was discussed before each session, with verbal confirmation from each participant. Data collection for the interviews took place over Zoom, and the submission of sample curriculum resources was completed using a Qualtrics survey (See Appendix H).

Data Instruments

When considering the types of data instruments needed to serve as evidence and supports, Yin (2017) recommends gathering six sources of information to triangulate a study's findings and claims: documentation, archival records, interviews, direct observations, participant observation, and physical artifacts. For this study, I gathered data that would support triangulation by conducting teacher interviews, reviewing internal and public-record program documents about the implementation and progress of the 1:1 program, teacher work products, lesson plans, outcome reports, board presentations, a historical analysis of focus group reports, and questionnaires. No student data was collected or reviewed as part of this study as the focus was on teacher pedagogy changes. Table 9 provides an evaluation crosswalk table (O'Sullivan, 1991) for the connection between the study's research questions and data instruments:

Table 9

Crosswalk Table of Research Questions and Data Instruments

	Data instruments		
Research questions	Questionnaires	Documents or Artifacts	Interviews
How do teachers adjust pedagogical practices in 1:1 classrooms?	✓	✓	✓
How do 1:1 devices in classrooms influence teacher pedagogical practices, including the planning and design of instruction, selecting content, and delivering instruction, including instructional strategies, assessment strategies, techniques, and procedures?	✓	✓	✓
How do teachers describe shifts in their classrooms since implementing a 1:1 program?	✓	✓	✓
How do teachers perceive student academic engagement in a 1:1 classroom?	✓	✓	✓
How do 1:1 devices in classrooms change communication for and between teachers and students?	✓	✓	✓
How do 1:1 devices in classrooms change communication for and between students?	✓	✓	✓

Structured Questionnaire

After reviewing and completing the Informed Consent process, participants completed a four-part questionnaire (See Appendix H). The questionnaire included focus areas on the teacher's background and demographic information, level of technology integration in the classroom, a self-assessment of TPACK levels, and perceived technology barriers for students in the classroom.

Part A: Background and Demographic Information

This first section of the questionnaire aimed to understand the teacher's demographics and their experiences with technology before engaging in the 1:1 program. Before the following sections were presented, questions were structured to understand any predispositions, positive or negative, to technology. In addition to gender and age, questions included years of teaching experience at the site and district, grades taught, and content areas where instruction is provided.

Part B: Level of Technology Innovation (LoTi)

In the next section, teachers responded to statements connected to their level of technology innovation and implementation in the classroom, also known as LoTi. A portion of the LoTi Digital Age Survey (Moersch, 2010) was used to assess how school teachers integrate technology into their instructional practices. The survey was developed based on the LoTi Framework (See Appendix Q), suggesting that teachers move across eight stages or levels of change as they implement technology in their pedagogy (Moersch, 1995, 1999, 2010). These levels include: (0) Non-use, (1) Awareness, (2) Exploration, (3) Infusion, (4a) Implementation [Mechanical], (4b) Implementation [Routine], (5) Expansion, and (6) Refinement (Moersch, 2010, 2011). As teachers move from level to level, changes can be observed in their instructional practices. An example of this transition is when teachers move from “Level 0 – Non-use,” where assignments and tasks require little to no technology skillsets. Later moving through other levels, teachers will facilitate higher echelon thinking, and students will solve authentic, real-world problems with technology. These transitions align with student-centered learning experiences where technology is viewed as an available resource to be used intentionally and not solely for technology's sake (Moersch, 1995).

The complete LoTi Survey looks at three main areas of focus: levels of technology innovation, personal use of technology, and instructional technology strategies. Since the focus of this study included a teacher’s level of technology implementation in connection to TPACK, only the first section was added to this study’s questionnaire. With more than 25 years of studies on the LoTi survey examining the content, criterion, and construct validity (Moersch, 1995; Stoltzfus, 2006, 2009), it has become a statistically valid and reliable tool with scores of $\alpha = 0.90$ overall (LoTi Connection, 2012; Mehta, 2011).

Participants were provided an introduction to this section which asked teachers to think about their “classroom before COVID-19 school closures, and remote learning [and] respond to the following statements in terms of [their] uses of technology resources in the classroom using the scale provided.” The twelve items used an eight-point verbal-frequency scale: Never (0), At least once a year (1), At least once a quarter (2), At least once a month (3), A few times a month (4), At least once a month (5), A few times a week (6), and Daily (7). Participant scores and feedback are included in Appendix O.

Part C: TPACK Self-Evaluation

In the third section of the questionnaire, participants responded to questions connected to each TPACK domain to self-assess their development in each area. Included items were selected from TPACK surveys that were previously verified with reliability scores between $\alpha = 0.90$ and 0.93 (Archambault & Crippen, 2009; Chai & Koh, 2017; Koh et al., 2015; Schmidt et al., 2009). Each of the 35 survey items in this section was rated based on a seven-point Likert scale: (1) Strongly Disagree, (2) Disagree, (3) Slightly Disagree, (4) Neither Agree nor Disagree, (5) Slightly Agree, (6) Agree, and (7) Strongly Agree. Calculations were determined based on the TPACK Domain, questions, and total possible scores in each area, as included in Table 10.

Table 10

Calculating Participant TPACK Scores

TPACK Domain	Items	Total Score	Possible	Calculation
CK	N/A	CK1+CK2	42	TS⁄TP
CK – Subject 1	13a-c	13a+13b+13c	21	TS⁄TP
CK – Subject 2	15a-c	15a+15b+15c	21	TS⁄TP
PK	11a-f	11a+11b+11c+11d+11e+11f	42	TS⁄TP
TK	10a-f	10a+10b+10c+10d+10e+10f	42	TS⁄TP
PCK	18a-d	18a+18b+18c+18d	28	TS⁄TP
TCK	17a-d	17a+17b+17c+17d	28	TS⁄TP
TPK	16a-d	16a+16b+16c+16d	28	TS⁄TP
TPACK	19a-e	19a+19b+19c+19d+19e	35	TS⁄TP
Calculated TPACK	N/A	↓↓↓↓↓↓↓↓↓↓	42	TS*TP

$$\frac{\left\{\left[\left(\frac{CK + PK + TK}{3}\right) * 0.6\right] + \left[\left(\frac{PCK + TCK + TPK}{3}\right) * 0.4\right]\right\}}{36.4}$$

Part D: Perceived Technology Barriers in the Classroom

In the final section of the questionnaire, teachers were asked to review their perceptions of student barriers to using technology in the classroom. Focus areas were based on studies that examined both teacher and student perspectives with a lens toward first-order barriers (Hew & Brush, 2007; Wood et al., 2005). This section aimed to understand how teachers' perceptions of student technology barriers related to a teacher’s LoTi and TPACK self-assessment scores. Each of the 15 survey items in this section was rated based on a five-point Likert scale: (1) No Impact, (2) Very Little Impact, (3) Somewhat Impactful, (4) Quite a Bit of Impact, (5) A Great Deal of Impact.

Document Analysis

In addition to 1:1 program documentation and BRSD publicly available presentations, three key document and resources areas were analyzed: (1) teacher sample curriculum resources, (2) historical survey reports, and (3) focus group results. The focus of each document type was to understand how teaching pedagogy was impacted by outside sources, context, or forces.

Teacher Sample Curriculum Resources

As part of the questionnaire process, participants were asked to provide lesson plans and other classroom materials from each TPACK domain (See Appendix J). Three participants provided materials that were analyzed for representations of TK, PK, and TPK. After completing the questionnaire and document analysis, I conducted semi-structured Zoom interviews to understand participants' classroom experiences and discuss their pedagogical changes. During these interviews, I asked follow-up questions about the materials provided and participants' interpretations of the connections to each TPACK domain.

Semi-Structured Interviews

Due to COVID-19 restrictions, participating teachers were not interviewed in person. Using semi-structured interviews, participants detailed their lived experiences and had an opportunity to make sense of the study’s phenomenon. The questions served as a starting place for discussion; however, I provided a more tailored interview experience with sample work and the questionnaire scores. For example, while I could not meet the participants in person during the interviews, I learned more about each participant through documents they shared and the questionnaires completed before each interview. All participants were interviewed using the same protocol.

Participants scheduled and engaged in three interviews as part of the study. As part of this three-interview approach, participants were included in the member checking process at the end of each interview. Several researchers provide recommendations and guidelines on performing member checking (Creswell, 2005; Stake, 1995; Yin, 2014). Each set of guidance has a slightly different perspective. Stake (1995), for example, identifies participants as actors and includes them in the reviewing a rough draft where participants are highlighted. The goal is for each actor to check for accuracy and provide feedback for any alternative explanations. While the feedback could be helpful, the researcher does not guarantee that the insights will be included in the final draft. Creswell (2005) describes member checking as:

> Member checking is a process in which the researcher asks one or more participants in the study to check for the accuracy of the account. This check involves taking the findings back to participants and asking them (in writing or in an interview) about the accuracy of the report. You can ask participants about the many aspects of the study, such as whether the description is complete and

> realistic, if the themes are accurate to include, and if the interpretations are fair and representative. (p. 252)

Unlike Stake, Creswell does not detail how to handle discrepancies between participant feedback and the researcher's interpretation. Yin (2014) advances member checking by seeking a participant's support of the findings and potentially generating new evidence that may not have been identified previously. Yin does caution that "participants may cling to their own perspectives and disagree with your conclusions and interpretation, but these readers should have the opportunity to challenge a study's key findings" (p. 199). Yin also indicates that the study should be considered unfinished if a disagreement occurs until the misalignment is resolved with further evidence or clarification.

Interview One

The first 45-minute interview focused on establishing a baseline profile for each teacher, understanding the training and professional development opportunities available throughout the 1:1 program, and learning about each teacher's instructional practices and examples of student behaviors with 1:1 devices. Developing a baseline included teachers reflecting on when devices were first available in the school and their current experiences. The first interview questions and their connection to the research questions are included in Appendix I.

Interview Two

In the second 45-minute interview, I summarized the first interview to account for the feedback and perform member checking. Participants reviewed their transcripts, and the researcher shared a summary of the previous interview. They also had the opportunity to provide additional information or correct any information. During the second interview, participants discussed their perspectives on using technology and making pedagogical decisions in an online environment. While COVID-19 and remote learning are not directly tethered to the research questions, I could not miss asking these questions because of this unique opportunity since participants were going through another set of pedagogical shifts. The second interview questions and their connection to the research questions are included in Appendix I.

Interview Three

In the third 45-minute interview, I summarized the second interview to account for the feedback and perform member checking. Participants reviewed their transcripts, and the researcher shared a summary of the previous interview. They also had the opportunity to provide additional information or correct any information. I also covered a few questions that bubbled from the first two interviews across participants. These sessions covered all questions to ensure a comprehensive data set across participants. The third interview questions and their connection to the research questions are included in Appendix I.

Participants also participated in an interactive activity based on Krauskopf, Foulger, and Williams' (2018) proof-of-concept study, which analyzed teachers' ability to reflect on their professional knowledge. The study evaluated the Graphic Assessment of TPACK Instrument (GATI) instrument initially developed for high school teachers by

Foulger (2015). Using Google Slides, the exercise was adapted for elementary teachers and involved participants using Google Slides to self-evaluate their perspective on TPACK and how social-emotional learning is connected to TPACK by adjusting each domain's size, shape, and proximity (See Appendix K). They were also asked to consider how Social Emotional Learning factors into the domains, if at all. Lastly, teachers were asked to discuss a representation of their ideal level of knowledge in each respective domain.

Data Collection and Procedures

While considering this study's procedures, I wanted to ensure that the participants had a safe, comfortable, and appropriate space and dedicated time to participate. Since qualitative interviews offer the opportunity to gain a more in-depth understanding of a participant, I wanted to be both sensitive and purposeful in the approach. As a former District staff member and knowing that these discussions would be about their classroom experiences and pedagogical practices, I promoted and recognized researcher responsibilities and reporting separation. These areas of focus and mitigation strategies were discussed in the researcher bias section on page 128. After submitting their Informed Consent, three 45-minute interviews were scheduled using PickTime[11]. With COVID-19 forcing the closure of schools and safety protocols, in-person interviews were not an option for participants and prioritized both parties' safety. Interviews were held

[11] PickTime is an online appointment scheduling service that facilitated the interview scheduling process. Available appointments were directly connected to the researchers calendar for live availability. Participants only provided their Participant ID as part of the sign-up process. Upon completion of the interview, all appointments were removed from PickTime.

using Zoom, a video conferencing platform, and a TPACK questionnaire on teacher pedagogy was delivered online. Participants received an e-mail invitation after scheduling their interview(s) signup and a reminder after completing the self-paced questionnaire.

Semi-Structured Interviews

Interview data was collected using three formats: (1) audio-only recordings of each Zoom meeting; (2) transcription of each interview and meeting notes provided by Otter.ai, an AI-powered transcription service; and (3) the researcher's paper-based notetaking. The audio from each interview was recorded directly on my personal laptop. All files were stored in an encrypted folder on the laptop, and no Zoom Cloud stored content or resources will be captured. The audio was only captured since each interview focuses on the participant's comments, feedback, and ideas – not on their video feed.

I used paper-based notetaking to identify highlights and areas for follow-up; however, this was being kept at a minimum to ensure that the participant knew that they had my focus and attention. All paper-based notes were destroyed after completing this dissertation. In addition to using paper, I leaned on Otter.ai, an AI-based transcription tool, to focus on the participant and the interview. The service provides a draft transcript after completing a Zoom meeting. Once provided, I listened, edited, and corrected any transcript inaccuracies. Any copies of the transcripts from the cloud-hosted environment were immediately deleted and were stored on my secured personal laptop. Otter's privacy statement cites that upon deletion, they "take measures to render such Personal

Information irrecoverable or irreproducible, and the electronic files which contain Personal Information will be permanently deleted" (Otter.ai Privacy Officer, 2020, p. 1). All transcripts stored locally were forensically destroyed after completing this dissertation.

Structured Questionnaire

The data from the questionnaire was collected using the Qualtrics service provided by Loyola University Chicago. Each participant was provided with a unique PIN at the end of the online Consent process. All response data was saved and stored locally, with cloud versions deleted within 48 hours of completion. All questionnaires stored locally were forensically destroyed after completing this dissertation.

The questionnaire provided an overall score for each TPACK region. These scores provided an opportunity to connect a participant's perception of their alignment to the score, a lens for comparing identified attributes in the document analysis, and another way to discuss changes in pedagogical practices. One respondent completed the survey twice, but their results were omitted from the study after discussion with the participant and confirming that they were duplicate submissions.

Participant Submitted Documents

Self-submitted curriculum documents were also collected using the Qualtrics service provided by Loyola University Chicago. Participants were able to upload Microsoft Word and PDF files as part of their responses. Also, they were asked to type in a description of the resource and any connection to a TPACK domain.

To protect the confidentiality of participants, each participant entered their Participant ID, which was provided at the end of the Consent document. All response data was saved and stored locally, with cloud versions deleted within 48 hours of completion. All participant submitted documents stored locally were forensically destroyed after completing this dissertation. Three respondents provided curricular documents and classroom resources. All participants who did not respond were sent follow-up communications; however, no additional materials were submitted.

Data Analysis

As the research questions echo the understanding that teaching and education change and evolve, the data analysis and collection processes coincided. By approaching data collection and analysis in this way, Merriam (2009) details that this allows a researcher to make changes and test emerging concepts, ideas, themes, and categories against data identified later in the study. The essential information usually comes from unstructured questions where the exact wording is not planned. Using structured questions and opportunities to advance other questions, I used a balanced approach, collecting specific data and questions before the interviews and introspective data to generate more questions to explore. The overall data analysis plan is detailed below, including the ten stages following Figure 21.

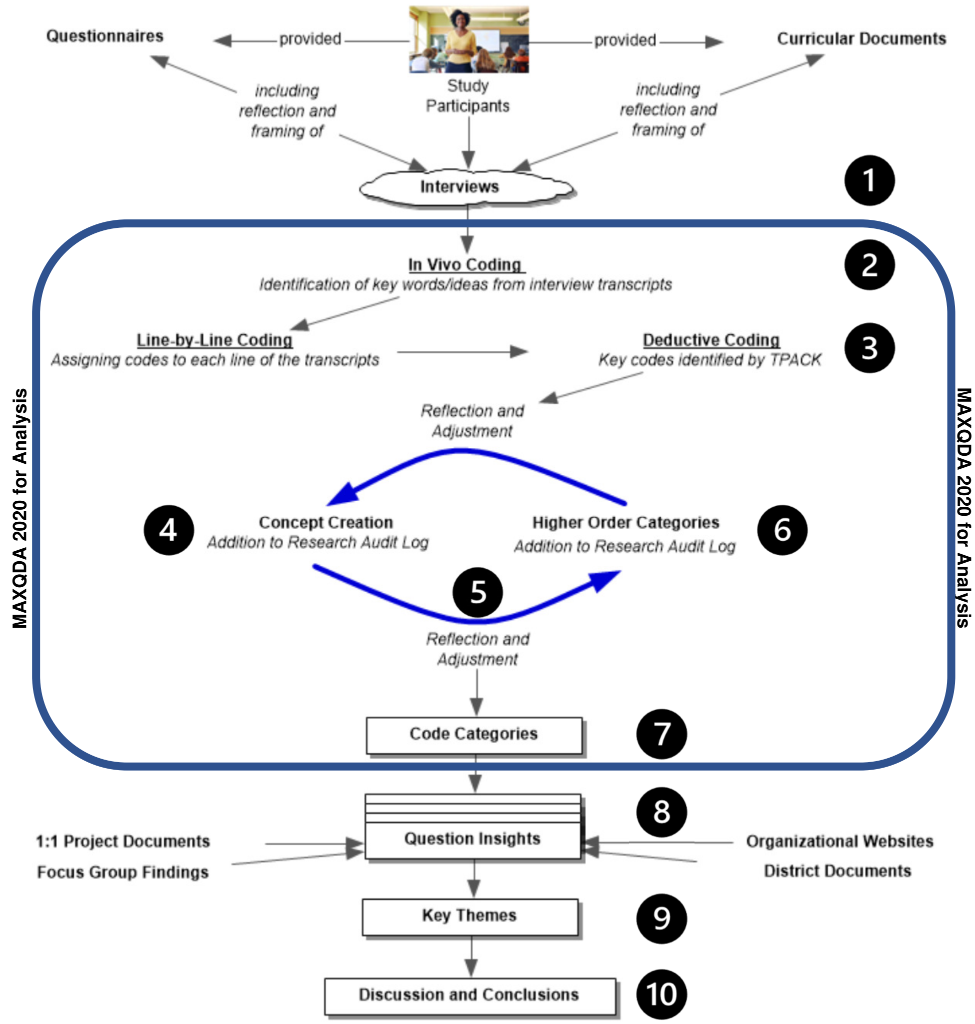


Figure 21. *Data Analysis Strategy*

As each interview was completed, it was transcribed on the same day. The expedited timing ensured that the discussions were still fresh in the researcher's memory and shared back information with each participant. As referenced previously, transcripts were generated from audio recordings using Otter.ai and then reviewed by the researcher for accuracy. The accuracy of the Otter.ai was dependent on the proximity of the microphone to participants, background noise in the environment, and ensuring that only one individual was talking at a time. On average, the AI-based transcription process was 80% accurate. The gaps in the transcription process involved corrections for overall accuracy, use of slang or jargon, running sentences with no punctuation, use of acronyms, and filler words like "um," "uh," and "eh." After reviewing the interview transcripts, each was organized into a folder by interview number. Document variables were assigned to the documents, including Participant ID, document group, and medium.

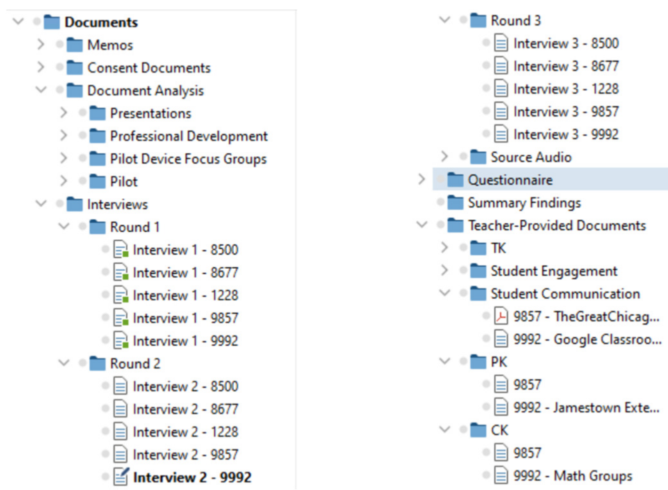
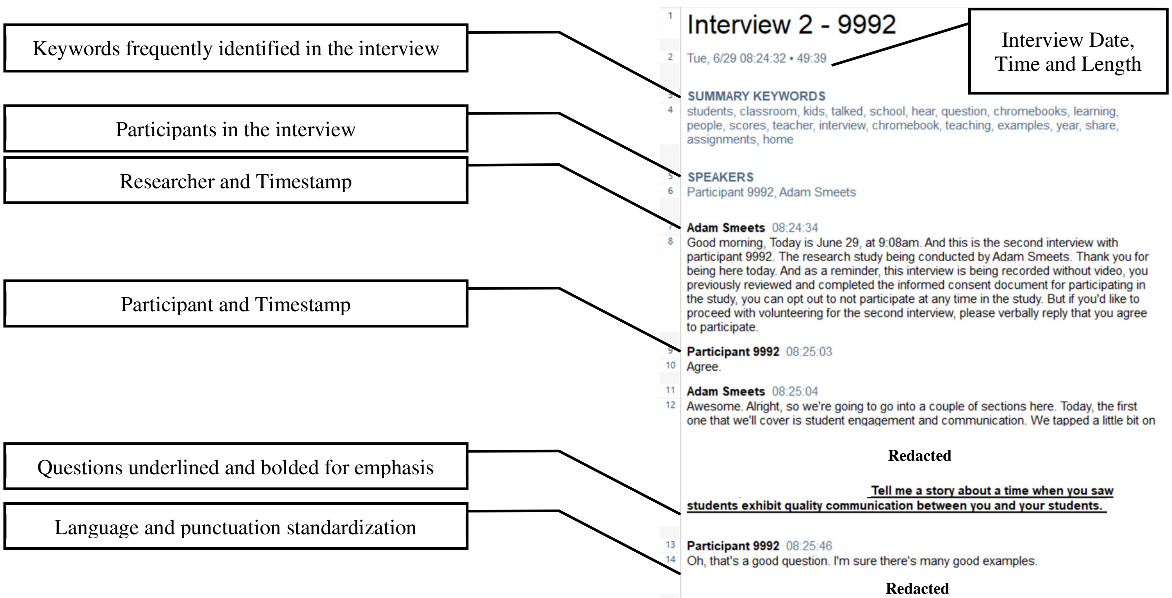


Figure 22. *Document Folder Structure in MAXQDA 2020*

To ensure that later stages analyzed similarly structured interview data, preparing each interview included the application of several recommended transcription strategies (Dresing & Pehl, 2015; Kuckartz et al., 2008): (1) each contribution was entered as a separate paragraph, (2) paragraphs for the participant and researcher were consistently introduced by "Participant 0000:" or "Adam Smeets" respectively, (3) language and punctuation were standardized slightly, but word order remained even if grammatical errors were present, (4) affirmations or agreement noises were not transcribed unless they interrupted the interview, (5) longer pauses and breaks were represented with dots and timing in brackets "(… 5 seconds …)", and (6) external interruptions were noted with brackets "((dog barking))." An example of this structure is included in Figure 23.



Note. Portions of this image are redacted as they contain actual transcript communications from the participant.

Figure 23. *Sample Transcript with Common Elements Identified*

Initial exploration of the interview data produced a word cloud (see Figure 24) that included anticipated keywords such as students (f=354), classrooms (f=348), Chromebooks (f=123), learning (f=116), and teachers (f=100), but also included other surprising representations like love (f=104), understanding (f=54), togetherness (f=54) and appreciation (f=45). These themes will be explored further in Chapters 4 and 5.

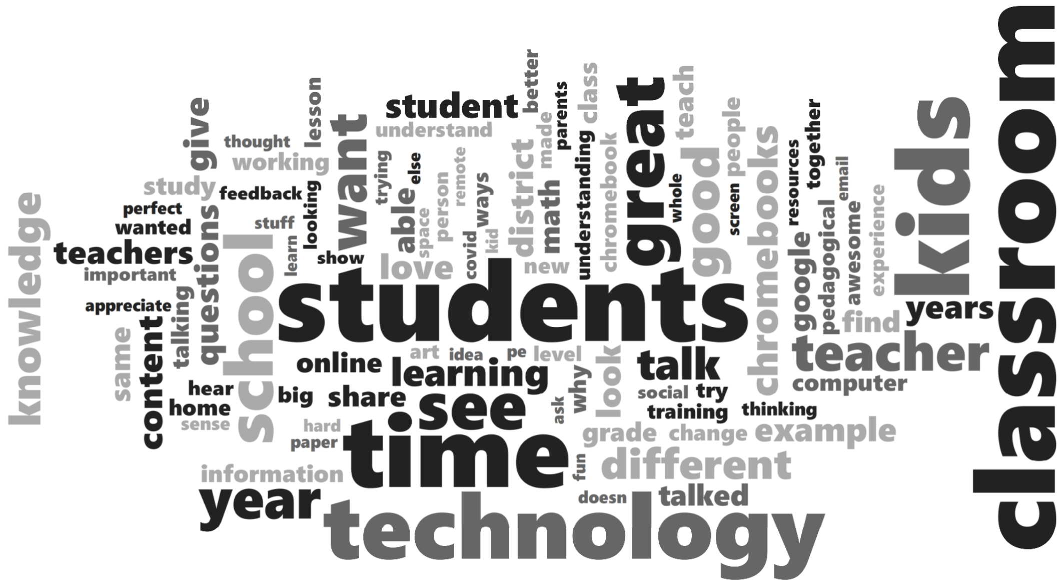


Figure 24. *Initial Data Exploration*

After exploring the interview data in Stage 1, the first coding cycle began by identifying keywords and ideas from documents, interviews, and other resources. In contrast, some researchers have noted that there is a perception that coding is just a technical exercise and a step toward higher-level thinking (Miles et al., 2020); it is where the analysis process can start. As referenced earlier, my goal is to prioritize the voice of the teachers in this study. In vivo coding was the logical first coding method used since it uses the actual words and phrases of the participants. Each of these codes represented a symbolic link to the information identified, which will be later distilled. Table 11 provides examples of the researcher's identification of In Vivo codes from interview transcripts. These quotations will be used throughout the remaining review of states in the coding and analysis process.

Table 11

Example In Vivo Coding Entries

Quotations from Interviews	Preliminary Code
It's **just a mindset**[1]. I think that **it's so hard**[2]. I'm coming from a **different world than these teachers**[3]. It really **depends on the teacher**[4]. We have t**eachers that have been here for 20-30 years**. We get **caught in this comfort zone**[6] where **we're not willing to change**[7].	[1] "just a mindset" [2] "it's so hard" [3] "different world than these teachers" [4] "depends on the teacher" [5] "teachers that have been here for 20-30 years" [6] "caught in this comfort zone" [7] "we're not willing to change"
So I want them to **play some games**[8] that I **hope it'll support what I'm looking for**[9] in that whatever the skill is that we're doing, and trying to **find things that aren't too baby or high school**[10].	[8] "play some games" [9] "hope it'll support what I'm looking for" [10] "find things that aren't too baby or high school"
I'm not a person that thinks about using **quick exit slips**[11], but I see where that would be great. **I don't take time to do that**. **I wish I did**[12]. As somebody who can see that possibility, that would be a **great use of technology**[13] and maybe in the next couple of years, **I should start doing that more**[14].	[11] "quick exit slips" [12] "I don't take time to do that. I wish I did." [13] "great use of technology" [14] "I should start doing that more."

After completing In Vivo Coding in the second stage, I started line-by-line (LBL) coding each of the interviews, followed by re-reading the interviews and assigning for a priori codes. As implied by the name, the process of LBL coding leads to applying a code to each line of data reviewed. LBL coding is time-consuming, taking upwards of ten hours for the interview data collected. Nevertheless, it supported opening up the data to ensure that a researcher does not miss any important details during the previous stages of analysis. An example of this exercise is included in Figure 25, with both LBL and deductive codes represented.

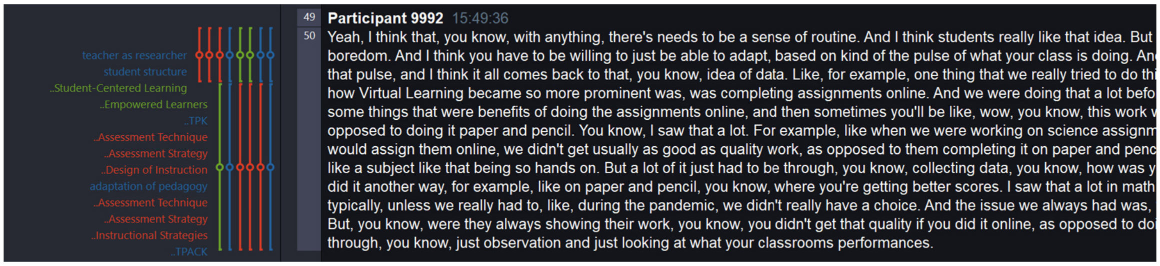


Figure 25. *Example Line-By-Line Coding Entries*

In addition to LBL coding, a thematic analysis of the data was conducted using a priori codes. These codes were developed from three sources: (1) BRSD's Portrait of a Graduate and its connections to the alignment of teacher expectations by the District (Bear Rapids School District, 2018b), (2) ISTE's Essential Conditions for Technology Integration to understand the District and school environment based on standards identified by the District (International Society for Technology in Education, 2021), and guided by the theoretical framework (3) Mishra and Koehler's (2006) TPACK domains. Further detail on the rationale and value for each code source and the set is included in Appendix P.

By applying the theoretical framework from this study, each form of data was used to develop an initial organizational bucket to identify technology-integrated instruction. Each bucket was evaluated while also looking for emerging themes and inductive codes. I focused on how a teacher's pedagogy changed rather than just TK, CK, and PK as independent data or story points. I opted to proceed this way because I wanted to take the first pass at developing codes, creating groupings, then revisiting the codes to check for alignment to essential research connections. Table 12 provides the movement from preliminary codes to the finalized codes used to develop concepts and, after reflection and adjustments, the resulting overall study themes.

Table 12

Example "Finalized" Code Entries

Raw Data	Preliminary Code	"Final" Code
It's **just a mindset**[1]. I think that **it's so hard**[2]. I'm coming from a **different world than these teachers**[3]. It really **depends on the teacher**[4]. We have t**eachers that have been here for 20-30 years**. We get **caught in this comfort zone**[6] where **we're not willing to change**[7].	[1] "just a mindset" [2] "it's so hard" [3] "different world than these teachers" [4] "depends on the teacher" [5] "teachers that have been here for 20-30 years" [6] "caught in this comfort zone" [7] "we're not willing to change"	• Mindset • Challenges • Tenure • Technology Rutt • Flexibility
So I want them to **play some games**[8] that I **hope it'll support what I'm looking for**[9] in that whatever the skill is that we're doing, and trying to **find things that aren't too baby or high school**[10].	[8] "play some games" [9] "hope it'll support what I'm looking for" [10] "find things that aren't too baby or high school"	• Gaming • Subject-Connected • Grade-Aligned
I'm not a person that thinks about using **quick exit slips**[11], but I see where that would be great. **I don't take time to do that**. **I wish I did**[12]. As somebody who can see that possibility, that would be a **great use of technology**[13] and maybe in the next couple of years, **I should start doing that more**[14].	[11] "quick exit slips" [12] "I don't take time to do that. I wish I did." [13] "great use of technology" [14] "I should start doing that more."	• Formative Assess. • Time Management • Aspiration

In Stage 4, concept maps were leveraged to develop concepts from the codes list. Novak and Gowin (1984) recognized that the use of concept maps raises to the surface meaning from a plethora of data. In this case, concept maps helped distill down the hundreds of codes into a set of concepts used to develop categories and themes. Looking at the research log, this was one of the more challenging stages. The logs reflect repeated frustration around "when will this reassociation end and the analysis begin;" however, this was indeed part of the analysis process. This stage developed a series of hierarchical terms that regularly raised whether two categories were mutually exclusive or could be further consolidated. In some cases, even if consolidation was possible, the concept was so broad that it served better as a standalone concept for further analysis.

Table 13

Example Concepts and Informal Concept Map

Preliminary Code	"Final" Code	Concept
[1] "just a mindset" [2] "it's so hard" [3] "different world than a lot of these teachers" [4] "depends on the teacher" [5] "teachers that have been here for 20-30 years" [6] "caught in this comfort zone" [7] "we're not willing to change"	• Mindset • Challenges • Tenure • Technology Rutt • Flexibility	Mindset Adaptation
[8] "play some games" [9] "hope it'll support what I'm looking for" [10] "find things that aren't too baby or high school"	• Gaming • Subject-Connected • Grade-Aligned	Assessment PK
[11] "quick exit slips" [12] "I don't take time to do that. I wish I did." [13] "great use of technology" [14] "I should start doing that more."	• Formative Assess. • Time Management • Aspiration	Classroom Management Personal Growth

Note. Color arrows are used to show how codes were associated with concepts, where codes from other interviews are aligned to existing concepts, and where two concepts were considered for merging (the dotted line between mindset and adaptation).

Reflexivity was a regular part of the analysis motion when distilling the data within and between Stages 4 and 6. For clarity, the use of *reflexivity* is distinctly separate from being *reflective*. While being reflective included my considerations on data collected and evaluating the information, the reflexive motion further required me to consider how my perceptions and beliefs impacted selecting specific themes and codes (Loughran, 1996; Schön, 1983). Through this reflection, adjustments were made to separate personal beliefs and values from the data provided by participants.

Looking back at my audit logs, a research whirlpool that I was circling in was linked to over-analyzing my connections to the concepts and feeling like the work was never “done.” Over analyzing codes and data is a common experience among qualitative researchers, but more so in cases where a researcher is close to the case(s) and site (Schutt, 2019). I frequently used Post-Its on my monitor and workspace to remind me to stay focused on the issue at hand, not on my connection to the site, participants, or technology. As I will review in Chapter 6, this led to a real opportunity for personal growth as a researcher to separate myself, as best as possible, from perceived outcomes and instead to listen to what the data is saying.

As noted in Stage 5, the reflection and adjustment process often determined where concepts could be consolidated. Higher-order categories often emerged once this consolidation process could not be completed any further on a set of concepts. These categories would include a broad enough representation of the previously merged codes, but not without losing the spirit and intent of the original codes and assigned data. This group of categories was then evaluated against other documents, and research was gathered to determine where additional insights may broaden or narrow the category's scope.

Following the development of code categories, further insights about the research questions were gathered from additional resources. Information was collected from 1:1 program materials, student and family handbooks, BRSD websites, and other District materials. All materials were either publicly available on the BRSD's current website, available through the Internet Archive Wayback Machine or provided by District leadership for this study. These additional data sources supported the triangulation of previously identified categories and the discussion in Chapter 5.

Discrepant cases are cases or responses that do not fit the general feedback or trend toward saturation and aim to modify a theory but not eliminate it (LeCompte et al., 1993). When discrepant data was identified, it was included in the findings; however, it may not fit the central themes or codes but is listed in the overall summary as an outlier.

Attempts were made to rule out alternative explanations or account for the feedback in documents or other evidentiary sources. One example area where these insights were in opposition with interview findings was from a 2017 Illinois Computing Educators Conference presentation delivered by the District. This slide visually represents TPACK as a three-stooled chair with legs supporting devices, content and learning spaces, and pedagogy/professional development (see Figure 26). Several other District documents also make similar representations, yet, in Chapter 4, nearly all participating teachers identified a theme involving not enough ongoing or non-existent training and professional development. This misalignment of understanding relating to professional development led to adding follow-up questions to the third round of interviews for all participants.

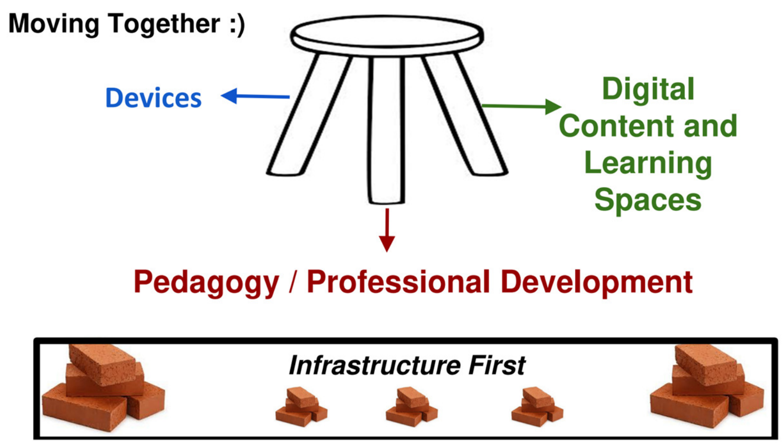


Figure 26. *District Representation of Pedagogical Grounding and 1:1 Devices*

In this example, the categories of mindset and adaptation remained; however, a new theme emerged from existing categories: professional development value. While professional development was promoted and identified as a value by the administration, this belief was not fully landed according to participants in the study, survey data, and focus group responses. Without these insights, a key theme would not have been elevated.

The nine stages detailed previously provide support for understanding the quality of this research and its trustworthiness. After identifying the key themes and insights from the data collected, a discussion of these results and conclusions is included in Chapter 5.

Research Quality and Trustworthiness

Trusting the findings of a qualitative study is the difference between a study that can provide actionable insights and one that lacks compelling evidence that can be dismissed. To reinforce the quality and trustworthiness of a case study report, Lincoln and Guba (1985) identified a set of strategies that include focusing on credibility, dependability, confirmability, transferability, and authenticity. I will identify the strategies used in this study and the supports used to reinforce study trust below[12].

Credibility

Credibility is related to the level of how "believable" a study is to the reader. I performed member checking with participants to confirm that I accurately represented their feedback. I adopted well-established research methods and peer-reviewed instruments. Further, I encouraged honest responses as an independent researcher by walking through the research consent process, anonymizing participant names, and removing identifiers. I engaged in reflexive exercises by monitoring my process of identifying emerging themes and noting the evolution in my Logbook (Lincoln & Guba, 1985). Once data saturation was reached where multiple participants repeated codes and categories, I noted these saturation points.

---

[12] There are many strategies in this section where crossover is present. For example, member checking and triangulation of data and instruments are leveraged across credibility, dependability, etc.

Dependability

Dependability[13] points to the likelihood that if alternative evidence were gathered, similar findings would be reached if repeated (Suter, 2014). I maintained a research audit trail using MAXQDA's Logbook. When opened, it automatically added a date/time entry and supported the documentation of thoughts, ideas, and wonderings. It features the same tools and styling options as other word processing tools. All raw information, including written field notes and documents, were stored and organized in a password-protected MAXQDA file.

As the instruments for this study were developed and adjusted, the decisions and goals for each were logged in the audit trail. These entries supported the data collection process intentions, which were integral during data analysis and reporting. Beyond audit logs, this study's findings were triangulated by identifying multiple data sources, including interviews, District documents, and questionnaires to inform themes, findings, and recommendations. Throughout the study, I added benchmark notes that included any adjustments or decisions related to procedures or the strategies that impacted trustworthiness. The overall audit trail served as the process notes for this study.

When reducing data volume and conducting unit analysis, my choices and notes were stored as entries in the Logbook. This data supports Malterud's (2001) belief that

---

[13] Koch (2006) posits that a study's trustworthiness is increased if a reader can review and audit the researcher's events, influences, and behaviors. Akkerman et al. (2008) suggest that audit trails represent an assuring quality approach in a qualitative-based study. Originating from the concepts of a financial audit (Koch, 2006), Lincoln and Guba (1985), and Halpern (1983), the audit trail includes processes for collecting raw data, coding and analyzing notes, reconstructing data and codes, and the processes used to develop themes.

"the reader needs to know the principles and choices underlying pattern recognition and category foundation," and it is not enough to declare merely "[…] that qualitative analysis was done, or stating that categories emerged when the material had been read by one or more persons" (p. 486). The structure of meaning units, codes, categories, themes were identified and classified, and the primary decision points were also entered into the journal. These included the connections of each theme to the existing research.

Confirmability

Confirmability is directly aligned with controlling researcher bias in the study (Suter, 2014). Patton (1990) indicated that while the best instruments do not require human skill or perception, he acknowledged that absolute objectivity is not genuinely possible. A researcher's bias is unavoidable. I used my Logbook to document my experiences and mitigate the risk that any findings are not from participants' lived experiences and my own. Reducing researcher bias required careful documentation of the interview findings, a thorough coding process, and an extensive audit trail. While I would have leveraged peer review outside of a dissertation as a program review, I leveraged debriefing and member checking to ensure that each participant's report and vignette represented their thoughts and ideas.

Transferability and Authenticity

Transferability is the ability for one study's findings to be applied to other situations and contexts (Merriam, 2009). Guba (1981) identified that there are two strategies for supporting transferability and study validity: (1) collecting descriptive and detailed data and (2) documenting descriptions that provide detailed context. In addition to providing a detailed, thick description of the District and site school in the study, vignettes were created from recorded interviews transcribed verbatim from each session. These vignettes supported providing an impactful and personal connection to each case. Throughout creating the vignettes, all notes and reflexive journaling were logged in MAXQDA as field notes. In regards to applying these cases to other teaching contexts, the teachers in this study work at a suburban elementary school in Illinois. They must meet the same standards as other teachers certified in Illinois.

Summary

Along with the theoretical framework and research questions, the methodology of this study serves as the foundation for understanding the pedagogical changes made by teachers in 1:1 classrooms. With 17 hours of teacher interviews, questionnaires, teacher curriculum documents, and other resources, the guard rails for this study were informed by a methodology plan which followed case study best practices. During COVID-19 closures, this study leveraged technology to deliver on a study that elevates teacher voices, identifies opportunities, and provides a focus on shifts in practice. In Chapter 4, the brilliant voices of teachers are lifted, and emerging themes from BRSD's data are highlighted. Chapter 5 will discuss these findings and conclusions from the study and Chapter 6 presents a researcher reflection on the doctoral experience.

CHAPTER IV

CASE STUDY RESULTS

Overview

The purpose of this qualitative, retrospective instrumental case study was to explore a district's adoption of 1:1 Chromebooks in elementary classrooms and how teachers changed their instructional practices because of the 1:1 adoption. This chapter presents the findings of the five three-part interviews, document analysis, and a questionnaire collected for this study. While there is no single approach to reporting the five resulting cases, this study uses story-telling and vignettes to present the cases, share stories, and highlight participant experiences and perspectives in connection to the research questions (Erickson, 1986; Okri, 1997). Chapter 5 will further examine the themes shared across the five cases using the constant comparative method (Glaser & Strauss, 1967), including their relevance and significance to addressing the study's research questions.

Five Teachers, Five Vignettes of Pedagogy in Motion

Each of the following five vignettes was developed based on each educator's interviews, questionnaire responses, and curriculum resources. The vignettes were crafted in response to each of the study's guiding research questions: (1) how do teachers adjust their pedagogical practices in 1:1 classrooms, (2) how do 1:1 devices influence their pedagogical practices, (3) how do they describe shifts in pedagogical practices, and (4) how do teachers describe changes in engagement and communication in their classrooms as a result of 1:1 devices? Each vignette is introduced with a quotation used to represent a prominent theme for each educator. Utilizing a quote symbolizes the detailed, thick description of each educator's connection to their teaching pedagogy.

“teaching like the way it used to be; when they trusted you”

This first case introduces Sally (a pseudonym), a 57-63-year-old elementary teacher in urban and suburban classrooms over the past 30 years. She is an early adopter of technology with a background in computer science and supporting the science curriculum development. Sally regularly tries out new resources and takes risks with new instructional strategies.

In her two years before BRSD’s 1:1 program, Sally worked with students in a STEM school classroom – a partnership with area school districts and co-sponsored by a local private suburban university. She developed lessons based on reaching across the content areas infused with instructional technology resources. Preparing lessons in this way required a lot of her time to prepare such interactive lessons, but it was a time when students deeply understood the value of her pre-work. According to Sally, “it was teaching like the way it used to be when they trusted you.”

> It was a lot of prep. As a teacher, I gained a lot of weight because the weekends were sitting down and just planning, planning, and planning, and more planning. I just did not get up from the couch where I sat, sat, sat, sat, and worked. Those times that I did not plan in advance, I was pulling it together nightly, trying to pull

> up things to do. However, it was a beautiful time because everything was not these little choppy sections like now we are going to do social studies, now we are going to do this. Instead, everything was just woven together.

Sally often developed daily lesson plans to evaluate resources that aligned with the learning goals for the day. At the same time, she considered potential new technology applications for use in the classroom. Early on, her focus was on understanding new technologies, troubleshooting issues when practicing in her classroom, and ultimately exposing students to resources not introduced or available in their school.

At the end of her contract with the STEM school, Sally was prepared to infuse her newly minted approaches, experiences, and pedagogy into her work at BRSD; however, she was met with a brick wall. From the STEM incubator, which developed a self-described fire for developing lessons that created deep understanding for students, Sally transitioned to a place of frustration and disappointment.

> When I came back, I was on fire. I was ready to go. Do you know what BRSD told me when I wanted to bring these ideas back? “No, let's not do that.” That was my biggest disappointment with BRSD – whether it was the fact that they were so big that they could not find a way or that they did not, or were not willing to find a way. And so that was that. I had a great experience at the STEM school, though.

Sally found that her ideas did not align because of BRSD’s size, expectations, and lack of administrative support for such an approach to classroom instruction. She continued to look for opportunities using her laptop and resources to support student exploration.

Shortly after returning from the STEM School, Kodiak Creek Elementary School (KCES) joined the 1:1 Chromebook pilot initiative launched at select elementary schools. She now had access to a classroom resource to refuel the fire for her teaching style. With access to devices, her students could engage in math activities in ways that historically were only available to two or three students given time constraints.

> As I was planning a math lesson, the goal was to understand balance. In the past, students would use a pan balance to show how items could be moved and adjusted to meet equal ratios. While I could have just brought in the pan balance from the science room, my students would not have had the opportunity to try and balance the pans. I found a lesson on PhET[1] that was a real gold nugget. It presents multiple shapes, but students do not know any weight values. Each student uses their Chromebook to engage in the experiment, figure out the values of each weight, and learn to balance the pans. They got the idea of adding on and taking off and that kind of thing really quickly.

In Sally's classroom, she is not afraid to try something new. Self-described as having no fear in the classroom, she fosters an environment of risk-taking for the potential learning rewards. If resources do fail, Sally and her students laugh it off, and the class moves on to

---

[1] PhET is a collection of interactive, research-grounded science and math simulations. A project based out of the University of Colorado Boulder, the collection is available free of charge to all students and teachers from sponsors and donors.

something else. Such a transition is a critical moment, as it also indicates to her students that they can take academic risks in a safe environment.

Sally did not recall professional development or learning opportunities when the Chromebook effort was launched. Instead, she summarized the experience as, “Hey, you are going to have these devices. And here you go.” On her wish list, she thought it would be helpful for teachers to have access to a Chromebook to practice lessons, identify troubleshooting steps, and ensure that activities will work as planned since the faculty experience is different from that of a student. During the launch, one of the biggest pitfalls was that teachers did not have resources to support their students; instead, needing to send them to another location for help.

When selecting content and tools for her courses, Sally considers several factors: does the content or device (1) support the standard or goal of the lesson she is trying to teach, (2) allow students to create or challenge their thinking beyond rote drill and practice, and (3) support student exploration or deeper dives on the lesson. To support these areas and fundamentally student inquiry, Sally questions whether the resources provided by the District miss the mark. While high-level tools support District-wide instructional goals, it would be ideal for accessing options that align with the overall curriculum beyond drill and skill exercises. Instead, Sally finds herself looking outside of District-sanctioned resources to see what will fit the needs of her students and Sally’s instructional goals.

> Each year I introduce several District tools used for math, reading, and writing. Without fail, I hear the moans and groans of students who say they are tired of using the same tools year over year. The programs have grown stale, and the students know it. By association, we look stale continuing to use them and not introducing new ways to use them.

Her utopian catalog contains standards-aligned resources and several options for implementation in the classroom. Today, she struggles with finding the available time to seek out these ideal resources. However, Sally shares her findings with other teachers by sharing her ideas via email and the teacher's lounge when available.

Considering how 1:1 devices have impacted Sally's measurement of student progress, she thinks that traditional practices are still valuable, like walking around the room and checking homework. By moving around the classroom, she has an opportunity to connect with each student offline and provide one-on-one support. From her reflection on remote teaching, Sally found that this practice, in addition to having the Chromebook as a vital link to learning, also curbed off-task behavior during independent student work.

> I noticed a lot of off-task behavior, especially during writing. Everyone has their ideas and is ready to write, but as I walk around the classroom, I see students all of a sudden clicking off browser tabs as you come around to them. While this was initially the case when the program launched, it is less now. But it is one thing that clicked with me this year when we came back from remote learning – I

started roaming the room expecting to keep kids on task. In reality, I did not.

Having 1:1 devices as part of their everyday existence has really helped. Further, having closed Chromebook time to tie up the lesson, check for understanding, and answer questions. Sally notes that she is not currently using exit slips or other checkpoint tools, but it is possible for her future use.

Sally notes that her students love working with the Chromebook devices and technology in general in her classroom. She notices that they are still engaging, communicating, and feeding off each other with group activities. Each year, Sally facilitates a discussion on cheating and reminds students that each group member needs to contribute and generate ideas. She noted that conflicts like cooperation, sharing, and teamwork occur in the classroom with or without Chromebooks. Students exhibit self-talk in these moments and discuss how they need to discuss their concerns and problem-solve to find a solution.

Overall, though, Sally has not observed where Chromebooks have been a barrier to learning and group work. In addition to the devices, Sally finds other social benefits that she has observed with communication between students. She notes that students will often ask if they can work in a Google Doc together but finds that they still socialize and exhibit shared creativity. More importantly, though, it allows a student to observe a peer's activities and bring them up to another level, bolstering everyone.

Sally describes that communication between her and the students is more robust than ever. It manifests most during writing assignments since students can present drafts of their writing while exchanging comments and receiving feedback from their teacher in near real-time. Providing such access and timely feedback can present challenges; however, as Sally experienced, students will be online fixing things and asking for input at midnight. In working with a student, Sally detailed that many of her students need a little reassurance or supporting information to keep moving forward. By using comments and exchanging information online, she can be the coach on the side rather than interfering with the process. Moving away from the red pen, she supports multiple revisions and opportunities to resubmit improvements. Students are also encouraged to share their writing to grow as writers and constructively critique their peers.

Today, Sally's classroom features a computer, a Ziggi documents camera, a smartboard, projector, webcam, and speakerphones. With her students using their Chromebooks between 50% and 75% of their day, she describes her classroom as more fluid, flexible, and exhibiting student freedom for what they can do than ever before. An example of this is her implementing an "Apple-esque" Genius Hour where students can explore a topic of interest and present it to the classroom. One issue included an examination of an area landfill where students gathered information and shared insights on how to reduce trash and increase recycling opportunities.

Sally participated in a self-evaluation to more deeply understand her TPACK scores. In Figure 27, she identified strengths in her pedagogical content knowledge and technological pedagogical knowledge. Unsurprisingly, she noted that she has the opportunity to further develop in relationship to her technological content knowledge;

however, she stated that this reflects the lack of District resources that support her and the curriculum. Sally's scores also ebb and flow based on the time, day, and technology used but felt these were accurate reflections.

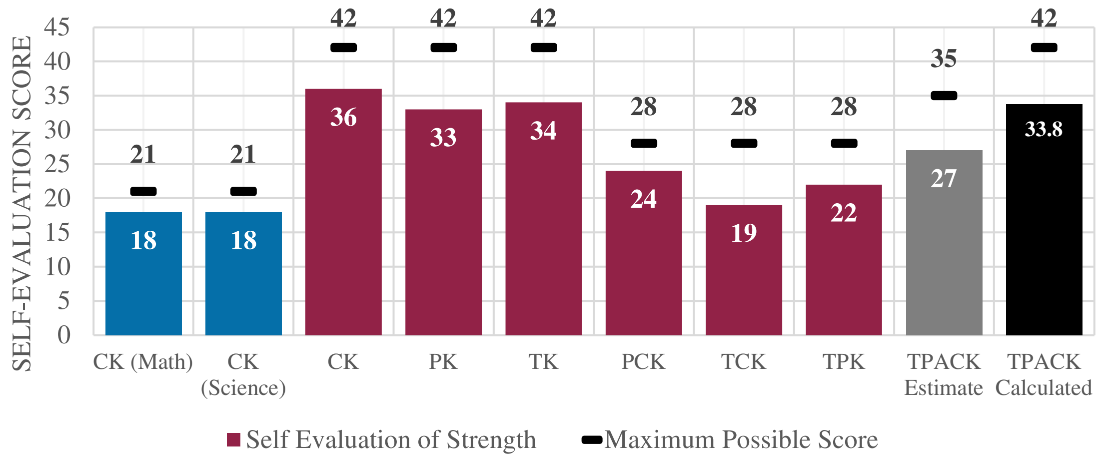


Figure 27. *Sally's TPACK Self-Evaluation Scores*[2]

Sally's TPACK self-assessment composite scores were used to create an estimated representation of the relationship between each TPACK domain (see Figure 28A). Sally was also asked to use shapes to represent her perceived relationship between each TPACK domain using a Google Slide presentation deck. The activity included adjusting the circles for proximity, priority, and the size of each domain in relationship to each other. While adjusting these shapes, Sally provided her feedback on the interplay of the domains. She organized her pedagogical and content knowledge circles in Figure 28B as more significant than her technical knowledge.

[2] CK scores for subjects areas are combined to create the overall CK score. PK, TK, PCK, TCK, TPK, TPACK (Estimated) had questions aligned to determine their overall score. "TPACK Calculated" was determined by calculating the overall weighted average of sub-scores from a total of 36.4 points and scaling to a score of 42.

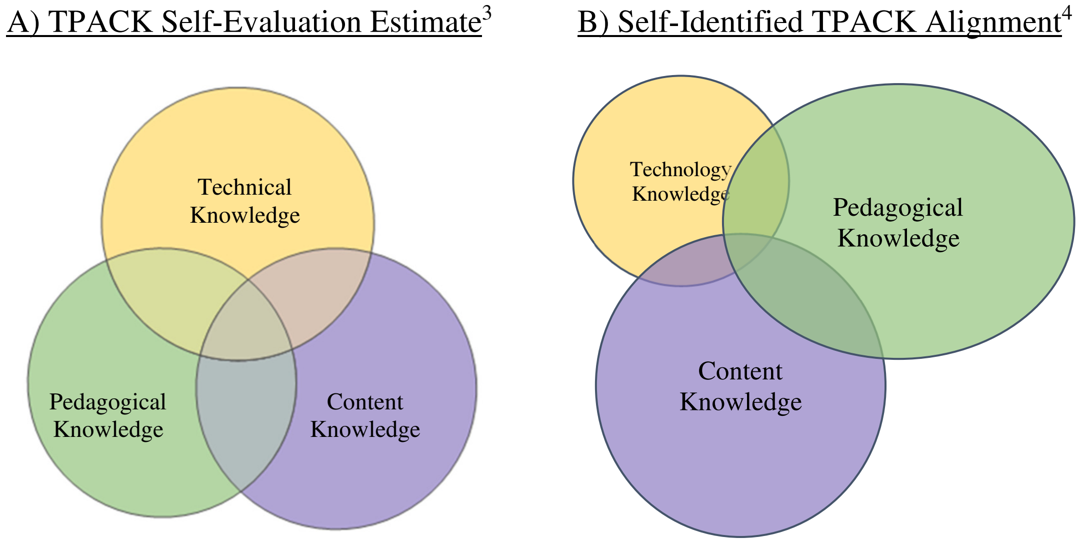


Figure 28. *Sally's TPACK Self-Evaluation and Alignment*

During her reflection on this process, Sally indicated that her historical experiences with technology position her more positively than other teachers who have had no experience with technology. She felt that her pedagogical and content knowledge were similar in size, shape, and affinity. In contrast, technology knowledge was slightly smaller since she has not kept up with the pace of technology in the classroom. When thinking about new incoming teachers to KCES, Sally felt that pedagogical knowledge was the most important since a teacher still knows how to teach even if you do not know everything about the content area. Most notably, when referencing the technology

[3] Sally and all other participants' self-evaluation estimates in Figure 28A were created using the Venn Diagram Plotter application created by Pacific Northwest National Laboratory. This program can draw proportioned and positioned Venn diagrams based on defined input values, including two and three circle Venn diagrams. The program supports entry of sizes and specific amounts of overlap between the two (or three) diagrams. This application is available at https://bit.ly/3jrcn89.

[4] Sally and all other participants self-identified TPACK alignment charts were scaled down, retaining aspects of fitting on each page but still directly copy her responses.

domain, Sally felt that new teachers could "dabble in that and explore later. They will use it a little bit but need to keep working on the content and pedagogy first."

Sally also responded to additional questions to understand her Level of Technology Integration (LoTi). The LoTi framework comprises eight non-linear stages that reflect technology implementation in their classroom (Moersch, 1995, 1999, 2010). As teachers move from level to level, changes can be observed in their instructional practices. Based on her scores, Sally is at the cusp of Integration: Mechanical (see Figure 29), where technology serves as a foundation to provide a rich context for her students to understand relevant concepts, themes, and outcomes. Sally identified that this also reflects some dependencies on pre-packaged resources in her classroom (LoTi Connection, n.d.).

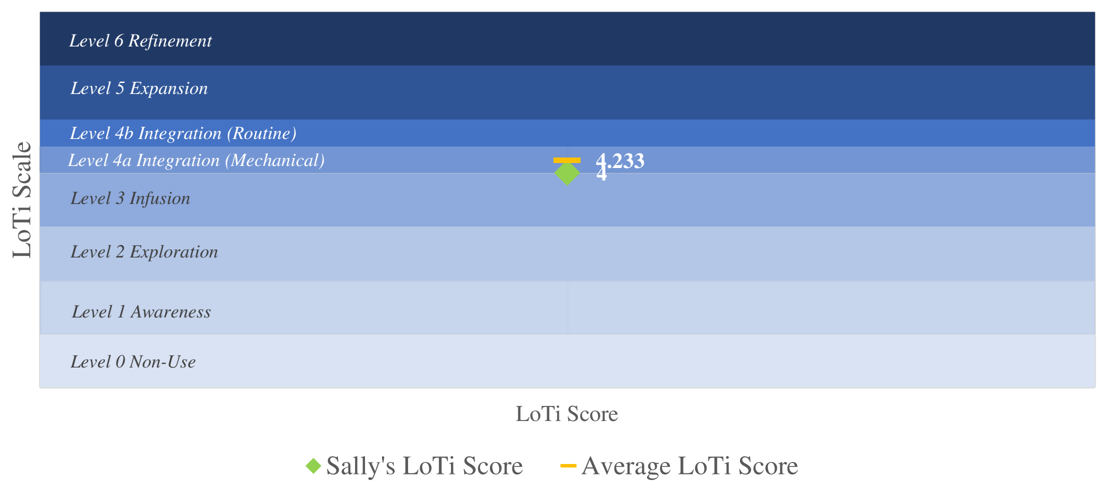


Figure 29. *Sally's Level of Technology Integration Results*

Sally linked some of these dependencies to the differences between her STEM school experience and returning to the KCES classroom. As a point of clarity, Sally noted that being at STEM would likely have resulted in a significantly higher score on the LoTi scale.

"technology meets in the gym"

The second case welcomes Poppy (a pseudonym), a 50-56-year-old elementary teacher with 27 years of experience – 22 served at KCES. As a physical education teacher, she works with students across grades K through 8. While Poppy finds technology interesting, she does not see herself as a technology guru but more as a consumer of technology. When starting her career in 1994, she never thought computers would ever be in a gym. Until the most recent years of her teaching career, Poppy was hesitant to use technology with students since the goal of her physical education courses was for students to unplug from technology. This apprehension was partly related to her students' level of technical abilities, which prevented her "fake it 'till you make it" approach. The other concern was that she found it challenging to incorporate technology with class sessions that only meet for 25 minutes three times a week.

In a Specials classroom, Poppy feels that because her space is not a "classroom" by District definition, the available opportunities for training and exposure to new resources are limited at best. Training sessions for technologies were offered during Institute Days, School Improvement Planning days, or during her cohort meetings – all of which meant that she could not participate. While classroom teachers had the opportunity to participate in these sessions, Specials teachers were "left to fend for themselves with any other available resources." Instead, Specials teachers like Poppy started sharing resources as a cohort. She was introduced to and found value in possible technology opportunities by talking with other physical education teachers. Early activities included students using a video camera and VCR to record themselves doing skillsets like swinging a golf club or baseball bat. During these experiences, Poppy was often trained on technology by her students, who pushed for using tools in her classroom.

> My kids ended up teaching me tricks, which I actually loved. Because we flipped our classroom and our kids became the teachers, which they found to be super cool. It was not because I had been trained by the District. It was because I had been trained by my kids. The kids had so much knowledge and opportunities to do the things in the classroom more than me. They taught me – and I let them. They just thought that was the best thing ever.

Making a move to consider technology resources in her classroom, Poppy looks at four main factors: (1) will it enhance my students' learning and understanding of what is being taught, (2) will the technology adapt to a student's individual needs, (3) considering her time limitations, is the tool efficient for use in the classroom, and (4) does it represent a quality resource. Poppy feels that a quality resource needs to be student-friendly, age-appropriate, and easy to read, understand, and navigate. Termed as "kid-ease," she finds that when these elements are not considered, students grow frustrated and exhibit off-task behaviors – the most common of which stems from needing to decode challenging words they do not understand.

She developed her own custom class search engine using Google's Programmable Search Engine offering to mitigate this. This service allows Poppy to pre-populate sites that will support younger students in their research process while filtering out websites that may not be aligned with the instructional goals.

> When students search for content for the assignment, it will bring up information because I have hand-picked all of the links that will go in that search engine. I know it is not Google, but it is just taking what I have chosen for them to look at that I have vetted and know is safe content for students. This allows them to only search for those resources that I have vetted and know are safe and quality materials.

Poppy often shares her findings at her staff and departmental meetings when identifying these resources. More specifically, though, she regularly meets with her Specials cohort to practice and exchange what has worked in her PE classroom. They have exchanged custom-created materials and co-facilitated lessons in each other's classrooms. She learned about Kahoot and its ability to provide interactive quizzes from another teacher. In addition to creating an experience her students would enjoy, the ability to quickly and easily create a quick resource was appealing. Poppy shared as an example that when she moved from offering a Fitness Across the Curriculum test in paper/pencil format to an online format, she reduced her manual grading time on 200 tests to 0 (see Figure 30). This format for delivery also supported Poppy's efforts to perform a statistical review and identify trends based on student responses.

FITNESS ACROSS THE CURRICULUM

20 POINTS TOTAL

Match the fitness concept that matches the fitness test.

Print your answer in the blank space.

Fitness Test

1. Sit and Reach ______________________

2. Push-ups ______________________

3. Curl-ups ______________________

4. Pacer ______________________

Fitness Concept

- ABDOMINAL STRENGTH
- UPPERBODY STRENGTH
- FLEXIBILITY
- CARDIOVASCULAR ENDURANCE

Circle one answer for each question 5-14

5. What is the recommended amount of daily physical activity?

a. 15 minutes b. 30 minutes c. 45 minutes d. 60 minutes

6. What is one benefit of good cardiovascular endurance?

a. Balanced Diet b. High Blood Pressure c. Improved Diet d. Strong Heart

7. What sport(s) or activity demonstrates strong cardiovascular endurance?

a. Bowling b. Golf c. Basketball d. Yoga

8. What is one benefit of good flexibility?

a. Decreased muscle injuries b. Increased Heart Rate c. Improved Diet d. High Cholesterol

9. What is a sport activity requires flexibility?

a. Gymnastics b. Dance c. Wrestling d. All of the Above

10. What activity increases and maintains abdominal strength/endurance?

a. Arm Circles b. Plank Position c. Jumping Jacks d. 50 yard Dash

11. Which activity increases and maintains upper body strength/endurance?

a. Bicycling b. Ice Skating c. Playing on Monkey Bars d. Soccer

Note. This document is a test developed by Poppy with the assistance of some of her PE peers regarding fitness skills, concepts, and vocabulary. It is given to 5th graders to determine whether they have gained the knowledge and skills taught since kindergarten to their start date at the site.

Figure 30. *Fitness Across the Curriculum Assessment*

Chromebooks made their way into Poppy's school in 2017 when KCES started distributing Chromebooks to upper-grade students. Her understanding at the time was that the program would be implemented in phases with grades 2 – 5, but then devices started to be issued to K – 1 students. She recalls regular experiences that the internet was unable to support the needs of so many students using 1:1 devices and everyday items where students would forget their chargers, charge their Chromebooks, or even bring their Chromebooks to school.

> It was a big learning curve for everyone, including parents. People freaked out when the computer lab was going away. Parents were mad that they needed to come to school. We heard it all the time. "I had to call my mom. Sorry, you had to come up here, mom. Thanks for my Chromebook."

Poppy shared that these delays impacted the student getting to work in the classroom, and often there were no alternative options available for that student until their device was returned to the school. As computer labs phased out of buildings, she noted that frustration grew that K – 1 students were prioritized for the space, even though they did not have access to devices at the time. The experience was such that it was something new, and by default, it does not matter how great it is; people will complain.

At the beginning of the program, her most direct connection to technology resources was her students' use of pedometers and heart rate monitors. She was hesitant bringing Chromebooks into her classroom because teachers did not fully understand the fundamentals of the devices, troubleshooting, and pedagogy. Poppy recalls that this was a sentiment that classroom teachers also shared. When sharing this feedback, Specials teachers and Poppy were directed to YouTube to train on Chromebooks and other related online tools. While she sees that there have been improvements in District training since Chromebooks were first introduced in the District, she still experiences that Specials teachers are often forgotten. Poppy has even heard other teachers refer to the Specials teachers as the "outliers." To this day, she has not used a Chromebook.

Poppy identified that technology and the use of 1:1 devices in her classroom have forced her to be a better teacher. While not a bad teacher previously, she found herself getting into the routine of complacent teaching where "you know what you are going to teach, when you are going to teach it, and how you are going to teach it." By integrating 1:1 devices in her classroom and student challenges for more technology opportunities, she had to rethink her teaching approach to support more innovative lessons while still having opportunities to disconnect.

Communication has never been an issue in her gymnasium for Poppy and her students. Often students will engage with her directly or off to the side when other students are engaging in an activity. Such a space creates an opportunity for students to discuss personal questions and or issues related to the task or assignment. She has created an inclusive classroom space, and students know her planning times. They often will visit her and discuss school and non-school-related items.

Poppy further develops this model through her use of classroom technology by creating activities that encourage engagement and communication like her iSpy exercise-focused activity (see Figure 31).

Figure 31. *Poppy's iSpy Classroom Activity*

Students often work together in teams or present team challenges to encourage competition. Developed using Google Slides, in this activity, Poppy's students look for a particular object and do an exercise that matches the number of items they found in the picture:

> I created a Thanksgiving-themed I-Spy activity where I had different images. Students need to identify, for example, how many pieces of candy corn they found in the I Spy. It has four different choices of numbers. So while the music

> played in the timer tick down, you chose the exercise and did that number. Then it revealed on the next slide the correct number. So if you had chosen the correct number, you were done. If you had not chosen the correct number, you did the number of candy corns and that exercise. Then we went on to the next one. So it was really fun. My kids were like, "This is really fun. Can you do another one for a different holiday?" I am like, of course, which worked out great because I kind of just use that as a template. However, it was a lot of work, but it was really cool. And then well received. So to me, as I said, that is a success.

Poppy used images, PDFs, word art, YouTube timers, and other imagery to assemble each slide.

Poppy also completed a questionnaire that asked about her teaching background, instructional practices, TPACK alignment, and beliefs on classroom barriers to technology adoption (See Appendix H). She identified having self-awareness in all domains (see Figure 31) with an opportunity to develop her technological content knowledge further.

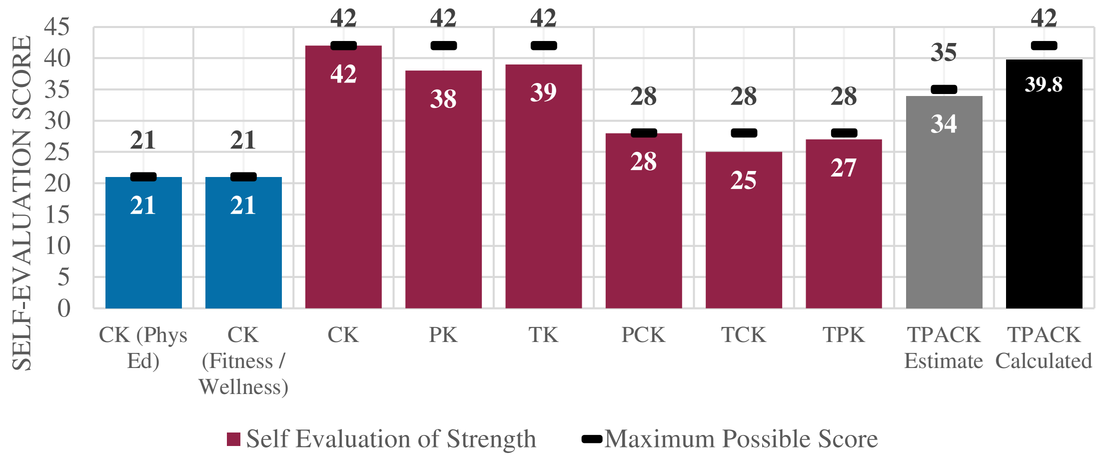


Figure 32. *Poppy's TPACK Self-Evaluation Scores*

Poppy's TPACK self-assessment composite scores were used to create an estimated representation of the relationship between each TPACK domain (see Figure 33A). While adjusting these shapes, Poppy provided her feedback on the interplay of the domains. She organized her content knowledge circle in Figure 33B as more significant than her pedagogical and technical knowledge domains. During her reflection, Poppy indicated that she has a firm grasp of the content knowledge domain as a veteran teacher because she regularly reviews materials and goes to conferences to make sure she remains current. Considering her pedagogy, Poppy noted that she is a visual, kinesthetic teacher and gravitates toward learning strategies that mirror this type of learning.

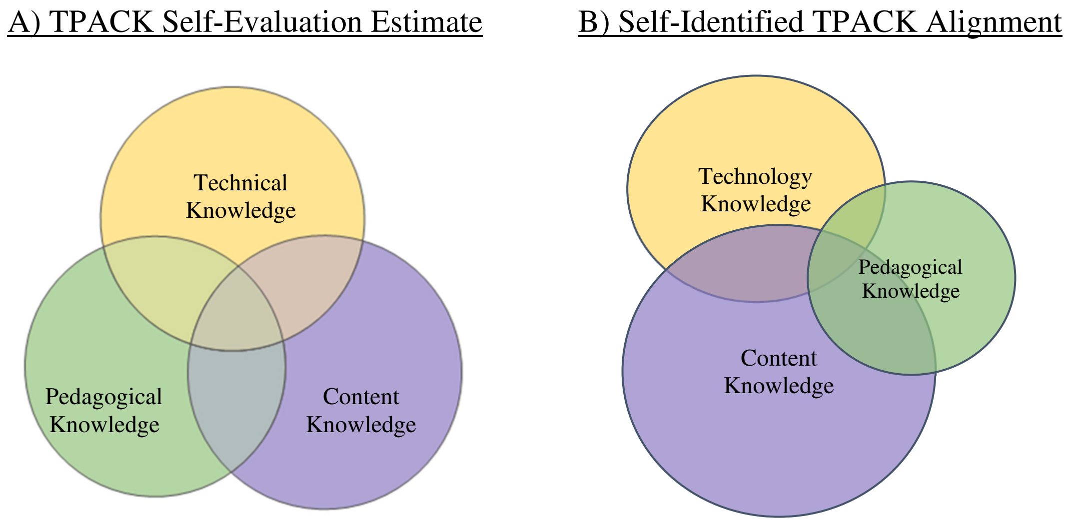


Figure 33. *Poppy's TPACK Self-Evaluation and Alignment*

As an example of this visual learning preference and pedagogy connection, Poppy provided her "Volleyball Pedagogy" that she used as an instructional unit (see Figure 34). The image identifies three areas showing how Poppy would seat or "arrange" students for different types of learning, including auditory, audio/visual, and kinesthetic learners.

Poppy noted that she did not add the technology component of her teaching to this diagram because it is rare that students were using their Chromebooks for a significant length of time during this lesson. Chromebooks are utilized primarily for out-of-class projects and assigned quizzes or related work in the gymnasium.

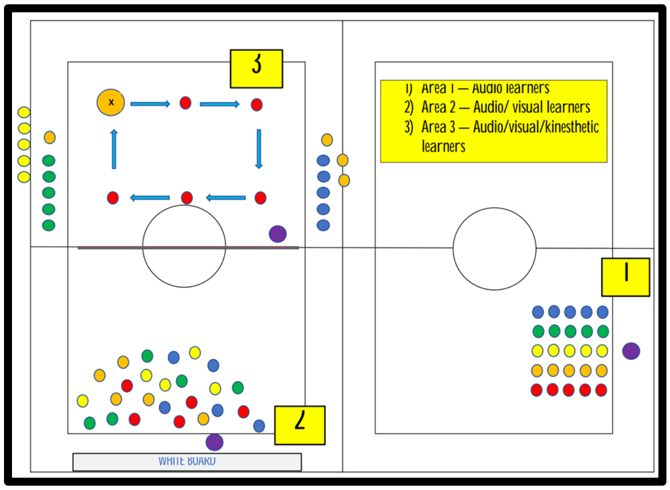


Figure 34. *Example of Classroom Arrangement for Learning Needs*

In addition to the limited use of Chromebooks in her space, today, Poppy's classroom features a LED projector, speakers, portable microphone and camera, and external PC HD camera.

Poppy's reflections pair with her Level of Technology Integration score (see Figure 35) in the range of Integration: Mechanical. Like Sally, Poppy's connection to Mechanical in the LoTi scale supports her rich context for students to understand relevant concepts, themes, and outcomes; however, there are some dependencies on previously developed resources in the classroom (LoTi Connection, n.d.). While she has used other online resources, Poppy indicated she is taking skills she has learned along the way to begin developing her resources and sharing them with her cohort of teachers. These include the iSpy activities and partnering with teachers from other schools to develop remote-based and in-person activities focused on physical education.

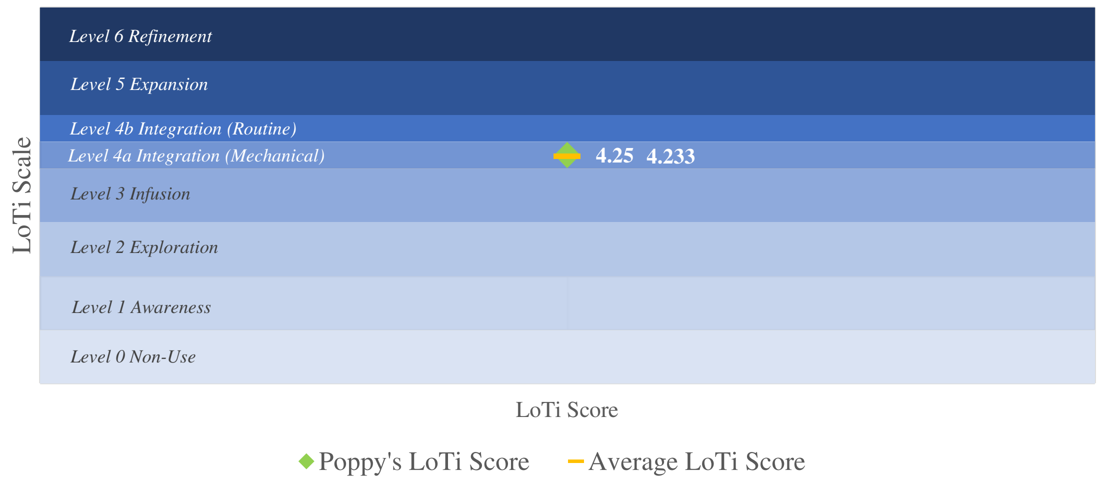


Figure 35. *Poppy's Level of Technology Integration Results*

"learning about a paintbrush before a keyboard"

Our third case introduces Amy (pseudonym), age 43-49, who has been an elementary teacher for the past 24 years at BRSD, with the past nine years serving as a K-5 grade Art and Art History teacher at KCES. Amy describes her use of technology in her classroom as minimal and focuses her efforts on using art tools like the pencil and art brush. She sees computers as just another tool for art and wants students to learn the hands-on basics before learning another computer tool.

> Every now and then, I tried to do a blog, but that went for one year, and then I did not keep it going because I do not think many people were using it. Another year I did [a grant request], and then I turned it in to get approved. I never heard anything. School started, and I did not follow up on it. It was just very minimal technology in my classroom, and I knew the bare minimum.

With 50 minutes per week of instructional time, she also finds that there is not always enough time to transition from presentation, activity, and cleanup to connect in another way. She has been able to work with specific technologies like her District laptop to meet District requirements like reporting attendance and presenting PowerPoints; however, she does not align lessons around 1:1 devices.

Amy's school joined the Chromebook initiative in 2017 when they were invited to join. When 1:1 devices were first discussed at KCES, Amy recalls a sense of abandonment regarding how Chromebooks were considered in the Specials since they were more focused on academics: math, reading, social studies, and other classroom subjects. There was a sense of fear that she would not know how to help her students since she did not use a Chromebook. Further, Amy shared a lack of awareness of how Chromebooks are used in classrooms at KCES. She wishes that the school could show and support students using their devices throughout the day, not just in the primary classroom.

When considering reducing this fear and anxiety, Amy thinks that training on 1:1 devices and usage in the classroom would be beneficial. For 1:1 device and pedagogy training to be successful, there needs to be an understanding of what happens in the Specials classroom – considering the similarities and differences.

> When I was sitting at school and district training sessions, it was always geared toward classroom teachers. I have no idea what they are doing, and I do not even know how to use it.

Much of the focus is perceived around the traditional classroom, not art, music, physical education, and library instruction. Training for Amy should be aligned to how technology could be practically used in these spaces and a set of recommended tools that connect to the curriculum. When discussing other content area instruction, Amy noted that content-area teachers had not visited her classroom to observe, nor has she visited a content-area teacher to learn how they use devices and technology in their space.

Amy has looked at a few applications and tools that could be used in her classroom. She considered the four criteria to determine if they would be successful: (1) the program is successful with students, (2) the resource is easy to use, (3) it is easy for teachers to implement, and (4) the tool is conducive to a classroom environment that is limited on time. Because success in Amy's classroom is aligned around a culmination of student projects from the term, she emphasizes the fourth criteria since it limits her ability to introduce new technologies or Chromebook-based resources.

When walking through her school after 1:1 devices were deployed, Amy described that students were often on their headphones and perceived to be focused. She could not tell whether they were engaged with the content, but they were glued to their screens. In addition to being glued to the screen, Amy notes that students are working more independently and not engaging in the same social ways that they have before. There is a tendency to lean to the Chromebook than work with your friend.

Amy previously tried recording a lesson and sharing it with her students. Similarly, there was high viewership and engagement with the video. She feels that this is because students really like video content on their devices and can pause, replay, and review the material again, while in the classroom with live instruction, questions are often held to the end of class. Like her previous observation, classroom discussion was more limited after reviewing the video at the next class meeting.

> Having a live and engaged teacher is really beneficial. Using the computer as an enhancement to a lesson is good, but not to teach the entire thing in the absence of a teacher as I have seen more of.

Amy feels that the Chromebook serves as an instructional replacement rather than a classroom resource in some cases. This sentiment keeps Amy from considering other uses of technology in her classroom.

Amy uses PowerPoint to share her materials with students in preparing for her lessons. She considers how bringing background knowledge, vocabulary, and multicultural elements interact with each unit. As part of this, she previews images and movies to embed in her presentations and considers the appearance because, as she describes, “I am an art teacher after all.” Amy does not use Google Classroom or share her slides with students; however, she has created a plan B. She has recently encountered technology challenges like a projector bulb that needs to be replaced or disconnected from the internet in her classroom. As a result, she prints her slides just in case.

As Amy creates resources or identifies related content, she shares these resources with her Art cohort colleagues. They collaborate around a Google Sites page to share links and ideas. Further, while they meet on Wednesdays once per month, the sixteen teachers also have an ongoing text message chain to share ideas and ask questions. This text exchange is an important communication vehicle for the group since it builds relationships beyond Art and as a personal and professional learning community.

Amy answered a series of questions about her TPACK competencies and beliefs on classroom barriers to technology adoption (See Appendix H). She has a strong self-awareness of pedagogical and content knowledge (PK/CK) with opportunities to develop in areas related to technical knowledge (TK) area, including TCK and TPK (see Figure 36).

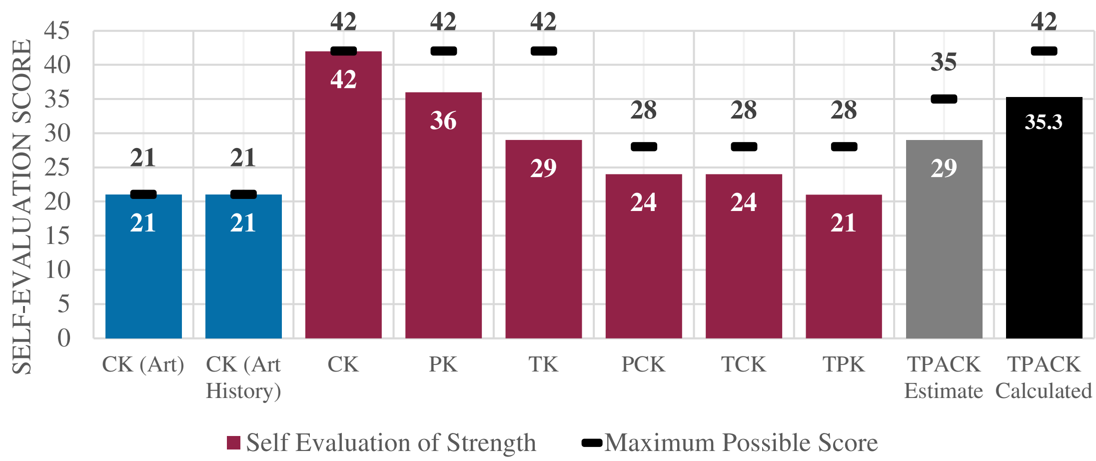


Figure 36. *Amy's TPACK Self-Evaluation Scores*

Amy's perspective supports the data from the questionnaire that she is:

> […] all about the content. Since I majored in art, I studied it that I know the most about that area. To teach it, since there are different ways that you would have to teach to the levels, you are always learning new ways to do that, but Art History does not change.

Amy has been laser-focused on her content area to understand that pedagogy is essential and changing; however, she has a perspective that technology has limited use in her classroom beyond presentations and sharing art on a projector.

Amy's TPACK self-assessment composite scores were used to create an estimated representation of the relationship between each TPACK domain (see Figure 37A). While adjusting these shapes, Amy provided her feedback on the interplay of the domains. She organized her content and pedagogical knowledge circles in Figure 37B as more significant and coupled than her technical knowledge domain.

A) TPACK Self-Evaluation Estimate B) Self-Identified TPACK Alignment

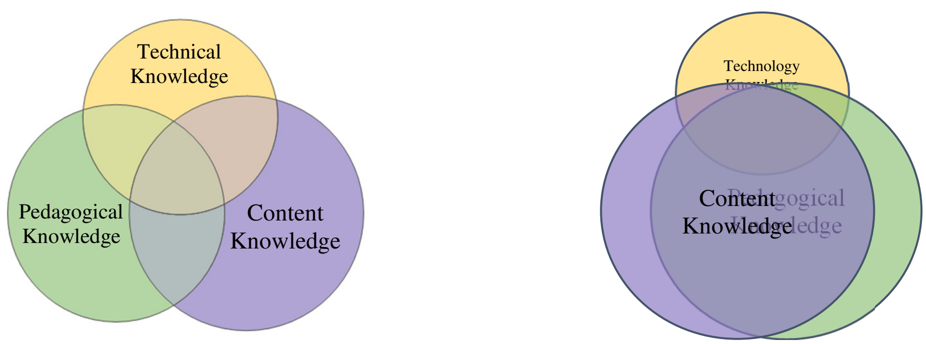


Figure 37. *Amy's TPACK Self-Evaluation and Alignment*

While adjusting the TPACK domain circles during her reflection, Amy indicated that while she has a crash course in using technology during remote learning, technology will not prioritize her content and pedagogy.

> How the face is broken up to do a self-portrait does not change, but how you teach it on that level does change. You would teach it differently to kindergarteners versus fifth-graders. So I am going to have to break it down even

more. So that is an ongoing learning process of just breaking it down and having different ways to teach the kids. Since I had a crash course in technology from remote teaching, I do not have that mastered yet. I am still working at it. I am still learning more, but the content the how to teach it is more my focus since I am more hands-on, and the technology will come after that.

As part of her reflection on her approach to learning and technology, Amy's Level of Technology Integration score (see Figure 38) is in the range of Awareness, mirroring her insights and feedback during the domain assessment. For Amy, in the Awareness stage, technology-based tools are either 1) one step removed from the classroom teacher, 2) used exclusively by the teacher, or 3) used to enhance teacher-directed lessons.

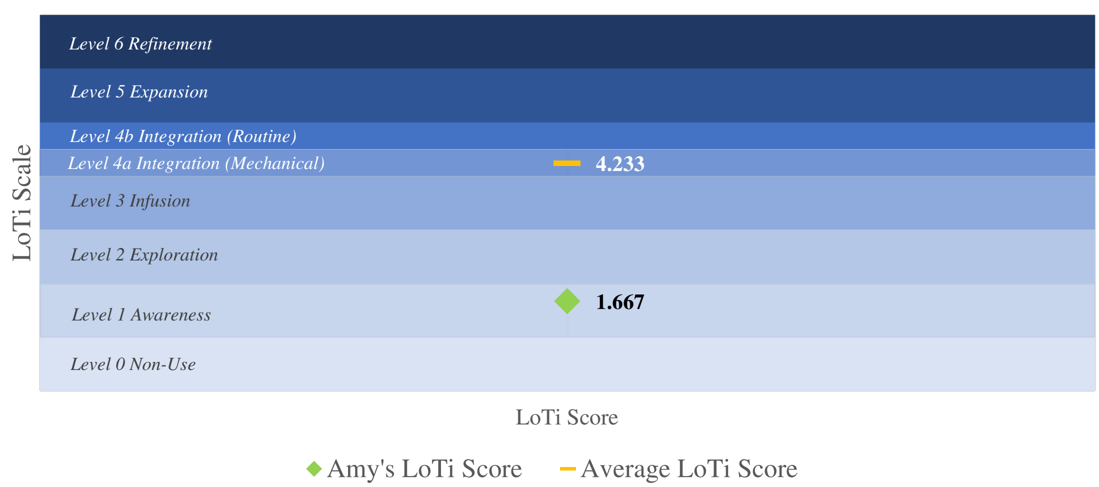


Figure 38. *Amy's Level of Technology Integration Results*

Amy's classroom has a document camera, projector, and computer, which she uses exclusively during her lessons. While one of her schools features a smartboard, Amy indicates that she does not use it except to project her presentations.

“keeping up with a speeding train”

Transitioning to the fourth case, we meet Terry (pseudonym), a 57-63-year-old elementary teacher for 22 years at BRSD. She has taught at KCES for the past seven years serving as a 4^{th}-grade teacher providing direct instruction in Science, Social Studies, Mathematics, and Language Arts. Terry worked as a teacher in several other states before working at BRSD to build her experiences with different types of curriculum and student age groups. Terry is self-described as having fundamental technology exposure and learning more through hands-on work with devices and resources.

Before 1:1 devices were implemented at her school, Terry used technology in limited ways, such as email, conducting research, and completing student assignments. She describes access to the building’s computer lab as a time crunch, given that they were assigned only 50 minutes per week to use the space. The time constraint made it challenging to complete a project or activity after getting the class started.

> While we had 45 minutes per week to use the computer lab, that was only one project a week. Then how do you work on that then the rest of the week? Do you wait until next week to go back to it? Or do you just confine it to that amount of time?

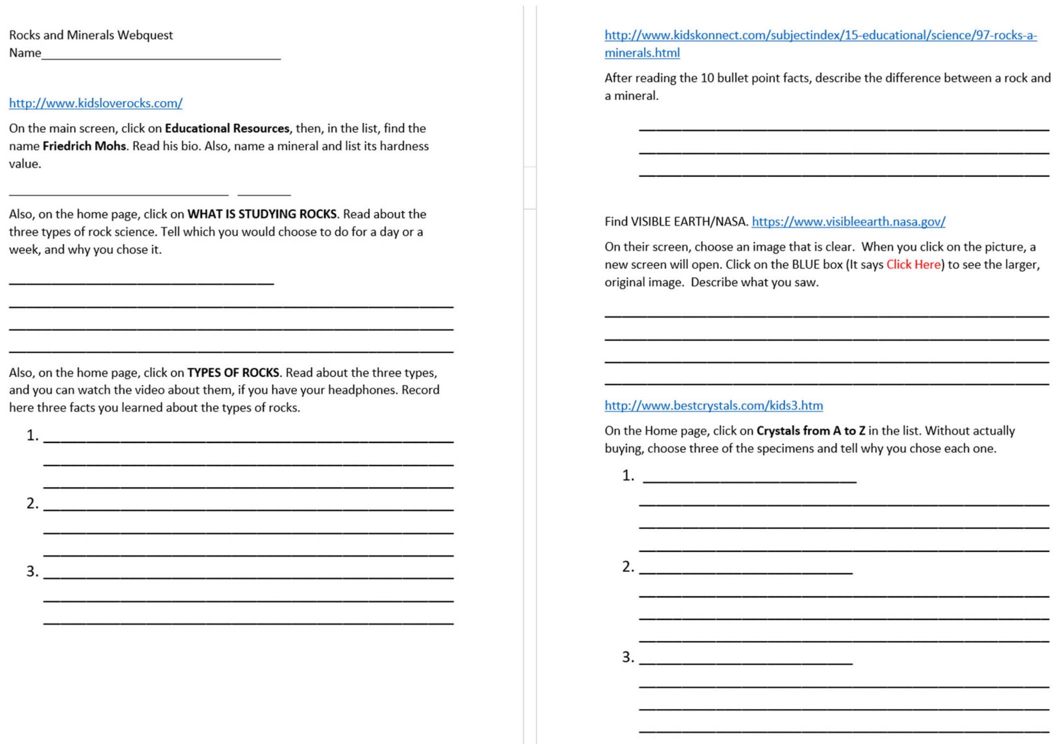
As a result, Terry described her experiences using the computer lab for her classes that “went from once a week, or we could get in twice a week, or three times a week, if we were working on a big project that for writing. That three times a week was rare, though.”

Overall, Terry sees that the Chromebook program has been successful because students have ownership of their classroom experience and develop their time management skills. Reflecting on the rollout of the 1:1 program at KCES, Terry recalled that very little training was provided to use the devices in her classroom or for the curriculum. She completed several online training activities through YouTube but learned more through hands-on engagement with her students and activities.

> […] other than learning how to open them up, turn them on, and make sure the kids could turn them on, I do not remember much teacher training. […] As far as someone sitting down and actually training us, no, not at all. Not at all.

During this time, her professional development was more focused on the content areas and not on technology for three reasons: (1) there were not a lot of available District resources, (2) she was unable to find other applicable training for her classroom, and (3) she needed access to more fundamentals-based training like keyboarding and troubleshooting. Looking back, Terry recommends that teachers have access to a device to learn and practice, understand how the keyboard and device function, and troubleshoot the devices with students.

As Terry considers the use of technology resources in her classroom, she looks at the following three factors: (1) accessibility and availability of the resource, (2) the resource offers differentiated exercises or instructional opportunities, and (3) can students successfully engage in the resource. Webquests are one type of activity that Terry creates for her students that combines these criteria. In an assignment on Rocks and Minerals, Terry identifies a series of websites and pre-vetted resources to encourage students to explore and understand more about key topics related to the lesson (see Figure 39).



Rocks and Minerals Webquest
Name________________________________

http://www.kidsloverocks.com/

On the main screen, click on **Educational Resources**, then, in the list, find the name **Friedrich Mohs**. Read his bio. Also, name a mineral and list its hardness value.

_____________________________ _______

Also, on the home page, click on **WHAT IS STUDYING ROCKS**. Read about the three types of rock science. Tell which you would choose to do for a day or a week, and why you chose it.

Also, on the home page, click on **TYPES OF ROCKS**. Read about the three types, and you can watch the video about them, if you have your headphones. Record here three facts you learned about the types of rocks.

1. ______________________________________
2. ______________________________________
3. ______________________________________

http://www.kidskonnect.com/subjectindex/15-educational/science/97-rocks-a-minerals.html

After reading the 10 bullet point facts, describe the difference between a rock and a mineral.

Find VISIBLE EARTH/NASA. https://www.visibleearth.nasa.gov/

On their screen, choose an image that is clear. When you click on the picture, a new screen will open. Click on the BLUE box (It says Click Here) to see the larger, original image. Describe what you saw.

http://www.bestcrystals.com/kids3.htm

On the Home page, click on **Crystals from A to Z** in the list. Without actually buying, choose three of the specimens and tell why you chose each one.

1. ________________________
2. ________________________
3. ________________________

Figure 39. *Rocks and Minerals WebQuest*

In addition to self-created resources, Terry also uses Newsela with her students, which offers 10,000+ articles from many genres. The articles are updated regularly and provide student progress summaries in real-time for teachers. Terry regularly uses the leveling feature. With a wide array of readers in her classroom, the reading difficulty level can be adjusted to support individual learners in Newsela. After reading an article, students complete a four-question comprehension quiz to check for understanding.

Considering assessment with students, Terry explored technologies for her students as an enrichment type activity to parallel the math she was doing in the classroom. She pays for IXL math, a subscription that engages students across content areas for personalized learning. Upon completing activities and pre-test assignments, Terry can identify how students perform in mathematics. The District used aimswebPlus, which screens and tracks math and reading performance; however, she always found differences in scores based on the IXL assessments. Terry describes a recent interaction involving a conflict between these scores and why multiple measures are essential:

> IXL helps me explain to parents how their student progresses through parent-teacher conferences and other discussions. One year, a parent wanted their student to advance to the next mathematics level as a previous sibling had. I shared that this was not the best year to do that; however, other tools were not indicating performance concerns. I needed other data to inform this, so I used IXL, which indicated that the student was not ready to skip two levels of math.

Her use of IXL allows Terry to monitor student performance frequently and ensure that students are moving toward or exceeding grade-level expectations in math and other content areas. She shares this and other tools with her colleagues through team meetings and gathers new insights from conferences and events.

Terry considers the benefits for assessment she has noticed but has concerns about student handwriting which has diminished in quality with the number of Chromebook activities assigned. Something as direct as writing half a page on a sheet of paper can be challenging for her students. Terry is interested in refocusing on the fundamentals like holding a pencil correctly, forming letters, and overall formatting. The use of pen and paper extends to the printed form of student writing. With students not able to print their documents from their Chromebooks, it has been challenging to share progress with families.

> Sometimes having a paper copy and having them be able to see it in printed form is important. The parents being able to see it in printed form was helpful. Without students being able to print, they did not have ownership of it. It was on screen, yes. Nevertheless, you had to remind them that "we worked on that." It is not as visual to them, and it gets lost in the clutter of documents that we save all the time. […] I know some parents may go online and check their student's work, but many of them do not. They do not see what their students are doing, so I print them out.

Terry answered a series of questions to review her alignment to TPACK, her instructional practices, and beliefs on classroom barriers to technology adoption (See Appendix H). She has self-awareness of pedagogical and content knowledge (PK/CK) with opportunities for development in the technical knowledge (TK) area (see Figure 40). When asked about the PCK score included in the chart below, Terry felt this was an anomaly and potentially a misunderstanding of the questions but that the other indicators were accurate. After re-reviewing the questions, Terry inverted her responses to the statements.

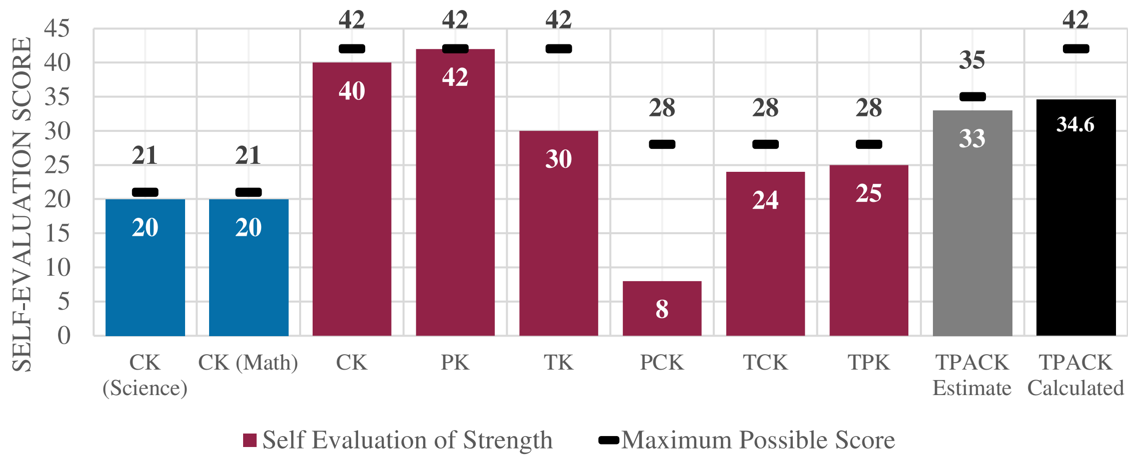


Figure 40. *Terry's TPACK Self-Evaluation Scores*

Terry's TPACK self-assessment composite scores were used to create an estimated representation of the relationship between each TPACK domain (see Figure 41A). While adjusting these shapes, Terry provided her feedback on the interplay of the domains. She organized pedagogical knowledge as her dominant domain and content knowledge in Figure 41B.

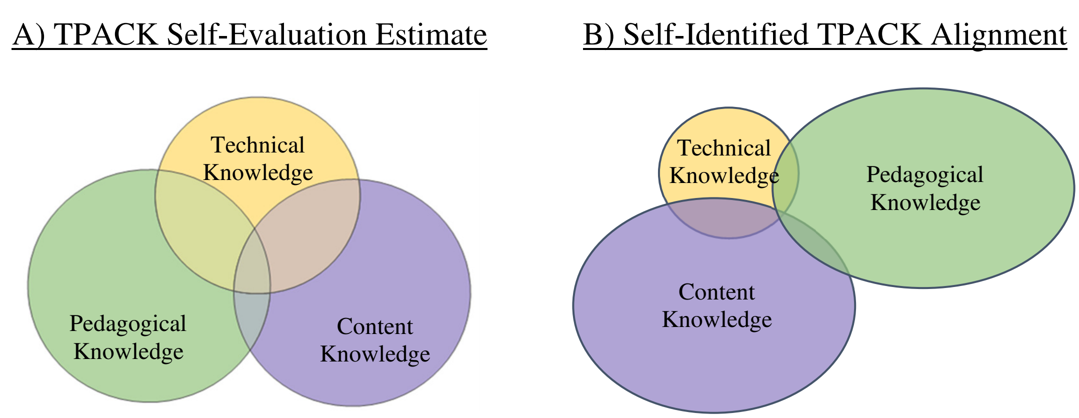


Figure 41. *Terry's TPACK Self-Evaluation and Alignment*

During her reflection on her TPACK domain alignment and the difference in sizes from technical knowledge to pedagogical and content knowledge, Terry indicated that her experiences with technology are on par with other teachers in her age group:

> I think there is still so much more that I could be doing or learning about with technology and usage. However, I think for the age group that I am working with, I think I am doing just fine. I just know that it is not nearly as much as I know about content and pedagogy.

In addition to Chromebooks, Terry's classroom features a computer, document camera, smartboard, on-screen microscope, room camera on a tripod, and speakerphones. As part of her reflection on trends in classroom technology and pedagogy, Terry commented that the role of technology in education has been changing, for her starting with the ways she engages with parents:

> […] technology is developing so much around us that it is a little harder to keep up with, as opposed to content and the other. You know, some of it stays the same for decades. Some of it has evolved greatly over the decades that I have been in education. But I think technology is moving in to be such a major part. We contact parents - we did not use to do that. We used to send home paper notes and little pieces of sticky notes attached to papers for parents to see. So I think it is gradually becoming such a bigger part that we do have to include it as, obviously, something we do.

This reflection pairs with Terry's Level of Technology Integration score (see Figure 42) in the range of Integration: Routine. At this level, students are engaged in real-world, authentic problem-solving using technology resources (LoTi Connection, n.d.).

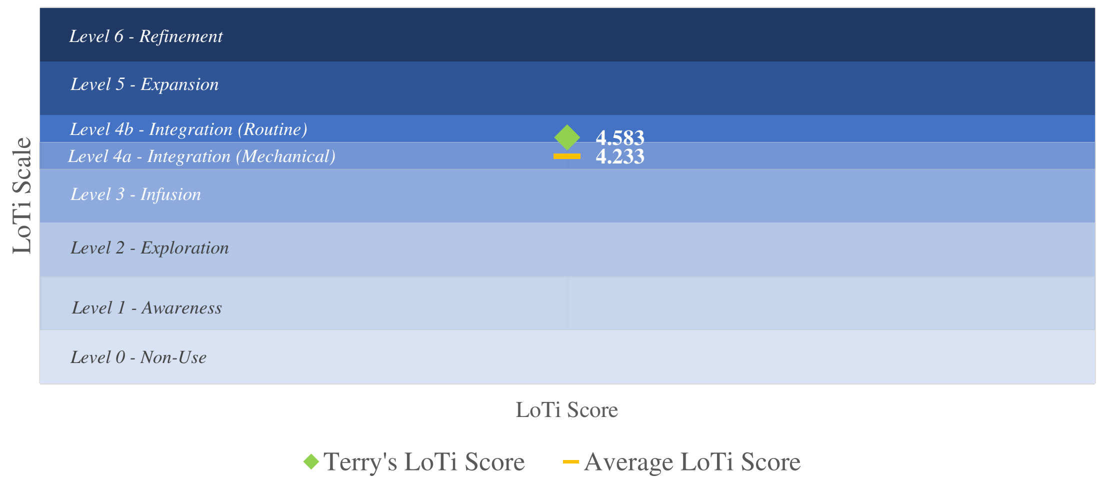


Figure 42. *Terry's Level of Technology Integration Results*

Terry noted that she is comfortable supporting a model of inquiry-based instruction. While at the same time, her next step for integration in the classroom would include emphasizing a more learner-centered, personalized, goal-setting structure and fostering a path of self-monitoring.

"mentorship and technologically bridging social-emotional learning"

In the last case of this study, we meet David (pseudonym), a 29-35-year-old elementary teacher, for the past six years. He has taught for the past four years at KCES providing direct instruction in Science, Social Studies, Mathematics, and Language Arts. David is committed to personal development and growth, including connecting to a teaching mentorship.

Before joining BRSD, David worked in a neighboring school district that used a device checkout program to access Chromebook devices with sixty allocated to the building. He experienced frustration and challenges scheduling the machines, let alone in a sequence of days. Also, his experience with Chromebooks was limited, with most of his learning coming through experimentation. With student excitement high in the school, the Chromebooks were a popular item. His exposure started with students typing papers and storing them in their online drives. At the time, he did not want to try complex things with students but instead focused on keeping things straightforward.

In his move to KCES, technology, in general, was more prevalent in the school and classrooms. David was part of the initial pilot program at Bear Rapids in the first year. The 1:1 program was selective in the number of schools, grades, and teachers that could participate. Kodiak Creek was selected as a participating school, and his classes were chosen for the pilot. David's impression of the pilot program was that the District wanted to gather feedback and understand how teachers used Chromebooks and grew the program. David recalls that the pilot was flexible, and nothing was structured in a way that required specific deliverables for each pilot teacher.

By starting at the ground floor, David connected with other pilot teachers during four scheduled meetings during the year to share insights and feedback. During these meetings, the focus was less on the teacher experience but on how students would use the technology. Several key questions that arose included, will students:

1. … be able to adapt to the new technology as quickly as we wanted them to?

2. … use them appropriately?

3. … pay attention in the classroom? … focus on the teacher in the classroom?

4. … take responsibility for the equipment?

During their meetings, teachers shared what they were doing with Chromebooks from a policy and procedure perspective, useful websites and how the program could change in the future. With the larger roll-out, David was a point person to answer questions from teachers new to the 1:1 program. He found that these questions persisted for the first couple of years as teachers acclimated to the devices. Most notably, David was asked about the right balance of screen time in the classroom.

> The big hot buzzword trend word you always heard about was screentime. And I think so many teachers were worried about, "I do not want to become too dependent on Chromebooks. I want to be sure my students have a balance of doing work on paper and just other activities in general."

In response to this question, David felt that giving students a sense of routine was important while balancing the pulse of the classroom. Today, David sees that most teachers have a balance of 50%/50% use in the classroom, emphasizing that the Chromebooks are not always open. Striking this balance requires that expectations be set in the classroom of how and when Chromebooks will be used. David included an example activity in Padlet where the class collectively determined the expectations and rules (see Figure 43).

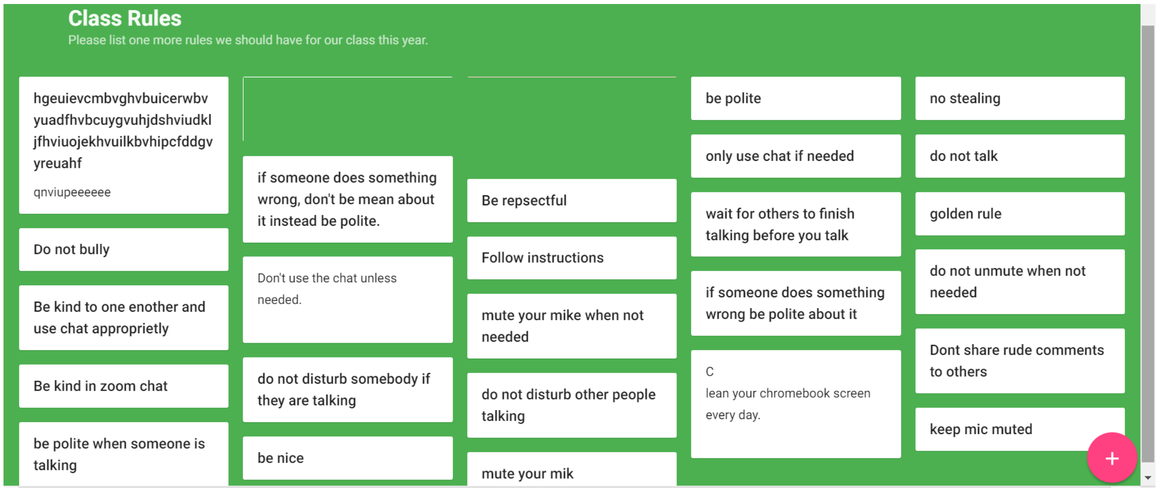


Figure 43. *Collaborative Classroom Rules Activity*

Understanding the classroom pulse included understanding the types of resources that engage his students. David regularly uses Twitter and other social media to locate new activities for his students but appreciated the support he received from the technology liaison in his building.

> I have to understand that, no, I have to be willing to look for those resources. I know my previous teammate, she is the liaison for the building, was always sharing emails that included things she was trying in her classroom. I really valued her insights and the things she presented to us.

In addition to identifying resources, David focuses heavily on engagement opportunities and if technology is the appropriate tool for delivery when he plans his lessons. As one example, he uses Mystery Science lessons to augment classroom discussions. This online program provides video-based experiments and lessons for students. In years past, David would have performed these lessons in the classroom. Students were more engaged when these experiments were conducted in the classroom. David feels that engagement includes asking questions, discussing ideas and what might happen next, and producing quality work. By moving lessons online through this service, David notes that this is a compromise and sacrifice based on the schedule of classes.

When looking at 1:1 devices and the impact on assessment measures, David found that scores differed with his math classes depending on the medium of delivery. Device-based math scores were often lower than paper and pencil testing.

> We faced the issue that while students were completing the assignments online, they were not always showing their work. So, you did not get that quality if you completed online versus on paper and pencil. To provide feedback and growth, we needed a method that shows their work.

He feels that the online delivery scores are due to student stamina since completing something online versus paper can take more time. Students, in turn, cut corners and do not always show everything. Reflecting on this, David noted that teachers asked students to complete 30 questions in an online assessment with a completion time of around 30 minutes. Internally, David's cohort reviewed this to see if it was effective and determined that they needed to change instead of the students. Instead of more extensive exams, students would receive more frequent homework.

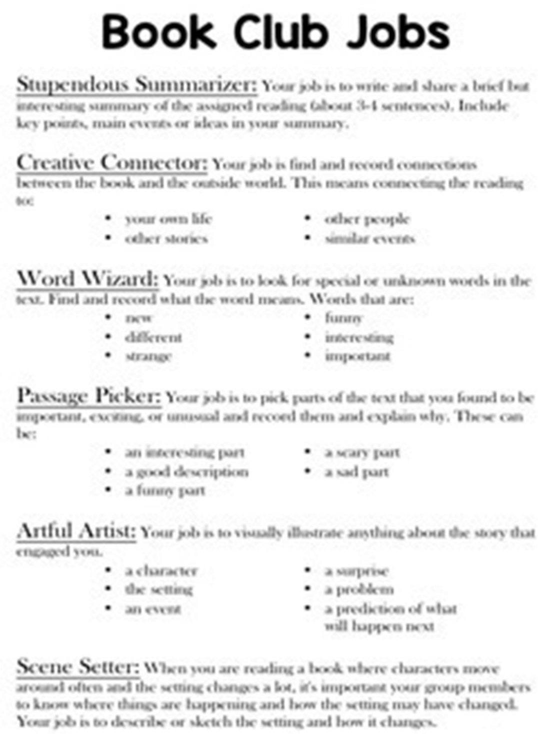
> This resulted in higher quality results on exams. This was the same with homework assignments. Instead of giving ten questions, we provided 4. They

> focused on the assignments and provided more quality responses than the 20 watered-down responses we received.

David's classroom is focused on social-emotional learning and the overall impact on his students. He is taking additional coursework to support his work with students in this area. He identified that some of his students hid behind their Chromebooks through his studies. They would rather complete an assignment with a group by sharing a document than talking to them in the classroom. While this can be beneficial when learning from home or completing a project after school, it creates a deficit in the classroom.

> Sometimes, I find it so hard with some of these students when they are just working in a group. You might have one or two students talking, and then there are two other students just sitting quietly. For those students, they are asking, "Can we just do this on a Chromebook? It is more comfortable for me." But I think that the social aspect is so important. If we do not teach that and encourage it, it will keep adding up over the years.

David notes that it is crucial to be strategic with how students are assigned work and support classroom communication. Some of his assignments are geared so that there is no possibility of not talking or engaging. One example includes his Book Club exercise where students are assigned a text and have different roles assigned for each student. David uses the handout in Figure 44 to guide the discussion of group roles.



Book Club Jobs

Stupendous Summarizer: Your job is to write and share a brief but interesting summary of the assigned reading (about 3-4 sentences). Include key points, main events or ideas in your summary.

Creative Connector: Your job is find and record connections between the book and the outside world. This means connecting the reading to:

- your own life
- other stories
- other people
- similar events

Word Wizard: Your job is to look for special or unknown words in the text. Find and record what the word means. Words that are:

- new
- different
- strange
- funny
- interesting
- important

Passage Picker: Your job is to pick parts of the text that you found to be important, exciting, or unusual and record them and explain why. These can be:

- an interesting part
- a good description
- a funny part
- a scary part
- a sad part

Artful Artist: Your job is to visually illustrate anything about the story that engaged you.

- a character
- the setting
- an event
- a surprise
- a problem
- a prediction of what will happen next

Scene Setter: When you are reading a book where characters move around often and the setting changes a lot, it's important your group members to know where things are happening and how the setting may have changed. Your job is to describe or sketch the setting and how it changes.

Figure 44. *Student Book Club Activity*

David shared another resource that mirrors the TV Show *Shark Tank* and includes design thinking as a school-wide activity. The goal is for students to work in groups to create an invention that improves people's lives. Along the way, they keep an idea notebook and model their invention using Flipgrid. All students in the school vote on their favorite invention aligned to "Be creative. Think outside the box. Have fun" (see Figure 45).

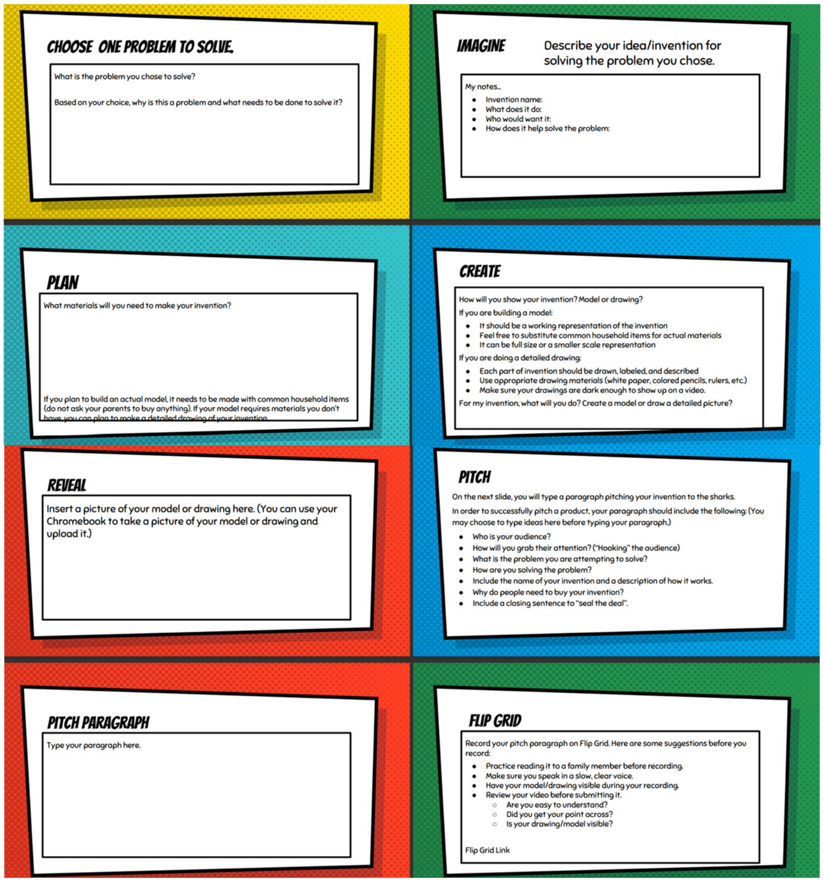
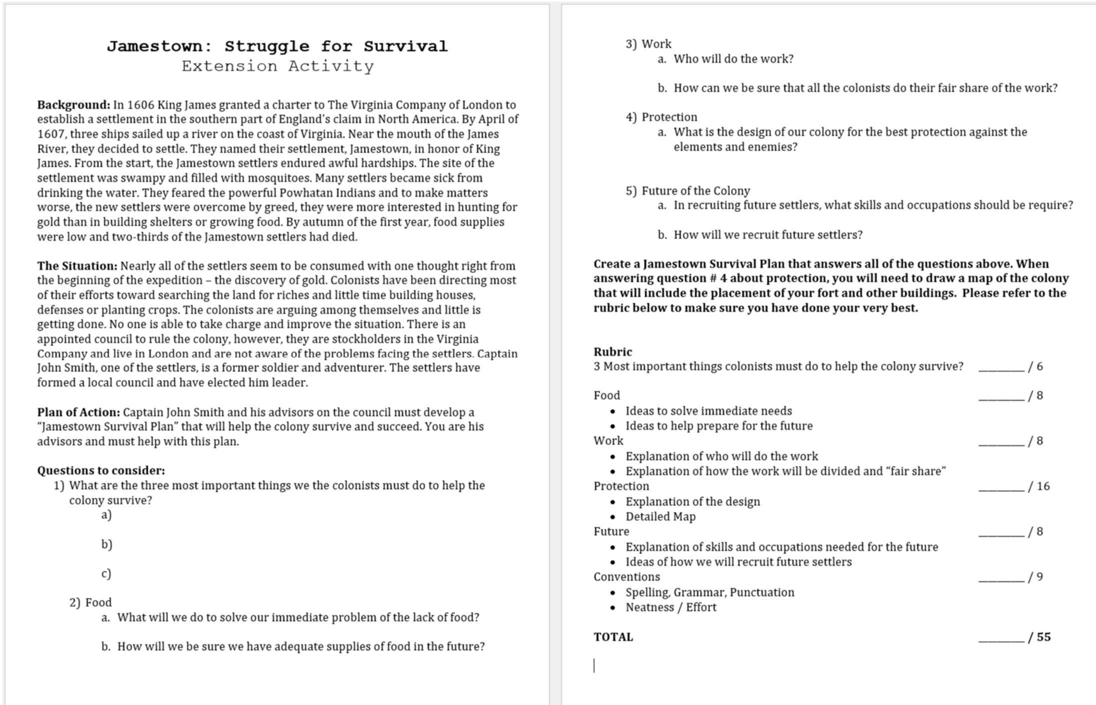


Figure 45. *Shark Tank and Design Thinking Challenge*

As a 1:1 classroom teacher, David notes that he has changed his teaching in many ways. Most notably, he is a facilitator and hands over much of the control to his students during activities. Feedback from students has been positive that they have the freedom to work, and for him, it is an opportunity to learn. David provided an example lesson that includes student groups and encourages autonomy and collaboration in an activity focused on developing a colonist survival plan based in 1600s Jamestown (see Figure 46).



Jamestown: Struggle for Survival
Extension Activity

Background: In 1606 King James granted a charter to The Virginia Company of London to establish a settlement in the southern part of England's claim in North America. By April of 1607, three ships sailed up a river on the coast of Virginia. Near the mouth of the James River, they decided to settle. They named their settlement, Jamestown, in honor of King James. From the start, the Jamestown settlers endured awful hardships. The site of the settlement was swampy and filled with mosquitoes. Many settlers became sick from drinking the water. They feared the powerful Powhatan Indians and to make matters worse, the new settlers were overcome by greed, they were more interested in hunting for gold than in building shelters or growing food. By autumn of the first year, food supplies were low and two-thirds of the Jamestown settlers had died.

The Situation: Nearly all of the settlers seem to be consumed with one thought right from the beginning of the expedition – the discovery of gold. Colonists have been directing most of their efforts toward searching the land for riches and little time building houses, defenses or planting crops. The colonists are arguing among themselves and little is getting done. No one is able to take charge and improve the situation. There is an appointed council to rule the colony, however, they are stockholders in the Virginia Company and live in London and are not aware of the problems facing the settlers. Captain John Smith, one of the settlers, is a former soldier and adventurer. The settlers have formed a local council and have elected him leader.

Plan of Action: Captain John Smith and his advisors on the council must develop a "Jamestown Survival Plan" that will help the colony survive and succeed. You are his advisors and must help with this plan.

Questions to consider:

1) What are the three most important things we the colonists must do to help the colony survive?
   a)
   b)
   c)
2) Food
   a. What will we do to solve our immediate problem of the lack of food?
   b. How will we be sure we have adequate supplies of food in the future?
3) Work
   a. Who will do the work?
   b. How can we be sure that all the colonists do their fair share of the work?
4) Protection
   a. What is the design of our colony for the best protection against the elements and enemies?
5) Future of the Colony
   a. In recruiting future settlers, what skills and occupations should be require?
   b. How will we recruit future settlers?

Create a Jamestown Survival Plan that answers all of the questions above. When answering question # 4 about protection, you will need to draw a map of the colony that will include the placement of your fort and other buildings. Please refer to the rubric below to make sure you have done your very best.

Rubric

3 Most important things colonists must do to help the colony survive?	______ / 6
Food • Ideas to solve immediate needs • Ideas to help prepare for the future	______ / 8
Work • Explanation of who will do the work • Explanation of how the work will be divided and "fair share"	______ / 8
Protection • Explanation of the design • Detailed Map	______ / 16
Future • Explanation of skills and occupations needed for the future • Ideas of how we will recruit future settlers	______ / 8
Conventions • Spelling, Grammar, Punctuation • Neatness / Effort	______ / 9
TOTAL	**______ / 55**

Figure 46. *Collaboration and Engagement Activity from David's Classroom*

As with this lesson, David has also moved to a feedback and growth mindset model. These motions have led David to consider using data to support his students and growth. He has observed that this is not always the case with teachers in his building. It is less tethered to years of service and more connected to their comfort zone and a willingness to change.

David's responses to the questionnaire about instructional practices and TPACK alignment represent a self-awareness of his pedagogical knowledge (PK/TPK) with opportunities for focus on content and technology. As part of his reflection on trends in classroom technology and pedagogy, David sees that teachers are going to have to continue to evolve as far as programs, engagement, the structure, and the whole organization of technology in schools.

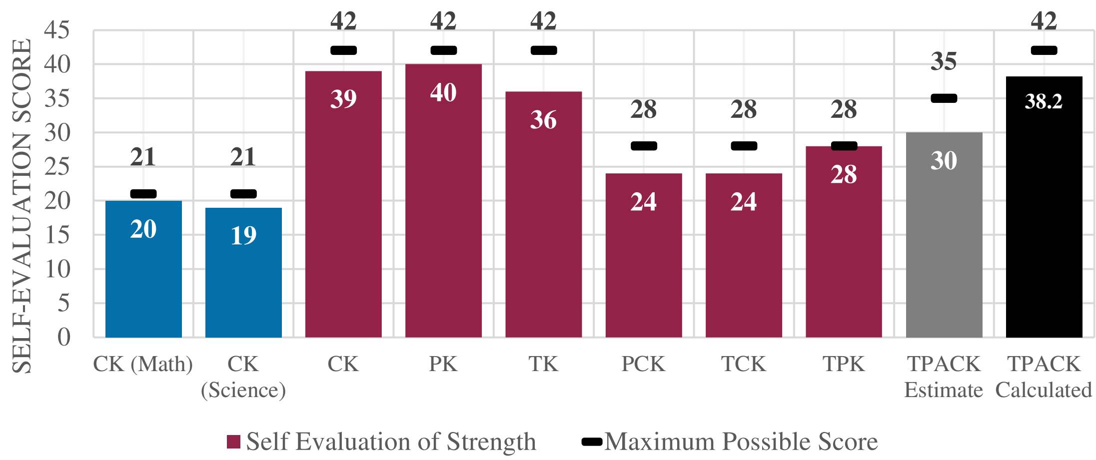


Figure 47. *David's TPACK Self-Evaluation Scores*

David's TPACK self-assessment composite scores were used to create an estimated representation of the relationship between each TPACK domain (see Figure 48A). While adjusting these shapes, David provided his feedback on the interplay of the domains. He organized pedagogical knowledge as his dominant domain and technology knowledge in Figure 48B.

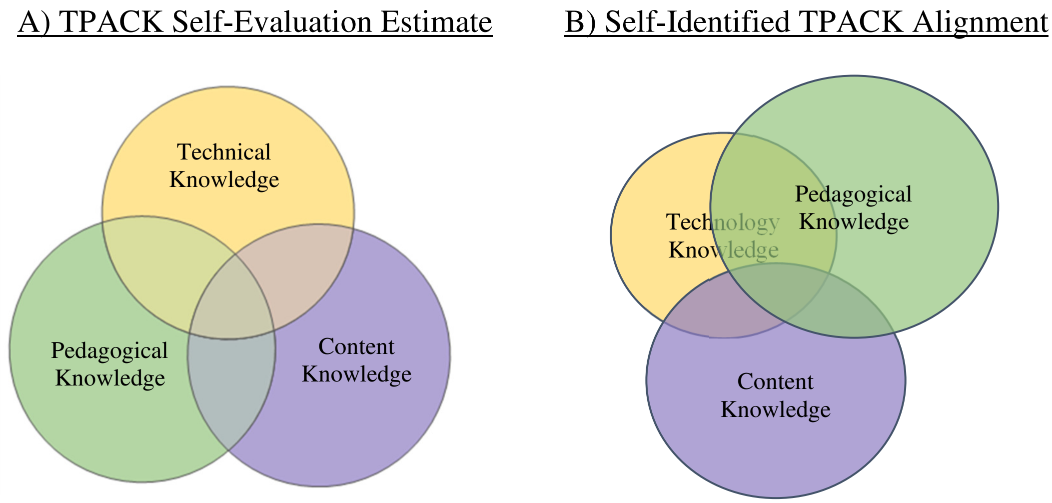


Figure 48. *David's TPACK Self-Evaluation and Alignment*

During his reflection on his TPACK alignment, David noted that he has a strong foundation for instruction and comfort with technology; however, with his constantly changing field of interest, there is always more to learn:

> I have a wide knowledge of different ways of how to instruct. I would say that with technology, as much as I feel comfortable with it, I still feel like there is so much that I have not discovered yet or other things that I can do. I would still say my content knowledge just for, you know, my years of teaching; I still feel like there is more information […] like the sciences […] or my content of writing is something that […] I continue to work on. So, I put that one may be as my smallest one (circle).

His LoTi score (see Figure 49) places David in the Refinement range, where the curriculum is learner-based and outside a standard classroom's four walls. Students are encouraged to use resources outside of the physical classroom and explore new tools and strategies, including subject matter experts (LoTi Connection, n.d.). Refinement mirrors David's examples for his lessons, assessments, and opportunities for students to explore with technology. In addition to Chromebooks, today, David’s classroom features iPads, laptops, cell phones, Ziggi documents cameras, a smartboard, projector, and speakerphones.

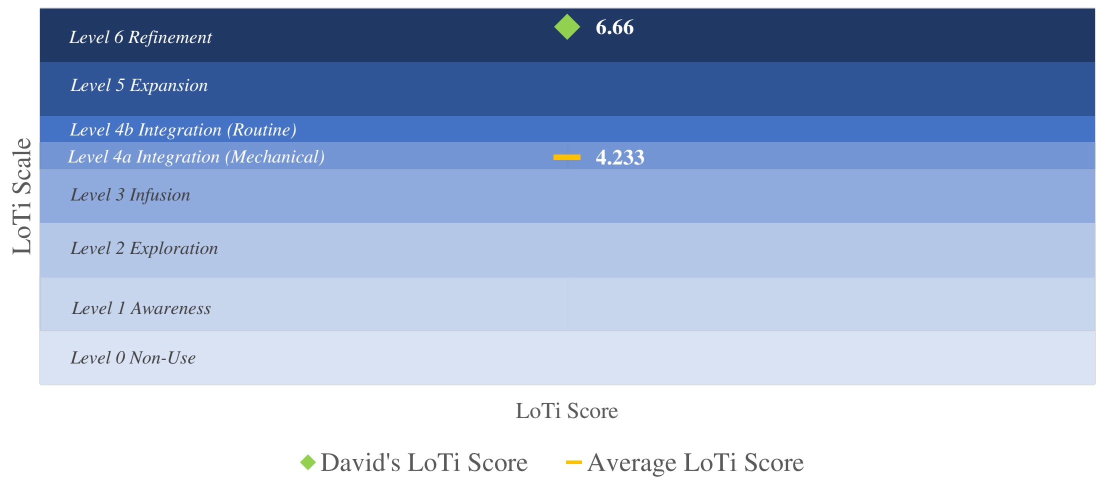


Figure 49. *David’s Level of Technology Integration Results*

Cross-Case Comparison

This section presents the study’s overall findings and is representative of the individual themes that emerged across each case. These themes are grouped into categories based on changes to teacher pedagogy: (1) planning and design, (2) content selection, 3) instructional activities, (4) assessment, (5) academic engagement, and (6) communication. Each case will be reviewed and analyzed in Chapter 5 to consider the implication of each theme on practice and potential recommendations for future research.

Planning and Design

When planning and designing 1:1 classroom instruction, teachers need to consider pedagogical practices such as the learning objectives, navigating the content and methods, facilitating instructional activities, and checking for understanding. Teachers in this study shared their thoughts and experiences about how 1:1 devices impacted their planning and design processes. Two cross-case themes emerged that noted how purposeful and intentional professional development supported case teachers' pedagogical changes and how a teacher's risk mindset impacts experimentation with planning and design.

Before 1:1 implementation at KCES, Amy, Poppy, Terry, and David had limited exposure to Chromebook devices and an understanding of 1:1 instructional design approaches for a device-based classroom. Sally used Chromebooks during her time at the STEM Academy. Each case represented that access to intentional, content-aligned training was essential to their adoption (or adaptation) and use of technology in their planning.

David was a participant in the 1:1 pilot and used Chromebook devices in his classroom at a former school district. Before the 1:1 program, he described his understanding of Chromebooks as "very basic with little to no knowledge and [...] the whole process of using them was a lot of experimentation because we did not know what we wanted to do with them." While David's exposure was limited, the District provided professional development meetings for pilot teachers and training on integrating technology into the curriculum. After training, David approached his lesson planning and design process differently. In a classroom that did not offer students 1:1 technology, David recalled monitoring and micromanaging the learning experience. His training and professional development experience supported a significant shift in the structure of his lessons, which now includes moving to a facilitator role "where [he is] not in everyone's business, 24/7, looking at students' work. It is such a relief not just from students, but for teachers, to give them that freedom to work." This change in pedagogical approach is reflected in his ability to critically reflect and provide insight on his planning and design process. In reviewing his practice, David considers the following questions: (1) What worked well? (2) What did not work so well? (3) What do I need to change? (4) What do I have to do better for my students? (5) How do I have to model this better for the future?, and (6) How can I focus on continuing to keep making it better overall?

Not all teachers had the same professional development and training experiences as David. After the initial pilot period when devices were issued school-wide, other case participants found that technology training was not purposeful nor delivered equitably to all KCES teachers. Poppy, for example, found that the training was not aligned to the content areas or scheduled in a way that supported her and other participants:

> A lot of the training […] was geared very much to the classroom teacher – not to Art, Music, PE, social workers, psychologists, or anyone who was not a classroom teacher. So that was frustrating because we wanted to use technology as well. I certainly did not feel ready to use them in my classroom, and the other

> thing is, I felt like they often would do training on Institute Days or PD mornings when the Art, Music, and PE departments would get together for our training. So, we missed many of those training sessions and then just had to figure it out.

Sally, who also participated after the pilot, could not recall any substantial training offerings on 1:1 devices or their application in her classroom, noting that "[…] for the most part we were told, 'Hey, you are going to have these devices, and here you go.'" She recalled implementation goals provided during the pilot program; however, these offerings were limited based on the time of day offered, topics covered, and connection to KCES Specials teachers' content areas. District goals included the delivery of professional development that would focus on pedagogy (see Figure 50):

"Pedagogy and digital (technology) are intersecting to open radical new ways of engagement and deeper learning."
Coherence (Fullan), 78

The next step is to evolve to a consistent 1:1 device access model. By doing so we equip and empower teachers to embrace and implement teaching strategies that utilize technology, allow access to digital curriculum, and ultimately provide students with more opportunities for engagement and deeper learning.

- **Implementation to align with curriculum adoption and revision**
- **Systematic staff development with a focus on pedagogy**
- **Process will be an evolution over time in contrast to a rapid conversion**
- **Begin with Middle School and add additional level in each subsequent year**

Figure 50. *District Vision for 1:1 Implementation*

Reviewing District documents from a 2017 ICE Conference presentation, leadership identified that training plans for teachers would include multiple modes of professional development, reinforcing micro-credentials, online course offerings for teachers, and Twitter chat discussions. At the same time, the presentation included slides about the value of how technology should be used as a support to instruction (see Figure 51).

Figure 51. *BRSD Support for Technology as Instructional Support*

Teachers like Sally and Poppy made pedagogical adjustments to varying degrees by seeking out their training and professional development. Their planning and design processes were impacted in ways that did not align with the original district vision. Amy noted that her lack of District-provided technology training was a barrier for her understanding of how to use technology in her Art classes:

> I am afraid because I do not know how to use it (the Chromebook). I do not know how to help them on their end. Because we do not have Chromebooks or training, if something happens, I will have no idea how to help or what their experience is.

Without this exposure and access to training, Amy did not make any changes to her planning and design processes, but further rooted in not using any zero student technologies and retaining PowerPoint as her method of lesson delivery:

> I have very minimal technology in my room, and I know what the bare minimum I need is. I am not ashamed to say I worked my way around it. No PowerPoints originally, and I got really good at PowerPoints. I would use those to present

> lessons or present an artist and their artwork or show a video of an artist. My students can then see live work or an interview, but that is really about it.

These examples represent technology adaptation and bypassing technology adoption in their classrooms. Unlike making pedagogical changes that led to technology adoption, teachers like Sally, Poppy, and Amy found it challenging to balance priorities, school and district expectations for using technology in the classroom, and the perceived heightened risk in trying something new with students.

To address her gaps by in access to professional development and training, Poppy used YouTube and online resource sharing platforms like Teachers Pay Teachers:

> They [content-area teachers] get the training from the professional, and we have to go off and find a YouTube video. Well, that does not seem right. In my opinion, as a veteran teacher, it just goes back to if these are things that we are expected to use regularly, even before you teach, those are the things that before you do it, you got to know how to use it. And that should be provided if that is the expectation.

She engaged with fellow Physical Education (PE) teachers to understand how they used technology and shared their lessons. These interactions shifted her outlook of classroom technology as irrelevant commodities in a Specials classroom to tools and resources to support students' physical and potential emotional wellness.

After sharing her developed resource online, Poppy learned that her activity was played in seven countries and the United States. One of the instructors reached out and shared that she adapted the lesson for some of her students with special needs for her physical education program. Other engagements with the PE teacher cohort led to Poppy trying new technology-enriched activities, removing barriers to adoption, developing her resources, and contributing to the larger Education community.

Terry experienced similar challenges as Poppy, finding very few times for self-study with her other responsibilities throughout the day. Compounded by limited Chromebook exposure by her students, Terry needed to prioritize technology training essentials on how to use the Chromebook over delivery approaches, integration, and lesson planning:

> I had to teach the kids how to use their tab key and start their first paragraph. So that was part of me learning to teach the methods of how you make a document, how you backspace, copy and paste, and all those keyboard steps that I did not even know at that point in time.

Terry adapted her planning and design approach to include time for ongoing technology essentials education for her and her students. This time was necessary; however, it pulled away from her content area goals to upskill and prepare her students, rather than having this training available in advance.

Beyond understanding how to open and power on and off the devices, Terry and other content-area participants needed to independently pursue their training, development, and support to expand their technical, pedagogical, and content knowledge. These stories were not uncommon, with Specials and classroom teachers noting the need to charter their path to understanding how technology can support instructional goals. When teachers were unable to access ongoing training or during the rollout of the 1:1 program, they developed their communities of practice in various ways. These included assembling their own teacher 1:1 cohort(s), creating Google Sites web pages to share information, posting on internal listservs, and visiting peer classrooms to observe technology in action. Amy even created a text message thread with her colleagues to stay connected while on the go. When asked about what topics her group of 15 other teachers across different District schools discusses via text, she shared, “Oh, you name it. Everything. We recently got a new document camera in our classrooms, so we were texting back and forth with how to set it up.” Sites like *Chromebooks in Health and Physical Education* are available online for many core subject areas and have emerged for the Specials subjects. Forming online learning communities supports teachers like the participants in finding new activities and ways to engage students in their classroom.

With varying degrees of access to training and professional development, each study teacher shared experiences highlighting the advancement or regression of their pedagogical use of technology when planning and designing lessons. These TPK changes reflected their mindset toward technology adoption, specifically concerning comfort and risk-taking in their classrooms.

Amy’s tolerance for risk and technology experimentation was driven by the District and School not providing clear expectations for the use of Chromebooks in her classroom:

> There were not any expectations for us. It was more of a personal choice and how comfortable we were. I was not comfortable with Chromebooks, so I did not do anything with them. And we were not expected to.

With unclear expectations for technology use in the classroom, Amy was comfortable with her level of technology use and resolved not to expand her TPK. She also adopted a risk-averse technology mindset which prevented her from evaluating technology in her courses beyond using PowerPoint presentations. More challenging, Amy moved further away from considering how technology can be used as a tool when planning for the delivery of instruction. She viewed the computer and projector as the evolved version of the transparency sheet. David noted that the lack of risk-taking with technology and comfort with the status quo is prevalent:

> Teachers get caught in this comfort zone where we are not willing to change. We are not willing to experiment at the very least. That makes teachers who are more experienced sometimes nervous because they do not exactly know how what they are about to try will work or be effective. They become frozen, and they are labeled with this persona that "if it is effective for me, then you need to adapt to my way."

This frozen state and approaching pedagogical unknowns were explored with David and Sally regarding connectivity challenges they experience in their classrooms and impact their planning and delivery of instruction.

While often connected to the impact on instructional activities and assessment, both David and Sally focus on connectivity concerns when planning instruction. Sally shared her experience when trying to structure lessons knowing that they may be impacted by intermittent access to the internet:

> My room was labeled 'the black hole' because we would have to go around and find where we could access the Internet. So, I ended up saying to the students, "Go out in the hall. See if it will hit the hotspot, or just restart your computer."

While Sally is nimble and focuses on trying new things with various backup plans, connectivity concerns directly impact her willingness to try new activities or assessments that require the 1:1 devices. Further, when students are no longer in the classroom, she needs to divide her attention to support students in and outside of their classroom. For some teachers, instruction and a dependency on internet connectivity present too challenging of a risk to overcome. David supported that he has experienced network outages at times, but teachers need to have a sense of flexibility "and be adaptable on both sides. Suppose we were going to complete an assignment online, great. If we are not going to be able to complete it online, we have to show that we can also do it offline."

Participants with a strong TK/TPK did not solely consider technology as their primary instructional delivery vehicle but instead as one available tool of many in their toolbox. The insights from David, Terry, Poppy, and Sally reflect a pedagogical shift. Participants noted that they may have approached looking at the design of instruction as continuing "the way we have always done it" prior to 1:1 devices. With these devices, they now understand how lesson design can be re-evaluated to support student learning and development using potential modern tools; participants exhibited positive improvements in their TPK and TCK.

When comparing questionnaire responses across participants, their planning and design experiences are impacted by reduced representations of TK, TPK, and TCK (see Figure 28, Figure 33, Figure 37, Figure 41, and Figure 48). Regardless of their LoTi or TPACK scores, all participants represented their technological knowledge below the estimated values indicated from their questionnaire responses (see Table 14).

Table 14

Change of TPACK Domain Representation from Estimate to Self-Identification

	LoTi Score	TPACK Score	TPACK Domains				
			CK	PK	TK	TPK	TCK
	Max: 7	*Max: 42*	was … than the estimated representation.				
David	6.66	38 (90%)	↑	↑	↓	↓	↓
Terry	4.58	35 (83%)	↑	↑	↓	↓	↓
Poppy	4.25	40 (95%)	↑	↑	↓	↓	↓
Sally	4	34 (81%)	↑	↑	↓	↓	↓
Amy	1.67	35 (83%)	↑	↑	↓	↓	↓

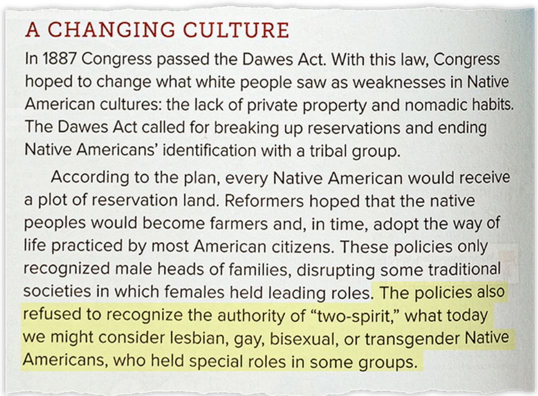
This same pattern developed when comparing their TPK and TCK scores; participants drew representations and shared feedback about lower efficacy in technology-connected domains than estimated based on their questionnaire responses. These patterns reflect teachers who may have a stronger TK but may not have the confidence to support risk-taking behaviors with technology. They may need further support during planning and delivery of instruction in their classrooms to develop increased confidence around their PK and CK.

Content Selection

While participants exhibited notable changes to strategies, TK, and PK, they also approached the selection of content and resources in ways that reinforced a classroom of 21st century diverse learners. This section will highlight the impact of highly diverse classrooms on content pedagogy, how technology has encouraged a more frequent review and refresh of content, and the evolving criteria used by teachers to identify high-quality resources.

Prior to 1:1 devices and supporting classroom technologies, participants often used publisher-provided and District-developed resources in the classroom. David and Poppy noted that access to classroom devices challenged their and fellow teachers' assumptions that their students share common references and values. Over the past five years, they found that a “one pedagogy” and “one curriculum” approach for all is not practical or realistic.

Terry noted that initially selecting content for a diverse classroom meant that she was “meeting each student at their level and figuring out their individual needs;” however, this evolved with the 1:1 technologies and her PK growth. With her classes, she noticed that textbook content and online resources were not recognizing, celebrating, or at times acknowledging the unique history and experiences of all of her students. Further, publishers and the State have opportunities to influence the content presented to her students. Terry recalled a recent article (see Figure 52) that she and her students reviewed, discussing how Texas and California textbooks tell the story of cultures and groups, milestones, achievements, and history.

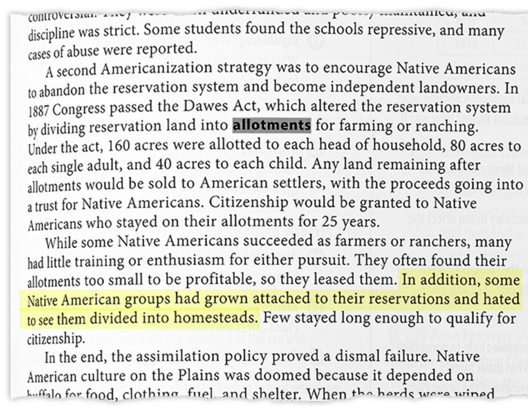


A CHANGING CULTURE

In 1887 Congress passed the Dawes Act. With this law, Congress hoped to change what white people saw as weaknesses in Native American cultures: the lack of private property and nomadic habits. The Dawes Act called for breaking up reservations and ending Native Americans' identification with a tribal group.

According to the plan, every Native American would receive a plot of reservation land. Reformers hoped that the native peoples would become farmers and, in time, adopt the way of life practiced by most American citizens. These policies only recognized male heads of families, disrupting some traditional societies in which females held leading roles. The policies also refused to recognize the authority of "two-spirit," what today we might consider lesbian, gay, bisexual, or transgender Native Americans, who held special roles in some groups.

In this excerpt, California's textbook[5] tells the story that in passing the Dawes Act, the government did not recognize gender identities or female leaders in its early work with Native Americans.



discipline was strict. Some students found the schools repressive, and many cases of abuse were reported.

A second Americanization strategy was to encourage Native Americans to abandon the reservation system and become independent landowners. In 1887 Congress passed the Dawes Act, which altered the reservation system by dividing reservation land into **allotments** for farming or ranching. Under the act, 160 acres were allotted to each head of household, 80 acres to each single adult, and 40 acres to each child. Any land remaining after allotments would be sold to American settlers, with the proceeds going into a trust for Native Americans. Citizenship would be granted to Native Americans who stayed on their allotments for 25 years.

While some Native Americans succeeded as farmers or ranchers, many had little training or enthusiasm for either pursuit. They often found their allotments too small to be profitable, so they leased them. In addition, some Native American groups had grown attached to their reservations and hated to see them divided into homesteads. Few stayed long enough to qualify for citizenship.

In the end, the assimilation policy proved a dismal failure. Native American culture on the Plains was doomed because it depended on buffalo for food, clothing, fuel, and shelter. When the herds were wiped

In the same section of the Texas textbook[6], there is no discussion of gender identity or roles when telling the story of the Americanization of Native Americans.

Figure 52. *Representation of Culture and History in State Textbooks*

Terry notes that as the teacher, she is responsible for adding content representing the world around their students, including creating conversations that examine and promote filling in gaps that may be missing or omitted from text resources. This conversation reinforced for Terry that it is essential to find "resources that allow students to have diverse choices, as well as diverse viewpoints."

Terry shared that it is not just in the online space where the content selection was challenging. She recommended that teachers need to "make sure that those choices are

[5] McGraw-Hill, "United States History & Geography: Growth & Conflict," California, P. 624.

[6] McGraw-Hill, "United States History Since 1877," Texas, P. 111.

available so that students have some individual perspectives on their learning." Terry's perspective and growth are echoed by Sally, who noted that it is essential for student backgrounds to be "shared and appreciated. Their backgrounds, their cultures, and making sure that that is visible to them, that they can access and share their perspectives on their families and personal experiences."

David, Terry, and Sally shared their change in content and resource selection criteria to ensure that instructional content and resources are reviewed and refreshed regularly. In describing this, David felt that some of his KCES colleagues consider District selections like Lexia[7] and Reflex[8] as their go-to curriculum resources year after year. Without a change in resources, approach, or structure, their students become bored and lose interest:

> Teachers get very dependent on some resources, which are their go-to's. […] By the time students get to the fifth grade, they are very familiar with how they work. The idea of just continuing to keep doing the same programs for five years, there is a sense of "okay, this is the same program I used last year – here we go all over again." Keeping it fresh with various tools for them to use is so important. I think that has a lot to do with how we should teach.

---

[7] Lexia (https://www.lexialearning.com/) is an online literacy resource that focuses on helping learners with reading, writing, and speaking. BRSD uses Lexia with students in grades K-5.

[8] Reflex (https://www.reflexmath.com/) is an online math resource that focuses on math fact fluency. BRSD uses Reflex with students in grades K-8.

Terry has witnessed the evolution of technology over the past 20 years. From her experience, the changes are about a journey of self-discovery and challenge in support of her students:

> I think it (technology) just is unfolded in so many directions, and I think we have to do the same thing. We have to continually add and discover and challenge ourselves to find the things that work best. With the curriculum that we have, which is wonderful, it is still making sure that it offers the opportunities to the kids that work the best for them to learn the material, and then some. So I think that is just opening yourself up a lot to what we can do. You know, what can we do to make this work for the kids?

This represents a shift in approach that was less flexible prior to technology devices in the classroom. While teachers could bring in their resources, texts, and materials, the ability and speed for teachers to explore, share and investigate with their students accelerated the time to learning.

The use of student devices in the classroom also supports the opportunity for all students to engage in classroom resources. Sally, for example, described her experience when teaching a math lesson that involved the use of a pan balance to show how weights placed on either side of a scale lead to reaching balance. One of the challenges was that her students could not interact with the resource because it was limited to the equipment in the classroom. Sally found a web resource from the National Council of Teachers of

Mathematics[9] that achieved the lesson goals and refreshed the static lesson (see Figure 53). In describing the resource, Sally shared that "students did not know the value of the shapes. They had to put them on the scale to figure out their values. This content was a gold nugget since I like to teach off my smartboard to create."

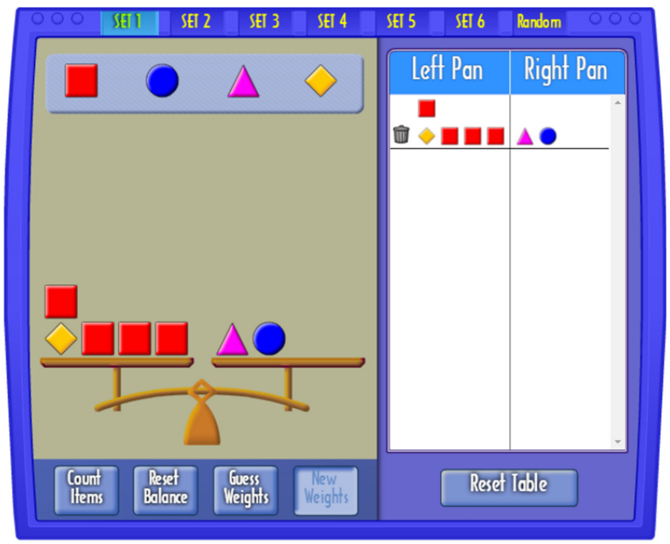


Figure 53. *1:1 Devices and Pan Balance Resource*

David echoed Sally and Terry's feedback that there has to be a push and pull with the content and lessons to adapt to their students. When he teaches, David makes minor changes different from the years past. Through his experiences, David embraces content changes and remixing approaches each year. In exploring the rationale behind why this is not the case for KCES teachers, he noted that comfort in content and strategy are drivers:

---

[9] The Pan Balance Shapes activity is available on the NCTM website at https://www.nctm.org/Classroom-Resources/Illuminations/Interactives/Pan-Balance----Shapes.

> Experienced teachers think there is a level of comfort in their content. They know what there doing with the resources and content, making comments like, "I know these Chromebooks are good, but I am just going to stick with what I know and do what I do best."

In addition to the diversity of their classrooms and more frequently evaluating content for lessons, participants shared how the criteria for determining the quality of resources evolved due to 1:1 student devices. While each participant noted many factors, the following three requirements were consistent across the group: the ability for a resource to extend or enhance the learning experience, the availability and accessibility of the resource, and the time and ease of student engagement.

Publishers provide a collection of worksheets and materials to supplement their textbooks. Sally and Poppy noted that these resources often reinforce skill and drill exercises, specifically the ability for a student to recall facts and information shared by the teacher. Both were very clear that these resources no longer fit their 1:1 classrooms. Sally made connections to the core curriculum standards, as well as expectations for 21st-century learners, which will be addressed later in this chapter:

> […] a good resource or content that supports creativity or challenge thinking is not just rote drill and skill practice. This is what I see a lot of. Many worksheets do the same thing, and I want to go a little more than that. If I am going to give them something technology, I want to be able to teach the basics and have them expand with the technology.

Poppy extended her support, noting that content resources need to extend the lesson goals but also not serve as a time filler:

> I do not use technology for technology's sake. I hate this word, but I do not use it for babysitting. Suppose I am going to use technology resources. In that case, I use them in my classroom because it is going to enhance what I am teaching and touch on and dig deeper into the concepts that I am using, or it is going to help my kids understand what we are talking about or doing.

While not explicitly referenced by Sally or Poppy, their descriptions of selection criteria and their current state mirror categories defined and evolved from Bloom's Taxonomy (1956) to Bloom's Digital Taxonomy[10] (Churches, 2008). Represented in Figure 54, the content previously used in participants' classrooms before 1:1 technologies emphasized supporting knowledge recall and "doing" activities.

---

[10] Bloom's Digital Taxonomy figure created by Fractus Learning (https://www.fractuslearning.com/) is licensed under a Creative Commons Attribution-Share Alike 4.0 International License.

Bloom (1956) developed a framework for identifying student educational goals in their classroom. In the first column of *Note:* Bloom's Digital Taxonomy by Fractus Learning is licensed under a Creative Commons Attribution-Share Alike 4.0 International License.

Figure 54, the original six levels are listed in progressive levels of thinking skills. Reflected in column two, Airasian, Cruikshank, Mayer, Pintrich, Raths, and Wittrock (2001) published a revision of Bloom's Taxonomy which moved away from static categories to reflect action words and engagement. In columns three through five, Churches (2008) extended Bloom's taxonomy using action verbs which reflected student cognitive processing and 21st century student learning.

Bloom's taxonomy	Bloom's modified taxonomy	Bloom's extended digital taxonomy	Functional Levels	Activities with digital tools	
		Sharing	Publicly sharing, publishing, broadcasting	Contributing to open social networks, publishing, broadcasting, networking	Higher Order Thinking Skills
Evaluation	Creating	Creating	Designing, constructing, planning, producing, inventing, devising, making	Programming, filming, animating, blogging, video blogging, mixing, re-mixing, wiki-ing, videocasting, podcasting, directing	
Synthesis	Evaluating	Evaluating	Checking, hypothesising, critiquing, experimenting, judging, testing, detecting, monitoring	Blog commenting, reviewing, posting, moderating, collaborating, refactoring, testing	
Analysis	Analyzing	Conceptualizing	Comparing, organising, deconstructing, attributing, outlining, finding, structuring, integrating	Hacking, mashing, linking, validating, reverse engineering, cracking	
Application	Applying	Applying	Implementing, carrying out, using, executing	Running, loading, playing, operating, uploading, sharing with group, editing	
Comprehension	Understanding	Connecting	Interpreting, summarizing, inferring, paraphrasing, classifying, comparing, explaining, exemplifying	Boolean searches, advanced searches, blog journaling, tweeting, categorizing, tagging, commenting, annotating, subscribing	
Knowledge	Remembering	Doing	Recognizing, listing, describing, identifying, retrieving, naming, locating, finding	Bullet pointing, highlighting, bookmarking, group networking, shared bookmarking, searching	Lower Order Thinking Skills

Note: Bloom's Digital Taxonomy by Fractus Learning is licensed under a Creative Commons Attribution-Share Alike 4.0 International License.

Figure 54. *Bloom's Taxonomy Revisions Crosswalk*

After implementing 1:1 technologies, opportunities to support higher-order, technology-based learning and activities presented fewer hurdles and barriers for case teachers. Terry references an example of these selections in her ELA lesson plan (See Appendix N). She includes a series of activities and skill-building work that includes technology resources for alternative assessments, discussed later in the chapter. Terry's use of this lesson plan template represents a movement to consider how content and technology can co-exist and support each other through student learning.

In addition to extending the goals and objectives of a lesson, Amy and Poppy noted the limiting factor of time when accessing and engaging with content. In Specials classrooms with time constraints like Physical Education and Art, students visit their classrooms one time per week for less than an hour. Amy shared that her hesitation with most content in the classroom is that her "…students are in, and then they are out of the classroom. I have to introduce a topic, have students get out their supplies, get to work, clean up, and then the next class comes in right away." Amy cannot borrow time from other content areas to explore the content more in-depth using new content or technology. This time constraint directly impacts what content Amy can include and the use of technology in her Specials classroom. Further, it challenges her ability to address her TPK and TCK because of the practicality of student schedules.

Poppy faces similar constraints with timing and finding content for student projects. In a prior assignment, her students researched non-traditional sports (i.e., they could not select soccer, basketball, football, or baseball). Before Chromebooks, her students would spend time in the library looking for content that was not always appropriate for the assignment. She describes the creation of a custom search engine to facilitate this process as well as what makes a quality resource:

> I then became savvy enough to create custom search engines. I would create engines for the kids to research non-traditional sports. I feel like I have spent probably a couple of years of my life going through resources and bookmarking, because why waste your time looking through bad resources?

The exercise of Poppy pre-selecting appropriate websites and coalescing them in one location for her students represents a modern translation from her prior experiences.

Previously, students would have visited the LMC and looked through encyclopedias, books, other print-based resources, and a few minutes on a shared computer. By making this adjustment, students learn about search criteria, determining reputable sources, and all within the confines of a web filter for age-appropriate content.

Terry shared that accessibility, similarly to technology, to complete an assignment has been a significant element of leveraging tools for learning. Terry's experience with the computer labs limited the time students could spend working on a research writing project. She shares how this supported creative lesson planning, as well as expanded students' writing capabilities:

> When we just had computer lab access, we could connect once a week and sometimes twice a week if we were working on a big project for writing. The one-to-one experience has been a dramatic change, where we could say we are going to work on this writing project or let us go to this site and read the article. Having access consistently has branched into more ideas and changes on the fly to lesson planning so much more.

When selecting technology tools for learning, Amy was in alignment when Terry, David, and Poppy shared how teachers have used technology in their classrooms and expressed that the tool needed to enhance her students' learning or what was being taught for the day:

> Technology is really fun. Technology is great. However, if it is not valuable for what is being taught, what is the point? I do not use technology for technology's

> sake or for, and I hate this word, babysitting. If I use technology in my classroom, I use it because it will enhance what I am teaching and touch on and dig deeper into the concepts I am using, or it is going to help my kids understand what we are talking about or doing.

Considering this perspective, Amy does not have her students use technology because she is not sure (or does not believe that) if technology-based content will add value to a student's learning experience or will just create a barrier to learning.

Case teachers noted that 1:1 devices had removed many of the barriers related to the availability and accessibility of content. Terry shared that prior to 1:1 devices, students would visit the Library Media Center (LMC) to pick out books, review a topic in the encyclopedia for a report, or look up a word in the dictionary. Easy access to content is crucial for teachers when identifying classroom resources. Terry shared that with 1:1 devices, the ability for students to collaborate and complete a writing project has impacted her TPK and touched on her approach to planning instruction. With electronic content resources available, Terry and her students can "work on a writing project together by going to a website to read an article. We can go to it together, reread it, and really study and learn it together." She uses Newsela[11] to enhance her lessons and as additional primary sources (see Figure 55). With access to a reporting dashboard, the content comes to life, informing how her students are progressing in real-time and their

[11] Newsela (http://www.nesela.com) is a standards-aligned, accessible, reading-level aligned and differentiated instructional content site used by teachers to support reading enrichment and engagement. They offer free access to curated news content, but offer paid options in ELA, Social Studies, Science, SEL and more.

reading and comprehension skills growth in article quizzes. Discussed later in this chapter, Terry also uses Newsela as an opportunity for formative assessment – a use for technology that she did not use prior to device availability.

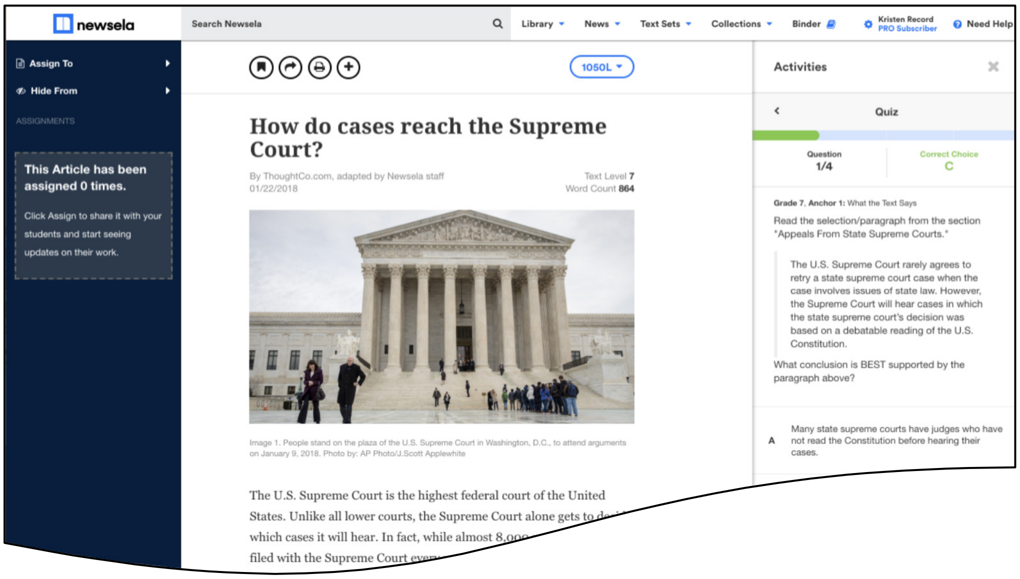


Figure 55. *Newsela Teacher Interface with Comprehension Questions*

While Terry's flexibility and classroom autonomy with content through sites like Newsela are beneficial, other content-area-specific tools were also noted as areas of opportunity. Sally emphasized that there are challenges with locating high-quality content resources. While she is willing to try new things and does not see something not working as a failure, she welcomes support in locating quality resources:

> I think it would be great if there was someone who could help us by giving us a couple of options. For example, you could try a couple of things with this standard. When those are presented and shown, you will likely try it once.

From their exposure and experience with 1:1 devices, all participants noted that having access to more district-recommended content and resources was necessary. Whether maintained by the District, School, or a shared location for and by teachers, participants wanted access to recommended "high quality" resources. This approach reflects a shift from considering how PK and CK worked together to how TK can be integrated and aligned across student learning.

Instructional Activities

As participants shared their pedagogical changes related to planning and designing instruction that informed content selection, they reflected on additional changes to instructional activities selected for their students. This section overlaps with the vignettes presented earlier in this chapter. To focus the analysis, participants shared two common themes discussed in this section: (1) how the changes in the world of work influence their activities and alignment with collaborative learning opportunities, and (2) changes in their roles and responsibilities as teachers.

Referenced in Chapter 2, the skillsets required for 21^{st}-century students have evolved to emphasize soft skills such as critical thinking/problem-solving, oral and written communication, teamwork, digital fluency, and leadership skills. While teachers did not explicitly state that they made changes to their TPK and PCK to reflect 21^{st}-century learner needs, their decisions regarding the instructional activities were in step with these and other soft skills. Aside from David's experience with a Shark Tank school-wide project which encouraged students to identify an invention or innovation, most instructional activities are based on conditions local to the classroom. Participants use digital classroom tools to engage in learning experiences and problem-solving daily. However, using technology and resources to solve real-world issues in their local community and personal importance to the student were the lowest scores across the questionnaire. With these questions receiving a majority of responses of "Never," participants have not linked student technology resources to the opportunity for students to explore issues local to their community and beyond.

1. My students propose innovative ways to use our school's advanced digital tools (e.g., digital media authoring tools, graphics programs, probeware with GPS systems) and resources (e.g., publishing software, media production software, advanced web design software) to **address challenges/issues affecting their local and global communities**.
2. My students use all forms of the most advanced digital tools (e.g., digital media authoring tools, graphics programs, handheld devices) and resources (e.g., publishing software, media production software, advanced web design software) to **pursue collaborative problem-solving opportunities surrounding issues of personal and/or social importance**.
3. My students **identify important real-world issues or problems** (e.g., environmental pollution, elections, health awareness), then **use collaborative tools and human resources beyond the school building** (e.g., partnerships with business professionals, community groups) **to solve them**.

When creating collaborative opportunities, participants shared that they focused on their students sharing their ideas, working together toward a common goal, or strategically creating activities that encouraged connections.

With schools responding to changes in the world of work and emphasizing increased collaborative learning opportunities, participants demonstrated shifts from their previous instructional personas, emphasizing lecture and sage on the stage. David finds that he is now in this capacity where he is no longer directing students, but he is a facilitator or coach as a result of 1:1 devices:

> I am not in everyone's business 24/7 looking at students' work. These devices are a relief for students and teachers to give them that freedom to work. I think my teaching has become more prominent because I can observe the work they have been doing, observe it, and provide feedback. I can then learn that this worked really well or did not work well; what do I need to change? What do I have to give my students better? How do I have to model this better for the future? How can I overall just continue to keep making it better?

While devices do not replace the teacher, students are explorers and adventurers when structured as part of instructional activities. By instilling trust and being the coach through the experience, David had an opportunity to extend trust and facilitate the learning process rather than micromanaging it:

> Giving students the chance to learn this stuff on their own, you would be surprised at how much they can adapt to without me just continuing to facilitate

> and instruct them on every single action that they do. It gives students a chance to be creative and for me to back observe the work and ask myself the questions, "What is the data telling me? How can I improve moving forward?" That is hard, especially for a first-year teacher, and I am still relatively new. I have only been doing this for six years; however, I keep finding myself just backing off more, giving them a chance to learn, and then intervening when I have to.

David's experience challenges early pre-service teaching program methodologies that learning needs to be formally structured down to the specific activities and interactions between teacher and student. He has made pedagogical changes that position him as an experimental researcher who supports student information gathering and sharing. This role shift is profound given his time in position, limited initial exposure to technology, and time at KCS. While he gained TK through his role, these practical experiences informed and guided his TPK development.

An additional manifestation of this open classroom model where students are the teachers is from Sally's Genius Hour program in her classroom. Sally uses less of her textbook and formally constructed lessons, aiming more for the introduction of a topic and encouraging her students to learn more about an area of interest:

> I started Genius Hour at the STEM school, and it is less about me making lessons that they have to learn while I am the sage on stage and more about what they want to learn. Yes, I know I have Standards that I have to meet, so I approach it in two ways: (1) We have not discussed a topic, but what do you want to learn about

> and present to the classroom?, or (2) Now that we have discussed a topic, what deeper information or topic would you like to explore? Students can search and find information faster and easier, so I am learning more on doing more student-based interest area activities to expand on the lessons we are teaching.

Sally's experience was a common one and reflected a pedagogical change that is deeply rooted – student and classroom control. Students can guide and direct their learning when Sally lets go of some control during the instructional activity topics and focus areas. At the same time, they present their findings to their peers, giving additional opportunities for Sally to coach and explore new topic areas of passion.

David finds that he is in a similar capacity where he is no longer directing students but acting in a facilitator or coach capacity as a result of 1:1 devices:

> I am not in everyone's business 24/7 looking at students' work. These resources are a relief for students and teachers to give them that freedom to work. I think my teaching has become more prominent because I can observe the work they have been doing, observe it, and provide feedback. I can then learn that this worked really well or did not work well; what do I need to change? What do I have to give my students better? How do I have to model this better for the future? How can I overall just continue to keep making it better?

Assessment

Using technology to monitor student learning, diagnose learning gaps, and address confusion are only a few benefits of formative and summative assessment. In this section, participants provided further insights into how their strategies for assessing student learning have evolved and using data to drive student impact.

When discussing assessment approaches used by participants, responses varied from an early entry using Google Forms to leveraging adaptive learning assessment software. Amy, for example, has moved from not having her students use Chromebooks but has considered using them to facilitate an exit slip process to capture learning and understanding from the period. While she is considering this, she retains her current pedagogical approach to assessing student progress and success by: (1) how well the student is focused, (2) if the student tried their best on the assignment, and (3) if they were engaged in the assignment.

In her use of Chromebooks in her PE classroom, Poppy shared that she alternated between one class meeting with in-class activities and the next class meeting as independent PE time. She established class activities that would be completed using a Google Form to submit their chosen activity. This change supports the ability for students to select an assessment that reflects their abilities. Once completed, students would also record their heart rate during the activity and the resting heart rate time. Historically, she has completed a fitness unit by giving students a test; however, she engaged in a more interactive form of activity-based assessment this year. These form entries supported students tracking their heart rate over time and conducting data analysis historically only offered or conducted in math courses.

Terry noted that she invests personal funds in IXL Math, an online enrichment resource that supports math and language arts, science, and more. She found that the online platform provides her with insights on how students are progressing in math, adjusts difficulty based on each student, and is invaluable based on her class usage. It has been beneficial in discussions with parents on areas to focus on at home and feedback on her class pacing. This resource changed how she engaged with parents because of performance data and the dashboard's opportunities to review student work. Further, it links a student's family because they can also engage with the materials.

Using data to guide instructional decisions is not a new concept in education; however, the frequency and amount of data points available to teachers have grown over time using 1:1 devices. Teachers noted that they did not see themselves as researchers because they did not have formal training in the space. However, they are all researchers in their classrooms, considering David, Sally, and other case teacher insights. Data-informed decision-making was a new focus area for the District while this study was underway. Our conversations included hesitation on using single-point data measures, the concept of data as a snapshot in time, and the use of various technology tools to inform practice.

Sally, for example, does not look at aimswebPlus reporting data, a standardized test that looks at math and reading progress for PK-12 students, or other District-based standardized test measures as supports for student instruction. Instead, she relies on her pedagogical beliefs, evaluating student soft skills and their personality insights:

> I was told and stuck with that aimswebPlus is a one-shot picture of your vacation that does not show the whole span of time. We went on a vacation where we got caught in a hurricane. If I showed you one of those hurricane pictures, you would say, "Oh my gosh, what a horrible vacation." Then I could show you the picture before the hurricane came instead, and you might say, "Oh, what a great vacation." I look at more than just a one-shot deal.

David mirrored Sally's thoughts, noting that the larger picture takes additional data, insights, and information to understand their needs fully. He detailed the experience when recommending and selecting students for an accelerated academic program. Fifth-grade teachers are a significant component in selecting these students for the accelerated program every year. Students also take a Cognitive Abilities Test (CogAT) test, which provides a CogAT score. If students hit so many points, they are automatically in the program. David shares his cohorts' experience with this process:

> Last year, we had a student who was a great kid and did well on this exam, but then you looked at his math performance scores, homework completion, and aimswebPlus scores; they were nowhere near the CogAT score. Yet, because the CogAT exam said he hit this score, he automatically got into the program. This result was tough for a lot of us to hear because we were thinking, "what are we really setting this kid up for?" Ultimately, we questioned if that data truly represents how he was in the classroom? Sometimes teachers get stuck on this

> idea that their district score says they are doing this but did we look at the other six or seven components that would fully represent who the student is?

Participants noted that they shifted away from summative, single-data point assessments and emphasized insights gathered over weeks. Poppy shared an activity where students created their own game that leveraged physical education principles but featured embedded assessments:

> They had to select appropriate equipment, safety guidelines, rules; they had to tell me what age level the game was appropriate for, whether it had to be played inside or outside, and be specific about what equipment they would need. They got to have actually three weeks of PE classes to work on it, and I would send them Google Forms each week. They were checking in each week so that I was not looming over them. They were not allowed to continue forward with their game until they had gotten feedback from me from their Google Form, and it was neat to see students progressing at their own rate. It gave me the opportunity to give feedback at different rates and not have everybody slam me at one time. They also had to choose which national standard or state standard for physical education and physical development they would use.

Poppy provided student voice and choice in this unit and used methods that ensured each group could continue forward, gather insights, and support their work. This assessment approach provided Poppy with ongoing insights into team dynamics, performance, and contributions from each team member, rather than only seeing the game when it was completed, and insights shared by each student.

Academic Engagement

During the first weeks of school, participants at KCES spend much time discussing and setting expectations for technology use in the classroom. While the devices have many benefits for students, teachers noted that engagement suffered without the structure of clear classroom expectations. David's experience is that he "emphasizes class procedures, his beliefs and visions are of when they should have the Chromebook open, and when they should not. Students get used to that routine, and they understand. Teachers like David and Sally also support engagement through differentiation and personalization of lessons while focusing on equitable classroom experiences for their students.

While students expressed interest in using their 1:1 devices for assignments and activities during expectation setting exercises, teachers like David noted that we should not discount the value of face-to-face engagements for content like science experiments. One resource he uses, Mystery Doug, addresses science questions by starting with a student's own experiences and experiments, then how those lead to answering their question. In addition to a video, they are often complemented by a hands-on lab experience. David noted that "when we did a lot of hands-on experiments in class about two years ago – our class loved them. They were always engaged; a lot of questions and discussions came from it. Overall, there was quality work from students too." In order to accommodate more time for other instructional activities, David and other teachers moved their Mystery Doug assignments to Google Classroom, including pre-recorded lab experiments from the company. David and his fellow cohort teachers "quickly realized students were not turning in good work. They were not nearly as engaged. They did not find it motivating or fun. It was the work they needed but did not give it their best effort comparatively." The lesson learned was that while resources can be moved to online formats, declining engagement is a risk.

When planning and designing instruction, a teacher focuses on meeting the needs of all learners in their classroom. In defining how they differentiate and personalize instruction for their students, participants noted that they consider (1) their content goals, (2) how students will make meaning out of the content, activities, and lessons, and (3) what students will create that exhibits their level of understanding. Teachers also need to consider individual student readiness levels, personal interests, and learning style preferences as an additional layer.

With the move to 1:1 devices in their classrooms, participants noted a significant shift in their ability to leverage technology and online resources to differentiate and personalize their students' learning experience. As shared previously, Terry's use of Newsela also includes a feature that adjusts the reading level of the article for "rising students and higher-level readers. Students in my class will adjust these levels many times a week, and it has been a huge enrichment because it is beyond the curriculum. […] It has made engagement and discussions differentiated and varied, too."

Because of this and other resources, Terry says that she has noticed that “the amount of writing that students have done with 1:1 devices, has been more quality and quantity because of the access to that writing piece on the screen.”

In addition to the delivery medium, Sally experiences adjustments in her classroom time structure and lesson pacing based on the student interventions needed. Based on formative assessments and observations, Sally can adjust her lesson on the fly:

> […] I will stop and let the kids that need a little bit more support have that intervention with me. So, I want the other kids to play some games to support what I am looking for in that skill we are doing. When I am trying to find things that are not too baby or too high school, there are times that I just like, “I do not know.” I would put ten things on the list and say, “Okay, let us divide up the class, and you guys play these three, you guys play these three, you guys play the YouTube one, and tell me what is good and what is not.” So I can have the kids do it sometimes; they tell me if it is too easy or too hard.

While Sally leans back on her PK prior to student devices, her approach encouraging team building and collaboration resonates through this example. These classroom exercises also indicate a shift in trust toward her students to participate in semi-guided exploration.

Communication

Before 1:1 devices in KCES classrooms, student-to-student communication was limited to physical interactions like passing notes, talking behind the teacher's back, chatting between classes, or gossiping on the bus ride home. Student and teacher communication was also limited by the scheduled class meetings or during a teacher's planning period. 1:1 student devices reduced communication barriers for students in and outside of school. The introduction of devices also came with the challenge of student maturity with technology and appropriate communication. Participants infused digital citizenship principles into many experiences, which ultimately changed their approach to supporting and facilitating discussion in the classroom.

In thinking of how Chromebooks impact student-student and teacher-student communication, participants did not identify any significant barriers to their students' use of Chromebooks in the first two interviews. In the questionnaire, however, participants responded to a series of questions related to individual barriers impacting students' use of technology (see Table 15).

Table 15

Top 5 Participant Responses to Barriers of Student Technology Use[12]

	N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
Technology problems	6	4.00	1.09	1.20	1.37	2.50
Technology access	6	3.83	1.33	1.77	0.44	1.34
Your own attitudes and beliefs	6	3.67	1.86	3.47	0.72	-1.88
Technology support	6	3.50	1.38	1.90	1.38	2.36
Your own knowledge and skills	6	3.33	1.51	2.27	1.27	1.53

Standard Error of Skewness = 0.845; Standard Error of Kurtosis = 1.741

The third interview presented the opportunity to follow up with participants on how their pedagogy has changed due to student devices and classroom communication. This section details their feedback and changes across the following four areas: (1) closing the feedback loop with student assignments, (2) encouraging and facilitating communication through peer activities, (3) engaging in difficult discussions through technology, and (4) technology and the impact on hard skills.

In thinking about her grading experience for student papers, Sally recalls gathering up all of her students' work, "taking it home and in isolation, providing feedback, bringing it all back and passing the papers out to students." With student

[12] The scale range for this set of questions was 1 – 5: (1) No Impact, (2) Very Little Impact, (3) Somewhat Impactful, (4) Quite a Bit of Impact, and (5) A Great Deal of Impact.

The full descriptive statistics for this questionnaire item are available in Appendix O. Six total responses were received for the study; however, one participant withdrew before starting the interview process but after completing the questionnaire. The withdrawn participant's results are included in this table.

devices and the use of Google Classroom, Sally notes that her approach to student feedback and communication on assignments has changed. Instead of gathering materials and creating feedback once at the end of the day, Sally can provide feedback throughout the day. Providing regular and ongoing comments creates a feedback loop and a supportive environment that reinforces the value of communication between teacher and student.

When completing assignments without the Chromebook, editing and providing comments was a time-delayed activity that interrupted the writing process. Not only does Sally provide feedback during the day, but she also has supported students outside of school hours; something that was not possible prior to student devices:

> Most of our writing happens on the Chromebook now. I can log in and make comments. They can comment back. They can fix different areas. I think that is probably one of the beautiful things about having the one-on-one Chromebooks and the writing and the fact that they can fix little things here and there and do not have to rewrite re-type, like the old times when you had a rough draft, and then you had to redo everything. It is a little scary, but I have had kids go on at midnight to fix their writing. It is crazy to see these students' hours working online and looking for feedback.
>
> I had a student that just needed much more one-on-one time. He would start with a comment that “I do not get this.” So, I would immediately go and say, “Okay, I am right here. What don't you get?” We just typed and commented back

> and forth, and back and forth. All he needed was just a little bit more reassurance or redirection or a little more information. Then he would get up and go, and I would say, "Okay, you got it now." So, just that kind of communication has just been beautiful with having Chromebooks.

Her responsiveness to student feedback requests has fostered a rich communication stream in the classroom and after hours. This stream also reinforced student-to-student communication because "they love sharing documents, writing together, and collaborating." She notes that her students often comment on each other's work before she has a chance. She then can transition to an observer capacity and change the feedback loop from once a day to an iterative approach.

David shared a different perspective that calls out an opportunity to stimulate class communication where sometimes his students find comfort in "hiding" behind their Chromebooks. Specifically, some of David's students prefer to complete assignments by sharing documents online and working independently at their desks:

> You see many of these [communication] deficits with students because they are inclined to hide behind a Chromebook. It is not just happening at school. Most of these students are doing it at home. They are either on their phones, tablets, or iPads. Even though they are hiding, a lot of great stuff comes from them. I sometimes find it so hard with students and breaking down communication when working in a group. You might have one or two talking, and then there are two

> that are just sitting there quietly. I think that the social aspect is so important. If we do not teach that, it will keep adding up over the years.

He notes that teachers need to be strategic when creating assignments that foster and, at times demand, student communication to address this. One example includes David's Book Club exercises (see Figure 44), where a group is assigned a set of books. Each team member is assigned a job each day, where specific jobs have communication dependencies. David shares that "this gives students no choice but to communicate because they cannot fill out their assignments if they are not doing their job." Example questions during these exercises include "What did you discuss with your class? How did you suggest making improvements?" From David's experience, students cannot always just be given the *opportunity* to connect and communicate; at times, you need to "essentially force them to be more social in the classroom, and there are ways to do that within-subjects." David shifted his outlook on TPK and PCK by considering the content and context for communication and using technology to facilitate students talking more in the classroom.

In addition to fostering communication about assignments, there are undoubtedly tricky conversations that arise in the classroom. This usually results in students not sharing their thoughts in fear of what other students may think. David uses a unique approach to create a safe space for these connections to occur:

> When students do not seem comfortable talking about topics, we try to find a platform that would give them that opportunity to communicate with me. As

> much as we want everyone to feel comfortable, we need to hear their opinions on different topics. It was a website where you could post virtual sticky notes and post a topic for students to talk about. From there, all the feedback that you could need was shared. It was nice because it was not just a way for that student to get their answer across, but it was a way for other students to see that. It was just a great way for everyone to participate.

This use of an open sharing board removes a barrier from a prior practice of using post-it notes to express opinions and feelings. Often, other students would see where their peers placed the post-it and connect their feedback to the writer. Using this electronic method, students can be "anonymous" when displayed in the classroom, while the teacher retains insights if the content is inappropriate.

While hard skills like the craft of writing and reading received broad support from case teachers, Terry noted one area of concern regarding Chromebooks and communications, which provided an interesting perspective on the impact of handwriting in elementary classrooms:

> Kids love to have their devices. Access to devices resulted in me not seeing as much of their handwriting as we did in the past. A student's handwriting development has been limited by their keyboarding. They can still write, but they do not write. In the world, maybe that is fine; however, some kids need to be writing because they are horrible at handwriting. I think they will go and have to make a chart or a graph and present something in middle school or high school,

> and their handwriting will be a disaster. There are a handful of kids who like keyboarding, it works well for them, but this does not help their deficit of not writing legibly.

While keyboarding represents an element of the hidden curriculum, it has come at the detriment of the craft and practice of handwriting. Student handwriting decline made Terry re-think her strategy on communication in her classroom with students, encouraging them to handwrite letters and notes to her and each other. While they can send an email or share a document, they also practice their handwriting by writing letters. She then has the opportunity to review their progress or make course changes informally.

While I expected the topic to be more represented across teacher feedback, only David recalled experiences that reflected how student maturity and access to devices later impacted his pedagogical practices. David shared that the LMC staff co-facilitates a discussion on device-based expectations; however, communications and other behaviors are not necessarily covered in depth. He expanded to include that there may be a perception that physical and verbal incidents and behavior have diminished in the classroom; however, David "sees that a lot of it has just transitioned to the digital world. [David] noticed an uptick in cyberbullying, intentionally physically damaging the equipment, distraction and lack of focus, and other off-task behaviors." Nonetheless, he wanted to clarify that more traditional classroom behaviors still exist. He has had students throwing their Chromebooks on the ground and shattering the screens and keyboard.

While student devices have remediated some of his classroom challenges, they have introduced others. With this transition, David needed to adapt his PK and TPK to include discussions of classroom-based behaviors and student behaviors in an online world. While this is directly connected to digital citizenship, there was a distinction on how the classroom is more deeply personal than the larger context of the World Wide Web. Students will sit across from each other and engage in discussions online that they would likely never share face-to-face.

Over the past two years, digital citizenship has been an area of focus for KCES and the District. The main points of BRSD's digital citizenship messaging are to be safe, be responsible, be respectful and think before you share. Each of the teachers had their spin on how they see students interpreting these points, but more critically, how they have changed as teachers from these discussions.

Amy felt that for her students, digital citizenship was about the appropriate use of technology and being "respectful of it, not misuse, the ability to go to different sites, like you, whatever site you are supposed to go to." David echoed Amy, saying his experience at KCES is that Chromebooks are "[…] for engagement and instruction in the classroom. They are only used for that access. Any other things that they might be using the Chromebook for are off-limits." The very concept of acceptable use sets behavior expectations for students of things to do and things not to do. While there are technical and administrative reasons for the discussion on acceptable use, the context creates a hurdle for some teachers who view student communications as violations of policy versus a new way of talking.

Terry keyed in on this perspective in her experiences and discussions she has had with parents about student use of technology in the classroom and collaboration:

> People who just go beyond the barriers of the usage policies just need to be reminded of what is appropriate and accessible to them. Then, we need to allow them to have choices and the freedom to ensure they stay within allowances that guide them. I think there is a lot of School guidance in using the devices because we are not always sure that the parents are watching or managing what the students do on and with their devices.

With this lack of certainty of discussions occurring at home, participants have modified their lessons to include discussions and opportunities to practice responsible digital citizenship behaviors. Poppy shared how she approaches digital citizenship with her students and is similar to Amy’s interpretation except that it is more aligned to a student experience:

> You need to be responsible and respectful of yourself and what you should be doing on a computer. So, what does that really mean? This is how you use your technology. I want you to imagine that your grandma and granddad are sitting on either side of you every time you use your technology. So anytime you are surfing the web, playing a game, chatting with your friends, or anything else, grandma

> and grandpa are on either side of you. If anything you are doing would embarrass grandma or grandpa, you should not be doing it.

Participants provided their insights on digital citizenship but arrived at a definition informed by ethics, morals, and interpretation. While they received handouts and a YouTube video on digital citizenship to inform their TK and PK, the jump for how TPK guides and supports communication and instruction is a lost opportunity. Thus, as noted earlier in this chapter, teachers lean back on each other and other resources to fill the gap.

Summary

The data collected during this study represents the diversity of teachers in the elementary schools at BRSD, ranging from apprehension in the inclusion of technology in the classroom through advancing curriculum and pushing boundaries of what is possible for the benefit of children. The questions presented during interviews and other data collected provide a glimpse into potential opportunities and ways to support, develop, and connect teachers to their 1:1 classroom and students. Further, students from the teacher's perspective code-switch between classrooms with relative ease while also challenging or pressing teachers who are not using technology. Chapter 5 will discuss these findings, themes, and concepts related to the study's research questions, review their implications, and pose further study and research opportunities.

In closing this chapter, I included a quote from Terry's interview about the value of reflection and starting to unpack her learning and growth up to this point:

These discussions helped me think back on all the experiences and transitions we have been through over these years. It helped me by talking it through, thinking it through, and remembering all the details way back when. It did bring back some thoughts about what has been working and how we have changed. Obviously, for the better, we should always get better. As we pile on more, I cannot complain because everything seems to work well. Even though we have added on more responsibilities, more learning, and more things we have to teach, it just all seems to work well. We just need a little bit longer of a day sometimes to get it all in.

CHAPTER V

DISCUSSION

Summary of the Study

The use of technology continues to expand in classrooms around the globe (Gray et al., 2010). While technologies are being used in lesson planning, assessment, and facilitating classroom engagement, pedagogical changes by teachers are not guaranteed to occur for teachers. While there is a host of research on the impact of 1:1 initiatives that provide devices to students for coursework, research on pedagogical changes by elementary school teachers is limited. Further, student engagement outcomes are well documented; however, fewer studies examine classroom communication and engagement from the teacher's perspective after a 1:1 classroom implementation. This study examines pedagogical changes made by teachers in 1:1 elementary classrooms, the barriers that prevented their adoption, and how devices influenced student-teacher engagement and communication. The research elevates the voices and experiences of teachers that joined the 1:1 program three years prior to this study. This study can inform administrators, practitioners, and technology professionals to consider adopting a 1:1 program or changing its current program. The following research questions were evaluated to explore these areas:

1. How do teachers adjust pedagogical practices in 1:1 classrooms?

1a. How do 1:1 devices in classrooms influence teacher pedagogical practices?

2. How do teachers describe shifts in their classrooms since implementing a 1:1 program?

    2a. How do teachers perceive student academic engagement in a 1:1 classroom?

    2b. How do 1:1 devices in classrooms influence communication for and between teachers and students?

    2c. How do 1:1 devices in classrooms influence communication for and between students?

This chapter will summarize the results and significant findings from the case study in the context of the research questions and literature. Then I will discuss the implications of this study for future research and the limitations encountered.

Summary of Key Findings

At the onset of the 1:1 device program, administrators thought that pedagogical changes were a given outcome. While administrators thought teachers were adopting technology, they were adapting to, and working around, the classroom technology rather than changing their teaching strategies, assessments, and procedures. In thinking about their adaptation journey and how to transition to full adoption, teachers described the various factors and conditions that resulted in opportunities for pedagogical change. In the absence of available training, all participants noted that developing a professional learning community and using external sources were integral in more deeply understanding the value of the 1:1 program and how to integrate technology in the classroom effectively. The use of data to inform classroom opportunities was limited based on the District's use of single data points to inform practice. Using limited data sets led to apprehension in how assessment and adaptive learning tools are used with students. However, teachers shared that they have changed their criteria when selecting learning technology tools.

Participants noted communication and engagement changes when considering how 1:1 technologies have impacted the classroom. While some students have become more withdrawn in the classroom and have declined in their soft and hard skills, teachers have addressed this by creating more planned activities that emphasize peer communications. Participants shared that their roles as teachers have also shifted from “sage on the stage” to facilitator and coach. This transition was only possible after the trust was established between teachers and their students. While teachers did not articulate barriers that students encounter when using devices for engagement and communication, their questionnaire findings noted that teachers' attitudes, beliefs, knowledge, and skills directly impacted their students’ experiences.

Significant Findings Related to Literature

The insights provided by teachers in this study were invaluable. While research articulated specific views of pedagogical change, the participants' perspectives provided further color and clarity for elementary 1:1 classrooms. This section will review the significant findings from the study in context to the research literature introduced previously focused on planning and design, content selection, instructional activities, assessment, academic engagement, and communication.

Planning and Design

Before the interviews and after document analysis, I anticipated that teachers would report mainly second-order barriers given the volume of reported training, professional development, and other initiatives that were planned to support them. Most feedback, though, aligned with a hesitancy for adoption and a tendency to adapt to technology resulting from a lack of clear organizational vision, access to professional development training, and technology support. Ertmer (1999) noted that teachers with these and other first-order barriers might feel frustrated and pressured to overcome each barrier *before* beginning the integration process.

During the interview process, I was reminded of teaching experiences in the 1800s when slate tablets were transitioning to classroom chalkboards. Teachers were apprehensive about chalkboards and went unused for long periods because teachers did not have the pedagogical knowledge to use them in a group learning environment (Shade, 2001). It is not surprising that most of the teachers in this study were not far along in the integration process based on LoTi and TPACK scores and are adapting to technology.

ISTE (2020a) identified that having a shared vision is one of the essential conditions for technology adoption. This includes having a collaboratively developed strategic vision that is understood universally. Further, the leadership team should be actively engaged and collaboratively solving problems. As noted in the previous chapter, teachers were generally able to define the purpose of the 1:1 program. Pilot teachers like David were able to articulate how the program's purpose translated into his use of technology in the classroom. Teachers outside of the pilot struggled to connect with or recall expectations from district leadership. However, they did note that the building principal guided the use, context, and building-level expectations. Without a district vision, individual schools and even classrooms started to carve out their expectations, considerations for what technology would look like in their classroom, and at times, even regress away from technology altogether.

Participant insights highlighted that adoption is not a binary outcome considering how teachers facilitate pedagogical change. It is inaccurate to assume that a teacher's pedagogy will magically align or change if you provide a piece of technology in the classroom. In order for fundamental pedagogical changes to be possible for the participants and their colleagues, they need access to ongoing training, opportunities for self-evaluation and assessment, as well as bridging a shared commitment with district administrators, students, and parents (Adelsberger et al., 2008; Collis, 1996; Kelly et al., 2009; Yildirim, 2000).

Previous studies have noted that having a foundational knowledge of classroom technology is critical for teachers (Brush et al., 2003; P. Ertmer, 2003; Lemke et al., 2003; Ware & Stein, 2014). Without opportunities to learn and practice the essential hard skills in a 1:1 classroom, like resetting a Chromebook, resetting a password, or troubleshooting a device that will not connect to the internet, teachers and students lose instructional time. Even further, they lose confidence in each other and impact a teacher's ability to consider higher-level technology applications. As noted later in this section, teachers created professional learning communities to develop a circle of knowledge sharing and fill the gaps in their current understanding.

Based on these gaps in pedagogical, curricular, and technical knowledge, the program's value, purpose, direction, and teacher pedagogy is no longer driven nor impacted by the district administration's original mission, vision, and, ultimately, intention. The program is now being driven and molded by the faculty and students. While this may meet one of the program goals to provide a unique learning experience for students, it can also be challenging for students to adapt to their teacher's different implementations throughout the day.

Content Selection

Research studies have found that teachers struggle with effectively using technology in their courses, but at the same time, schools are not supporting teachers who need reinforcement to support these resources effectively ((Kelly et al., 2009; Peck & Sprenger, 2008; Stobaugh & Tassell, 2011)). Overall, teachers noted that they have either worked around these challenges by forming their support networks or have maneuvered around the technology expectations. This section will review professional learning communities, technology learning tools, and social-emotional learning associated with participant insights.

As noted in the discussion on professional development at KCES, teachers developed pods of support without training and direction. While teachers may not have articulated their groups as PLCs, they served as a group of professionals who supported each other, shared resources, developed new approaches and strategies, and led to their version of adoption occurring in these self-driven spaces. Further, teachers contribute to the greater education community by sharing their curriculum development work. I would be remiss if I did not articulate the feedback that teachers noted direct support from their Curriculum and Instruction team prior to this academic year but indicated a change in the culture and approach to development efforts. With the pandemic, this was not surprising as administrators and district leaders were working through overall strategy; however, it highlights the opportunity for recovery and reinforcing the program goals and mission.

Evaluating technology tools that can augment or replace portions of an instructional lesson requires teachers to understand their content area and technological pedagogy. This frame supports determining a technology's relative advantage in a teacher's classroom. Without factoring this, teachers will work in isolation toward individual classroom goals rather than cross-content area goals (P. A. Ertmer & Ottenbreit-Leftwich, 2013; Herrington & Kervin, 2007; Painter, 2001). Amy, as one example, has explicitly focused on her use of technology rather than factoring in the student benefits in using technology to support their art learning experience. Further, in expressing that she was unaware of how Chromebooks were being used in other content areas and Specials classrooms, the opportunity to develop cross-content area strategies is limited to non-existent. This limits the ability for students to engage in discussions, make connections, or share experiences in other classes.

In contrast, Poppy used technology in her Physical Education classes and connects to interactive games and projects. Considering that student learning is a social experience and a product of human interaction, by Poppy making connections across the curriculum, she is helping to support the needs of and reinforcing each content area more holistically. Throughout the study, I anticipated hearing about specifics related to their approach to inspection of resources. However, participants used these sessions to describe their needs, improve their practice, and promote solutions. There is an opportunity to facilitate further development with teachers on information literacy and connections to pedagogical practice.

Instructional Activities

Future-ready, 21st-century skill-building, technology-focused classrooms require reliable access to the internet and support when issues arise. (CoSN et al., 2017, 2019a). Fractures in the classroom experience occur when such an infrastructure cannot meet the demand or scale to meet new technologies. While historically, the District increased its internet capacity to meet the demands for new media (Smeets, 2020), teachers are still experiencing access and connectivity issues in parts of District buildings. During site visits for other 1:1 K-12 districts, the Technology Director identified several areas that needed to be prioritized. Based on participant feedback, two areas still need to be addressed: (1) providing appropriate staff support in elementary schools and (2) a robust infrastructure that could support the new wireless devices (Gorbatkin, 2011). Teachers noted that their support provides a quality experience; however, they are overloaded with support requests.

Further, classrooms have connectivity issues that result in students working in the hallways or wherever a connection is possible. These connectivity and access issues directly impact student opportunities and limit a teacher's capabilities in the classroom. Considering the ability to change one’s pedagogy, the three factors identified previously directly impact a teacher’s willingness and ability to take risks and experiment with new technologies.

Assessment

Teachers are researchers and data analysts, among the many other roles they support. This requires teachers to consider a host of factors to access, generate, manage, interpret the data and act on their findings (Knapp et al., 2006). However, this assumes that teachers have a level of confidence in making decisions that involve data analysis and interpretation (Means et al., 2011). In this study, teachers articulated that using more than one data source was critical and understood that data is not a static indicator of student success. Missing from the interviews were discussions about measuring student success and performance in the classroom through data. Aside from their grade books and assignments, teachers noted a limited ability to access “data about students.” While reports are available, the concern is that the information does not apply to their classrooms or needs. Teachers like Terry use other tools to inform her using IXL Math.

On the other end of the spectrum, teachers like Amy abandoned these measures and used effort, risk, and attempt as student performance indicators. This leads to an opportunity for the District to discuss qualitative and quantitative measures of student success with and without technology.

Academic Engagement and Communication

While studies have noted improved communication and collaboration opportunities for students, several caveats exist (Dunleavy et al., 2007; Fairman, 2004; Mouza, 2008). Teachers need to approach technology with assignments and activities that support intentional communications and refactoring their role in the classroom to facilitator or coach. Teachers are introducing more collaborative projects and group efforts that result in more frequent teacher-student and student-student communication (Fairman, 2004; Shapley et al., 2009). In this study, teachers noted that they have successfully transitioned their former independent work to group-based activities. This was only possible by developing shared trust; however, teachers can identify intervention strategies and ensure student engagement by connecting with more collaborative group projects. Teachers also noted that they were more connected than ever, finding after-hours communication more regular, and students appreciate these interactions.

Teachers emphasized that when considering how 1:1 technologies have impacted the classroom, they have noted classroom communication and engagement changes. While some students have become more withdrawn in the classroom and have declined in their soft and hard skills, teachers noted that they addressed this by creating more planned activities that emphasized peer communications. Participants shared that their roles as teachers have also shifted from “sage on the stage” to facilitator and coach. This transition was only possible after the trust was established between teachers and their students. While teachers did not articulate barriers that students encounter when using devices for engagement and communication, their questionnaire findings noted that teachers' attitudes, beliefs, knowledge, and skills directly impacted their students’ experiences.

Implications for Future Practice

The findings from this study raise a series of opportunities to positively impact future practice for teachers, school district leaders, and university preparation programs. Members in the cohorts below should consider the recommendations and scale of implementation at their school or district that supports teachers in 1:1 elementary classrooms. Further, cohorts should consider how they can support other groups in their knowledge journey, whether in pursuit of advancing one pedagogical, technological, or content knowledge.

Curriculum and Instruction (C&I) Teams

As is the case at BRSD, 1:1 device program responsibility is often split between the technology (operation and support for equipment) and the C&I department (pedagogical use and application). A partnership between both departments is essential for the success of the program. Teachers noted throughout this study that there was a divide between the support for the technology and approaches to use technology in pedagogically appropriate ways. A large portion of this partnership connects to the opportunity and essential need for ongoing professional development. New initiatives are often front-loaded with training but do not continue the learning journey after the first few months. Please do not assume that teachers have a base set of technical knowledge or that they will disclose their level of understanding. Developing a basic skills technology workshop, followed by tracks of training options, would develop teacher technological pedagogy and self-efficacy.

While autonomy in the classroom is necessary for teachers, as noted by participants, the sentiment was also that teachers face technology resource overload. The Curriculum and Instruction team, responsible for curriculum decisions across schools, should identify recommendations that support lesson delivery, assessment, intervention, and unit goals while ensuring representation across the content area and Specials. These resources would be welcomed by teachers that are dipping their toes in the water with technology and looking for low-risk, district-supported entry points.

As Terry, Sally, and Amy shared, it is never too late to introduce technology essentials training for teachers. Whether for understanding how to troubleshoot student technology issues, plan lessons, or use the Chromebook from a student perspective, technology foundations can positively impact a teacher's experience with 1:1 devices.

Schools Leadership and District Administrators

For school leaders and district administrators, the resounding message from this study is to ensure that there is a communicated vision for any 1:1 program. While this should not include explicit activities, the vision should establish requirements and goals around technology in schools. The rationale for this expectation is that teachers need to articulate the mission and ensure that they are aligned, not working against the objectives. At the same time, teachers need support, and so do their students. A lack of vision or expectations results in reprioritization in other areas of the organization or the perspective shift of "business as usual."

As with the mission and vision, opportunities for evaluation and assessment are ongoing. Administrators should regularly seek to understand how the program works for each constituency. This process needs to include all teachers, not just content area teachers. If there are Specials teachers that are not using technology, seek understanding and follow-up on how to support them in their classroom. While technology does not need to be a requirement, several cases in this study felt unsupported and did not have access to content area-specific toolsets.

Connectivity was an area of concern for teachers and their students. In several examples, teachers had their students working in the hallway of their classroom due to a lack of wireless access in their rooms. Technology departments should conduct ongoing site surveys to understand and respond to drop zones or areas with limited connectivity.

David, Terry, and Sally experienced challenges with the heavy-lift that goes along with finding new resources for the classroom. Whether it was finding the time to start the search process, shifting mindsets from status quo to refreshing their content, or risk-taking, participants who did not support time and space stalled in their exploration of new content.

Teachers

For teachers, while the recommendations noted in this section may be implemented at varying degrees in their school, there are multiple opportunities to expand their TPACK framework. First, teachers should identify a colleague or a group of teachers to develop a professional learning community. Teachers may already belong to a cohort where introducing TPACK would not be possible for the group to consider. Teachers should share the ideas and resources created; however, they should not feel limited to sharing only with this group.

Secondly, technology does not require teachers to create unique resources for every assignment or lesson. Why reinvent the wheel if a catalog of resources exists and can modify them to meet class needs? There are many online platforms like Teachers Pay Teachers, which spotlight the creative work of teachers, as well as implementation recommendations.

Next, teachers are researchers. While traditionally they have access to qualitative approaches, quantitative data is often more limited outside their classrooms. Use the opportunity to review online resources for data methods, teacher recommendations for measures and instruments that guide instruction, as well as what teachers consider "important" data points for student success. Teachers should discuss strategies for approaching student learning, data-informed decision-making, and technology as a grade-level team.

Lastly, and most importantly, teachers should continue to press for their classroom needs and clarify what is needed to be an effective teacher. For example, if training on strategies for supporting student engagement in music, contact the C&I department, other music teachers, or even consider other district outreach efforts to gather resources.

Pre-Service Teacher Preparation Programs

A unique opportunity exists for pre-service teacher programs to include technology-based pedagogy training. Programs today may not offer technology as a core requirement, instead offering a single class unit around technology. For curriculum leaders in higher education, the need exists to develop a baseline course that provides an understanding of educational technology while also enriching each course with technology-based resources to support ongoing and developing student-teacher efficacy.

Recommendations for Future Research

Due to the pandemic, I could not visit classrooms and observe pedagogy in action. It would benefit a future study to include classroom observations of how teachers incorporate technology and their student responses to these resources. Further, communication and engagement observations would be other factors that would be well served from these classroom visits.

The immediate context of this study was not to evaluate the impact of COVID-19 and remote learning on pedagogical practices. However, during the interviews, it was clear that teachers had opinions and insights to share based on their remote learning experience. While initial research studies are starting to be released by the academic community, further ethnographic studies on how remote learning has led to sustained change in teaching practices.

In tandem with understanding remote learning and pedagogical change, I recommend follow-up studies to examine how trauma impacts teacher reflexivity and pedagogical change. Teachers in the study noted haziness, inability to recall events, and former practices in the classroom prior to remote learning. Further, the pain and loss experienced by teachers and their students did not appear to be processed by the participants. Future studies and research would benefit from understanding how teachers process their roles and responsibilities in teaching with a cloud of emotional trauma and loss hovering during the pandemic.

CHAPTER VI

REFLECTION

March 19, 2013

For the past 33 years, my operating persona has been a heads-down full-time student and, more recently, that of a full-time working professional, absorbing as much information as possible and continuing until a terminal degree was achieved. After charging through an undergraduate degree, completing a Master of Education in a year, and doctoral coursework in another year, I was lost in a vicious cycle known as ABD – "All but Dissertation," also known as "All but Done." Asking myself why the writing was not happening, why my interests would fain, and researching topics that changed more than daily stories in the Chicago Tribune, I realized that I lacked field-based professional experience. Such experiences would ultimately ground my studies and research. It was a defeating experience to watch the sands fall through the hourglass and the completion window close on 90 credit hours of doctoral work at another university.

The fire was burning more than ever to challenge me academically, professionally, and intellectually. After four years of carrying the emotional debt and burden, it was time to release this debt and apply to Loyola's doctoral program. I completed my Curriculum and Instruction doctoral program application, not thinking I would be accepted or even considered. About a month later, I received a request to interview with the School of Education faculty, which made the reality of starting over a genuine possibility. On March 19, 2013, sitting in the lobby, many thoughts raced through my head: research theories, perspectives on current events in education, how to lead change, and more. Nevertheless, I was met with personal introductions and a question that I was not prepared for:

> Welcome and thank you for coming in today for this interview, Adam. Let's start by sharing why Loyola's doctoral program is the right fit at this point in your life. You are in ABD status at the University of Delaware and are now looking to start a second doctoral program. Why?

Sitting in a black steel conference chair in front of the School of Education faculty panel, eyes and ears focused on my response, I shared my story – the good, the bad, and the ugly: but most importantly, the reality. While freeing, it was frightening because the most vulnerable part of myself was exposed to the interview committee – those of whom I would be in coursework as a student. After lots of deep breathing exercises, I received a letter of acceptance to the program two days later.

After two years of rigorous and rewarding coursework, high passing the Program's comprehensive examinations, and many (many) cups of coffee, I was ready to begin the dissertation journey. Around this time, my husband and I learned that our attempts at IVF would be successful, and we would welcome triplets to our lives.

I found myself struggling with this dissertation at some of the brightest and very darkest times of my life. While I was thrilled that we would welcome three healthy, beautiful children into our lives, I also found myself entering into a deep spiraling depression[1]. Among other issues, I was facing the potential reality of finding myself in an ABD state, again, along with taking care of newborn triplets. Further, I became angry, frustrated, and disappointed that I was no longer that twenty-something doctoral student who had the freedom and flexibility to dedicate the time, energy, capacity, and, most importantly, thought space it deserved.

During this time, I lost my voice as a writer, was lost in the process, and could not find my way out. Many nights I considered stopping in the program and accepting the reality of switching titles from doctor to parent. Facing these moments, I always kept something that Dr. David Ensminger shared with his students on the first day of class – "no doctorate program is worth a marriage, a family, or anything you plug into the sentence." Further, according to my sister, these titles can "be a both/and situation, rather than an and/or." Understanding that prioritizing yourself does not devalue others is a concept that I only understood and embraced in writing the last year and a half. My road for completing this dissertation was not an easy one to navigate. To restart the writing engines, I needed to engage in regular self-talk about the value of this experience, why grit is a component of overall perseverance, and that the "best dissertation is a done dissertation."

Dr. Ensminger and Dr. Kathleen were the ideal powerhouses for helping me cross the finish line in this experience. They helped me recover my writing voice, like a buried

---

[1] I've decided to share this information because it is often an unspoken reality of the emotional duress and sanity balancing act that can occur for (doctoral) students, including those working and with families. I am aware that this study will be available publicly and am making the decision to include this to shed light on this topic – and the recovery that's possible.

treasure covered by pounds of sand. Dr. Ensminger was always there as an objective lens to my writing, stimulating ideas and calling out my wandering stories – but most importantly, identifying when I needed to ask for help. He told me what I needed to hear rather than what I wanted to hear. While he has deflected praise previously, he rescued this experience for me and supported keeping me accountable for its outcome in some of my darker moments. Dr. Kathleen, whom I love that I get to call Doctor, was not only my friend in this program but a guiding light forward. Her status calls, feedback on the experience, unwavering confidence (even when I did not have any), and writing sessions were like having a cheering section on each page. Crossing that proverbial finish line several years prior, she held the "Let's Finish This" sign and represents perseverance, determination, and the art of what is possible. To both Dr. Kathleen and Dr. Ensminger, I will be forever grateful.

Approaching Commencement, I am learning to give myself grace and celebrate a study that I am proud of, representing my caliber of work. I carefully considered this reflection and how I might look at it ten years in the future for employers or other students and researchers. For doctoral students reading this reflection, please do not let this story deter or scare you from experiencing the dissertation process. Quite the opposite, it will test and teach you lessons in ways that you did not know possible or that you even needed. This story represents the experience and human being behind the process – a testament to determination. In the end, this reflection serves as a reminder for me of what is possible when you have the right team, the right approach, the right attitude, and days like March 19, 2013, when someone is willing to take a risk.

My children have been so flexible and understanding while working on this dissertation. They each drew a picture that they wanted to include in "Papa's Big Paper." Included below are their celebratory drawings:

A beautiful unicorn created by our daughter, Harper.

Our daughter, Collins, created a wonderful family portrait.

A happy rainbow created by our son, Emmett.

APPENDIX A

PERMISSION TO USE COPYRIGHT-PROTECTED MATERIALS

The agents included below provided written permission to use their copyright-protected content in the context of this dissertation. This permission does not extend to use outside of this dissertation unless the copyright owner provides express permission. Items that do not require copyright clearance due to expired status, being in the public domain, having a Creative Commons license, materials provided by participants, or District provided materials are not included.

Page	Reference	Agent of Release	Notes
27	Figure 1	Matthew Koehler and Punya Mishra	Copyright release received.
39	Figure 2	Taylor & Francis Group	Email permission received.
43	Figure 4	American Society of Cinematographers	Email permission received.
45	Figure 5	TeachWithMovies.org	Email permission received.
47	Figure 6	UNICEF	Email permission received.
48	Figure 7	UNICEF	Email permission received.
50	Figure 8	Drew Sheneman	Email permission received.
53	Figure 9	Jacob Anderson	Email permission received.
57	Figure 10	IDC	Email permission received.
82	Figure 11	Pearson	Email permission received.
220	Figure 52	McGraw-Hill	Email permission received.

APPENDIX B

IRB APPROVALS TO CONDUCT HUMAN SUBJECTS RESEARCH

LOYOLA UNIVERSITY CHICAGO

OFFICE OF RESEARCH SERVICES

Printed on: Wednesday, May 12, 2021

Dear Adam Smeets,

On Tuesday, May 11, 2021 the Loyola University Chicago Institutional Review Board (IRB) reviewed your application for confirmation of exemption titled "**Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms**". Based on the information you provided, the IRB determined that this human subject research project is exempt from the IRB oversight requirements according to 45 CFR 46.101.

If you make changes to the research procedures that could affect the exempt status of this project, your proposal should be reevaluated by the IRB to confirm it is still exempt from the IRB oversight requirements. To modify this proposal, please submit an Amendment/Project Update Application using the online CAP program. Complete details about the application process and your responsibilities can be found on the Office for Research Services web site.

Please notify the IRB of completion of this research and/or departure from the Loyola University Chicago by submitting a Project Closure Application. In all correspondence with the IRB regarding this project, please refer to IRB project number #3100 or IRB application number #7193.

Best wishes for your research,

Loretta Stalans

Loretta Stalans, Ph.D.
Chairperson, Institutional Review Board
lstalan@luc.edu

The first approval (project 3100, application 7193) from the Institutional Review Board was received without language regarding compensation for participants. Of note, no participants were recruited for the study before submitting a request for an amendment to include compensation for participants.

OFFICE OF
RESEARCH SERVICES

Printed on: Monday, July 5, 2021

Dear Adam Smeets,

On Monday, June 7, 2021 the Loyola University Chicago Institutional Review Board (IRB) reviewed your application for confirmation of exemption titled "**Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms**". Based on the information you provided, the IRB determined that this human subject research project is exempt from the IRB oversight requirements according to 45 CFR 46.101.

If you make changes to the research procedures that could affect the exempt status of this project, your proposal should be reevaluated by the IRB to confirm it is still exempt from the IRB oversight requirements. To modify this proposal, please submit an Amendment/Project Update Application using the online CAP program. Complete details about the application process and your responsibilities can be found on the Office for Research Services web site.

Please notify the IRB of completion of this research and/or departure from the Loyola University Chicago by submitting a Project Closure Application. In all correspondence with the IRB regarding this project, please refer to IRB project number #3100 or IRB application number #7606.

Best wishes for your research,

Loretta Stalans

Loretta Stalans, Ph.D.
Chairperson, Institutional Review Board
lstalan@luc.edu

The second approval (project 3100, application 7606) from the Institutional Review Board was received in response to an amendment that included language for compensating participants. Compensation for research participants was provided for their time and inconvenience, as well as a recruitment incentive. Participants fully completing the study received a $50 American Express gift card. The gift cards were purchased with the researcher’s funds and delivered by email to the participants’ email addresses. Since subjects reserved the right to withdraw their participation from the study, payment to participants was prorated at $10 increments.

APPENDIX C

DISTRICT LETTER OF COOPERATION

Logo Redacted

May 3, 2021

Loyola University Chicago
Institutional Review Board
c/o Research Services
Granada Center, Suite 400
Loyola University Chicago
1032 W. Sheridan Road
Chicago, IL 60660

To Whom It May Concern:

This letter confirms that [redacted] supports, consents, and provides permission for Adam Smeets to conduct a research study in our school district as part of the requirements for his doctoral program. This research study will focus on the changes in teacher pedagogy as a result of 1:1 devices in elementary classrooms.

I understand that Mr. Smeets will contact teachers in one of our elementary schools to recruit up to 12 participating teachers. Mr. Smeets will request participation from the school by reaching out to the building principal. For teachers who volunteer, this study will involve Mr. Smeets conducting three interviews by Zoom, asking for sample lesson plans or other curricular items, and distributing a survey.

I understand that the report on findings will be in aggregate, and no one will be identified by name or other critical distinguishing factor(s). Further, I will not, nor will any other member of the district, receive the names of the participants in the study. De-identified summary findings will be shared with me, the building principal, participating teachers, and any other designated administrators at the conclusion of this study. No student interviews or student materials will be provided as part of this study.

Sincerely,

Signature redacted

Dr. Adrian Talley
Superintendent

cc:
Adam Smeets, Doctoral Candidate
Dr. David Ensminger, Research Chair

Footer Redacted

Information on this page was redacted to ensure the confidential information, including but not limited to phone numbers, addresses, participants, or other identifying information.

APPENDIX D

PRINCIPAL LETTER OF INTRODUCTION

Dear Principal,

Your school is invited to participate in a dissertation research study that seeks to understand how teacher pedagogy is changed in 1:1 elementary classrooms. The secondary goal is to understand changes to student engagement and communication in the 1:1 classroom. For your assurance and support of my outreach, this request was previously reviewed and approved through a signed Letter of Cooperation from the District Superintendent, Dr. Adrian Talley.

The time anticipated for teachers to participate in this study is 3 hours. Teachers that agree to participate in the study will be asked to:

- Complete a Consent to Participate in Research form;
- Participate in three 45 – 60-minute Zoom meetings hosted using a Loyola University Chicago Zoom account;
- Provide at least four example classroom materials, including lesson plans, curriculum plans, or other teacher work products; and
- Complete a brief survey.

In the first interview, I will focus on a teacher's background, instructional practices, and 1:1 devices, reflecting on when devices were first available, along with their recent experiences with 1:1 devices. In the second interview, I will summarize their first conversation to ensure that I have an accurate account of their feedback. We will discuss their perspective using technology and pedagogical decisions in an online environment during the second interview. In the third interview, I will summarize their overall conversation to ensure that I have an accurate account of their feedback.

For teachers that agree to participate in this study, the results would be critical in understanding the changes, experiences, and negotiations of pedagogy that occur not only in your school but potentially for other districts considering 1:1 implementation.

Sincerely,

Adam Smeets
[redacted][1]
asmeets@luc.edu
Mobile: ([redacted]) [redacted]-[redacted]

[1] Information on this page was redacted to ensure the confidential information, including but not limited to phone numbers, addresses, participants, or other identifying information.

APPENDIX E

TEACHER LETTER OF INTRODUCTION AND INVITATION

Dear educator,

You are invited to participate in a dissertation research study that seeks to understand how teacher pedagogy is changed in 1:1 elementary classrooms. The secondary goal is to understand changes in student engagement and communication in a 1:1 classroom. My study request was previously reviewed and approved through a signed Letter of Cooperation from the District Superintendent and your building principal.

The time anticipated for participating in this study is 3 hours. If you agree to participate in the study, you will be asked to:

- Complete a Consent to Participate in Research form included below;
- Participate in three 45 – 60-minute Zoom meetings (hosted using a Loyola University Chicago Zoom account for your confidentiality);
- Provide at least four example classroom materials, including lesson plans, curriculum plans, or other teacher work products; and
- Complete a brief survey.

In the first interview, I will focus on your background, instructional practices, and 1:1 devices, reflecting on when devices were first available, along with your current experiences with 1:1 devices. In the second interview, I will summarize our first conversation to ensure that I have an accurate account of your feedback. We will discuss your perspective using technology and pedagogical decisions in an online environment during the second interview. In the third interview, I will summarize our overall conversation to ensure that I have an accurate account of your feedback.

Should you agree to participate in this study, the results would be critical in understanding the changes, experiences, and negotiations of pedagogy, and curriculum and instruction, that occur not only in your school but potentially for other districts considering 1:1 implementation.

Please click here (or highlight and visit the following URL https://luc.co1.qualtrics.com/jfe/form/SV_fAmy88GvArfV8MUfiC2) to participate in this study.

Sincerely,

Adam Smeets

APPENDIX F

CONSENT TO PARTICIPATE IN RESEARCH

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

CONSENT TO PARTICIPATE IN RESEARCH

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

Introduction

You are being asked to take part in a research study being conducted by Adam Smeets for a dissertation under the supervision of Dr. David Ensminger in the School of Education at Loyola University Chicago.

You are being asked to participate because you are a teacher in a District 204 elementary school that utilizes 1:1 devices as part of classroom instruction. For this study, I am looking to interview up to ten (10) elementary teachers who worked at a District elementary school for the past three years when the 1:1 program started.

Please read this form carefully as it provides information relevant to the study. Please ask any questions you may have before deciding whether to participate in the study.

Purpose

The goal of this research is to understand how teacher pedagogy is changed in 1:1 elementary classrooms. The secondary goal is to understand changes to student engagement and communication in the 1:1 classroom. For reference, the research questions of this study are:

1. How do teachers adjust pedagogical practices in 1:1 classrooms?
    - How do 1:1 devices in classrooms influence teacher pedagogical practices, including planning and design of instruction, selecting content, and delivering instruction, including instructional strategies, assessment strategies, techniques, and procedures?
2. How do teachers describe shifts in their classrooms since implementing a 1:1 program?
    - How do teachers perceive student academic engagement in a 1:1 classroom?
    - How do 1:1 devices in classrooms change communication for and between teachers and students?
    - How do 1:1 devices in classrooms change communication for and between students and students?

Should you agree to participate in this study, you would be providing information that will be critical in understanding the changes, experiences, and negotiations of pedagogy not only in your school but potentially for other districts considering 1:1 implementations.

Procedures

The time anticipated to participate in this study is 3 hours. If you agree to be in the study, you will be asked to:

- Complete this Consent to Participate in Research form;

- Complete this Consent to Participate in Research form;
- Participate in three 45-60 minute Zoom meetings hosted using a Loyola University Chicago Zoom account;
- Provide at least four example classroom materials, including lesson plans, curriculum plans, or other teacher work products; and
- Complete a brief survey.

In the first interview, we will focus on instructional practices and 1:1 devices, reflecting on when devices were first available and current experiences with 1:1 devices. We will discuss your perspective on using technology and pedagogical decisions in an online environment in the second interview. This final interview will cover a few questions to close the first two interviews, followed by an interactive activity. I will then share a summary of our overall conversations to ensure that I have an accurate account of your feedback.

Risks/Benefits

There are no foreseeable risks involved in participating in this research beyond those experienced in everyday life.

There may be no direct benefits to you from participation. However, this research will help advance our understanding of the changes that 1:1 devices can have on pedagogy, student communication, and engagement.

Confidentiality

In completing the questionnaire, confidentiality will be maintained to the degree permitted by the technology used. Your participation in this online survey involves risks similar to a person's everyday use of the Internet. Your responses will remain confidential and assigned a pseudonym and case number. We will only report the findings in aggregate; no one participant will be identified by name. The final report will be used for completing my dissertation defense. De-identified summary findings may be shared with select program administrators after this study.

During the two Zoom meetings, you will not use an Indian Prairie School District 204 login account or a District Zoom meeting link. No interview artifacts or materials will be stored on or transferred to District storage or hardware. All materials stored will be maintained on a laptop dedicated to this project and secured in a locked drawer when not in use.

Transcriptions will be created by making an audio recording of the interview, which will be removed upon verification of transcript accuracy. You will be assigned a pseudonym to protect your identity. After completing my dissertation defense, any transcriptions will be permanently deleted.

Voluntary Participation

There is no cost to participate in this study. Participation in this study is voluntary. If you do not want to be in this study, you do not have to participate. Even if you decide to participate, you are free not to answer any question or to withdraw from participation at any time without penalty.

You will not receive any benefits from, or any rights in any developments, inventions, or other discoveries that may come out of this research. By completing all components of the research study, you will receive a $50 gift card to Starbucks or another retailer as compensation for your time and any inconvenience. Since you can withdraw your participation, payments will be prorated at $10 increments. For example, only completing the questionnaire would result in a $10 gift card. Compensation will be delivered electronically through eGift card delivery.

As a staff member of the school district, your decision to participate or not will have no effect on your current employment or relationship with the District. Further, if you currently are or will be a student of Dr. David Ensminger, your participation will not affect your current relationship as teacher and student or the course.

Contacts and Questions

If you have questions about this research study, please feel free to contact me at asmeets@luc.edu or [redacted] or the faculty sponsor Dr. David Ensminger at densmin@luc.edu or [redacted]

If you have questions about your rights as a research participant, you may contact the Loyola University Office of Research Services at (773) 508-2689 and speak with the Compliance Manager.

By clicking the "Yes" button/text listed below, you are indicating that you have read the information provided above, have had an opportunity to ask questions, and consent to participate in this research study. You will be given a copy of this form to keep for your records.

✓ Yes, I consent to participate in this research study.

No, I do not consent to participate in this research study.

Continue >>

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Your participant ID is 1981.

Before submitting your response, please write down your participant ID, as you will need this when completing the survey and providing future materials. This will connect your responses to your pseudonym in support of your confidentiality.

Please enter your first and last name.

Your first and last name will NOT be used in this study. You will be assigned a participant number and pseudonym.

Please enter your preferred email address for communications related to this study.

This can be a personal or work email address - a personal email address is recommended.

← Previous Page | Continue >>

Survey Completion

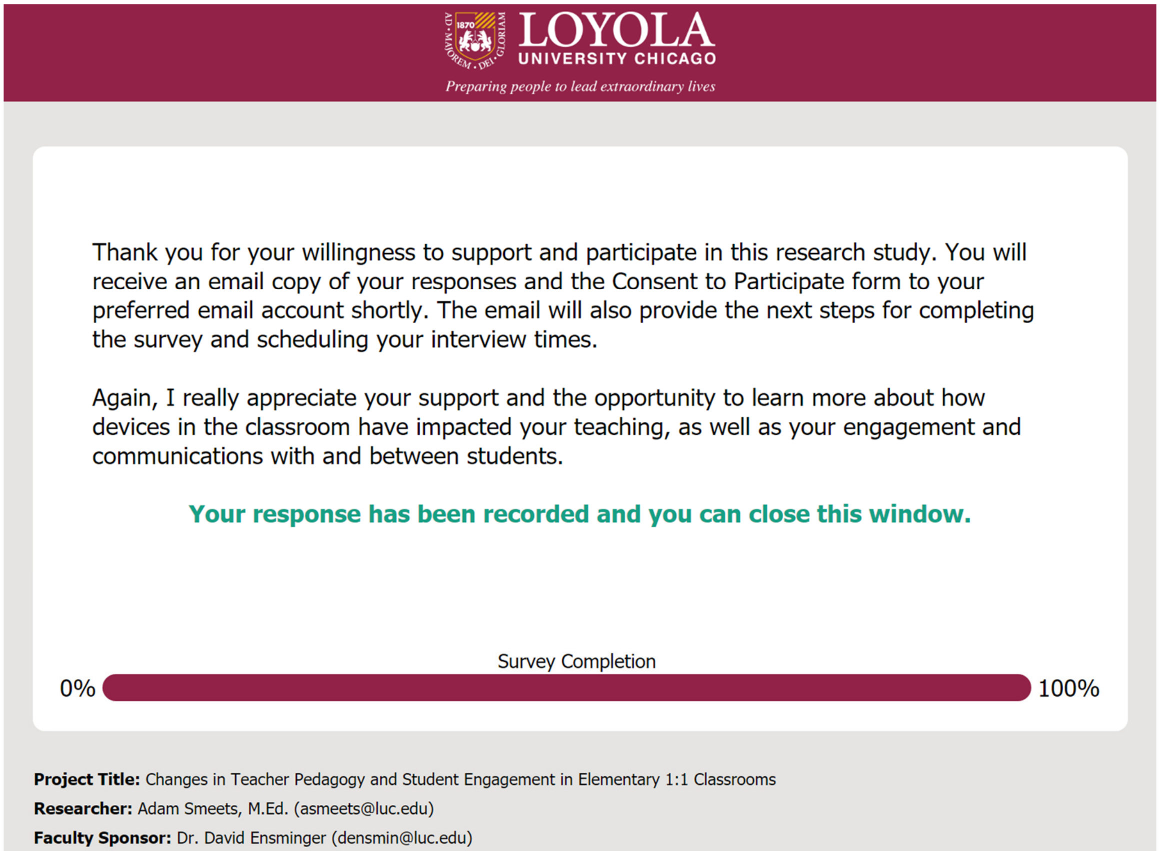
0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

Participants recorded their "Participant ID" from the consent, which was used as a unique identifier instead of first and last name across the study.



LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Thank you for your willingness to support and participate in this research study. You will receive an email copy of your responses and the Consent to Participate form to your preferred email account shortly. The email will also provide the next steps for completing the survey and scheduling your interview times.

Again, I really appreciate your support and the opportunity to learn more about how devices in the classroom have impacted your teaching, as well as your engagement and communications with and between students.

Your response has been recorded and you can close this window.

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

Upon completing the Consent to Participate in Research, the participant reviewed the summary on the response page, including a closing note of appreciation. This screen provided access to a PDF document containing the completed Consent to Participate in Survey Research.

APPENDIX G

CONSENT TO PARTICIPATE IN INTERVIEW RESEARCH

CONSENT TO PARTICIPATE IN INTERVIEW RESEARCH

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

Introduction

You are being asked to take part in a research study being conducted by Adam Smeets for a dissertation under the supervision of Dr. David Ensminger in the School of Education at Loyola University Chicago.

You are being asked to participate because you are a teacher in a District 204 elementary school that utilizes 1:1 devices as part of classroom instruction. For this study, I am looking to interview up to ten (10) elementary teachers who worked at a District elementary school for the past three years when the 1:1 program started.

Please read this form carefully as it provides information relevant to the study. Please ask any questions you may have before deciding whether to participate in the study.

Purpose

The goal of this research is to understand how teacher pedagogy is changed in 1:1 elementary classrooms. The secondary goal is to understand changes to student engagement and communication in the 1:1 classroom. For reference, the research questions of this study are:

1. How do teachers adjust pedagogical practices in 1:1 classrooms?
    - How do 1:1 devices in classrooms influence teacher pedagogical practices, including planning and design of instruction, selecting content, and delivering instruction, including instructional strategies, assessment strategies, techniques, and procedures?
2. How do teachers describe shifts in their classrooms since implementing a 1:1 program?
    - How do teachers perceive student academic engagement in a 1:1 classroom?
    - How do 1:1 devices in classrooms change communication for and between teachers and students?

- How do 1:1 devices in classrooms change communication for and between students and students?

Should you agree to participate in this study, you would be providing information that will be critical in understanding the changes, experiences, and negotiations of pedagogy not only in your school but potentially for other districts considering 1:1 implementations.

Procedures

The time anticipated to participate in this interview is 45 – 60 minutes. If you agree to be in the study, you will be asked to verbally consent to participate in interview research.

There are a total of three interviews as part of this study. In the first interview, we will focus on instructional practices and 1:1 devices, reflecting on when devices were first available and current experiences with 1:1 devices. In the second interview, we will discuss your perspective on using technology and pedagogical decisions in an online environment. This final interview will cover a few questions to close the first two interviews, followed by an interactive activity. I will then share a summary of our overall conversations to ensure an accurate account of your feedback.

Risks/Benefits

There are no foreseeable risks involved in participating in this research beyond those experienced in everyday life.

There may be no direct benefits to you from participation. However, this research will help advance our understanding of the changes that 1:1 devices can have on pedagogy, student communication, and engagement.

Confidentiality

In completing the questionnaire, confidentiality will be maintained to the degree permitted by the technology used. Your participation in this online survey involves risks similar to a person's everyday use of the Internet. Your responses will remain confidential and assigned a pseudonym and case number. We will only report the findings in aggregate; no one participant will be identified by name. The final report will be used for completing my dissertation defense. De-identified summary findings may be shared with select program administrators after this study.

You will not use a Bear Rapids School District login account or a District Zoom meeting link during the three Zoom meetings. No interview artifacts or materials will be stored on or transferred to District storage or hardware. All materials stored will be maintained on a laptop dedicated to this project and secured in a locked drawer when not in use.

Transcriptions will be created by making an audio recording of the interview, which will be removed upon verification of transcript accuracy. You will be assigned a pseudonym to protect your identity. After completing my dissertation defense, any transcriptions will be permanently deleted.

Voluntary Participation

There is no cost to participate in this study. Participation in this study is voluntary. If you do not want to be in this study, you do not have to participate. Even if you decide to participate, you are free not to answer any question or to withdraw from participation at any time without penalty.

You will not receive any benefits from or any rights in any developments, inventions, or other discoveries that may come out of this research. By completing all components of the research study, you will receive a $50 gift card to Starbucks or another retailer as compensation for your time and any inconvenience. Since you can withdraw your participation, payments will be prorated at $10 increments. For example, only completing the questionnaire would result in a $10 gift card. Compensation will be delivered electronically through eGift card delivery.

As a staff member of the school district, your decision to participate or not will have no effect on your current employment or relationship with the District. Further, if you currently are or will be a student of Dr. David Ensminger, your participation will not affect your current relationship as teacher and student or the course.

Contacts and Questions

If you have questions about this research study, please feel free to contact me at asmeets@luc.edu or [redacted]-[redacted]-[redacted][1] or the faculty sponsor Dr. David Ensminger at densmin@luc.edu or [redacted]-[redacted]-[redacted].

If you have questions about your rights as a research participant, you may contact the Loyola University Office of Research Services at (773) 508-2689 and speak with the Compliance Manager.

Statement of Consent

---

[1] Information on this page was redacted to ensure the confidential information, including but not limited to phone numbers, addresses, participants, or other identifying information.

Please respond with a “Yes, I agree to participate” after I read the following statement.

By stating, “Yes, I agree to participate,” you indicate that you have reviewed the information provided above, have had an opportunity to ask questions, and agree to participate in this interview. You will be given a copy of this form to keep for your records.

APPENDIX H

CONSENT TO PARTICIPATE IN RESEARCH AND SURVEY

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Welcome back! Thank you for being an integral part of this study - it is my belief that this will have transformational opportunities for your school, other educators, and the education community. I know that you have many things on your plate at this time of year; however, your feedback and insights are **invaluable**.

To set the stage, on the next page you will see a "Consent to Participate in Survey Research." This is the same consent you reviewed previously, except that it is asking for your consent to complete the survey provided. It is best if you can complete this survey in one sitting (~15 minutes); however, you can save your progress and return later to complete the survey later.

There are <u>no</u> correct or incorrect answers. Please answer honestly and how you feel about each question asked. Again, your individual responses are not being shared with your school, other teachers, district staff or members of administration. As a reminder, all data is being stored securely and under the guidance of Loyola University Chicago.

Again, thank you for being part of this study! Please click, "Next Page" to continue.

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

CONSENT TO PARTICIPATE IN SURVEY RESEARCH

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

Introduction

You are being asked to take part in a research study being conducted by Adam Smeets for a dissertation under the supervision of Dr. David Ensminger in the School of Education at Loyola University Chicago.

You are being asked to participate because you are a teacher in a District 204 elementary school that utilizes 1:1 devices as part of classroom instruction. For this study, I am looking to interview up to ten (10) elementary teachers who worked at a District elementary school for the past three years when the 1:1 program started.

Please read this form carefully as it provides information relevant to the study. Please ask any questions you may have before deciding whether to participate in the study.

Purpose

The goal of this research is to understand how teacher pedagogy is changed in 1:1 elementary classrooms. The secondary goal is to understand changes to student engagement and communication in the 1:1 classroom. For reference, the research questions of this study are:

1. How do teachers adjust pedagogical practices in 1:1 classrooms?
    - How do 1:1 devices in classrooms influence teacher pedagogical practices, including planning and design of instruction, selecting content, and delivering instruction, including instructional strategies, assessment strategies, techniques, and procedures?
2. How do teachers describe shifts in their classrooms since implementing a 1:1 program?
    - How do teachers perceive student academic engagement in a 1:1 classroom?
    - How do 1:1 devices in classrooms change communication for and between teachers and students?
    - How do 1:1 devices in classrooms change communication for and between students and students?

Should you agree to participate in this study, you would be providing information that will be critical in understanding the changes, experiences, and negotiations of pedagogy not only in your school but potentially for other districts considering 1:1 implementations.

Procedures

The time anticipated to complete this survey is 15 minutes. You will review a series of questions and provide the answer that best represents your opinion.

Risks/Benefits

There are no foreseeable risks involved in participating in this research beyond those experienced in everyday life.

There may be no direct benefits to you from participation. However, this research will help advance our understanding of the changes that 1:1 devices can have on pedagogy, student communication, and engagement.

Confidentiality

In completing the questionnaire, confidentiality will be maintained to the degree permitted by the technology used. Your participation in this online survey involves risks similar to a person's everyday use of the Internet. Your responses will remain confidential and assigned a pseudonym and case number. We will only report the findings in aggregate; no one participant will be identified by name. The final report will be used for completing my dissertation defense. De-identified summary findings may be shared with select program administrators after this study.

No materials will be stored on or transferred to District storage or hardware. All materials stored will be maintained on a laptop dedicated to this project and secured in a locked drawer when not in use.

Voluntary Participation

There is no cost to participate in this study. Participation in this study is voluntary. If you do not want to be in this study, you do not have to participate. Even if you decide to participate, you are free not to answer any question or to withdraw from participation at any time without penalty.

You will not receive any benefits from, or any rights in any developments, inventions, or other discoveries that may come out of this research. By completing all components of the research study, you will receive a $50 gift card to Starbucks or another retailer as compensation for your time and any inconvenience. Since you can withdraw your participation, payments will be prorated at $10 increments. For example, only completing the questionnaire would result in a $10 gift card. Compensation will be delivered electronically through eGift card delivery.

As a staff member of the school district, your decision to participate or not will have no effect on your current employment or relationship with the District. Further, if you currently are or will be a student of Dr. David Ensminger, your participation will not affect your current relationship as teacher and student or the course.

Contacts and Questions

If you have questions about this research study, please feel free to contact me at asmeets@luc.edu or [redacted] or the faculty sponsor Dr. David Ensminger at densmin@luc.edu or [redacted].

If you have questions about your rights as a research participant, you may contact the Loyola University Office of Research Services at (773) 508-2689 and speak with the Compliance Manager.

Statement of Consent

By clicking the "I agree" button below, you are indicating that you have read the information provided above, have had an opportunity to ask questions, and agree to complete the following survey and participate in this research study. You will be given a copy of this form to keep for your records.

✓ Yes, I consent to participate in this survey as part of the research study.

No, I do not consent to participate in this survey as part of the research study.

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms
Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)
Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Please enter your participant ID.
Your participant ID was included on your email communication when signing up for the study.

2437

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms
Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)
Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO
Preparing people to lead extraordinary lives

Section A

How many years of experience do you have serving as a teacher in a District 204 school?
Please enter a whole number.

14

How many years of experience do you have serving as a teacher at your current school?
Please enter a whole number.

10

What grade level(s) do you teach? *Check all that apply.*

Preschool (PK)

Kindergarten

1st Grade

2nd Grade

3rd Grade

4th Grade

5th Grade

What content area(s) do you teach?

English, Mathematics, Social Studies

What is your average class size?

24

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

What technology resources are available in your classroom?

Projector, computer, smartboard

What is your age?

Please use the age ranges identified below.

Under 21	22-28	29-35	36-42	43-49	50-56	57-63	64-70	71-77	78-84

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

To which gender do you most identify?

Female

Male

Transgender Female

Transgender Male

Gender Variant / Non-Conforming

Prefer Not to Answer

Not Listed
Please use the text box below to specify the gender you most identify.

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms
Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)
Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Section B

Thinking about your classroom **before** COVID-19 school closures and remote learning, please respond to the following statements in terms of your uses of technology resources in the classroom using the scale provided.

Our classroom's digital tools and resources are used exclusively for classroom management and professional communication (e.g., accessing the Internet, communicating with colleagues or parents, grading student work, and/or planning instructional activities).

A few times a week

- ○ Daily
- ● A few times a week
- ○ At least once a week
- ○ A few times a month
- ○ At least once a month
- ○ At least once a quarter
- ○ At least once a year
- ○ Never

My students and I use the digital tools and resources (e.g., interactive whiteboard, digital student response system, online tutorials) primarily to supplement the curriculum and reinforce specific content standards.

I model for my students the safe and legal use of digital tools and resources while I am delivering content and/or reinforcing their understanding of pertinent concepts using multimedia resources (e.g., PowerPoint, Keynote), web-based tools (e.g., Google Presentations), or an interactive whiteboard.

I use the digital tools and resources in my classroom to promote student creativity and innovative thinking (e.g., thinking outside the box, exploring multiple solutions).

I engage students in learning activities that require them to analyze information, think creatively, make predictions, and/or draw conclusions using the digital tools and resources (e.g., Inspiration/Kidspiration, Excel, InspireData) available in my classroom.

I assign web-based projects (e.g., web collaborations, WebQuests) to my students that emphasize complex thinking strategies (e.g., problem-solving, decision-making, experimental inquiry) aligned to the content standards.

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms
Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)
Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Section B

Thinking about your classroom **before** COVID-19 school closures and remote learning, please respond to the following statements in terms of your uses of technology resources in the classroom using the scale provided.

My students use the classroom digital tools and resources to engage in relevant, challenging, self-directed learning experiences that address the content standards.

At least once a week

- ○ Daily
- ○ A few times a week
- ● At least once a week
- ○ A few times a month
- ○ At least once a month
- ○ At least once a quarter
- ○ At least once a year
- ○ Never

Problem-based learning occurs in my classroom because it allows students to use the classroom digital tools and resources for higher-order thinking (e.g., analyzing, evaluating, creating) and personal inquiry.

My students apply their classroom content learning to real-world problems within the local or global community using the digital tools and resources at our disposal.

My students propose innovative ways to use our school's advanced digital tools (e.g., digital media authoring tools, graphics programs, probeware with GPS systems) and resources (e.g., publishing software, media production software, advanced web design software) to address challenges/issues affecting their local and global communities.

My students use all forms of the most advanced digital tools (e.g., digital media authoring tools, graphics programs, probeware with GPS systems, handheld devices) and resources (e.g., publishing software, media production software, advanced web design software) to pursue collaborative problem-solving opportunities surrounding issues of personal and/or social importance.

My students identify important real-world issues or problems (e.g., environmental pollution, elections, health awareness), then use collaborative tools and human resources beyond the school building (e.g., partnerships with business professionals, community groups) to solve them.

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms
Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)
Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Section C

The purpose of this section is to gather information about combining technology, pedagogy and content knowledge in the teaching and learning process. For each item, choose **only one option** (Strongly Disagree, Disagree, Slightly Disagree, Neither Agree or Disagree, Slightly Agree, Agree, Strongly Agree) that best describes you. Please answer all of the questions and if you are uncertain of or neutral about your response you may always select "Undecided."

I have the technical skills to use computers effectively.

Slightly Agree

- ○ Strongly Disagree
- ○ Disagree
- ○ Slightly Disagree
- ○ Neither Agree or Disagree
- ● Slightly Agree
- ○ Agree
- ○ Strongly Agree

I can learn technology easily.

I know how to solve my own technical problems when using technology.

I keep up with important new technologies.

I am able to create web pages.

I am able to use social media (e.g. Blog, Wiki, Facebook).

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Section C, Continued

The purpose of this section is to gather information about combining technology, pedagogy and content knowledge in the teaching and learning process. For each item, choose **only one option** (Strongly Disagree, Disagree, Slightly Disagree, Neither Agree or Disagree, Slightly Agree, Agree, Strongly Agree) that best describes you. Please answer all of the questions and if you are uncertain of or neutral about your response you may always select "Undecided."

I am able to stretch my students' thinking by creating challenging tasks for them.

Slightly Agree

- ○ Strongly Disagree
- ○ Disagree
- ○ Slightly Disagree
- ○ Neither Agree or Disagree
- ● Slightly Agree
- ○ Agree
- ○ Strongly Agree

I am able to guide my students to adopt appropriate learning strategies.

I am able to help my students to monitor their own learning.

I am able to help my students to reflect on their learning strategies.

I am able to plan group activities for my students.

I am able to guide my students to discuss effectively during group work.

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms
Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)
Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA
UNIVERSITY CHICAGO
Preparing people to lead extraordinary lives

Think about one content area/class/subject that you provide direct instruction for. Please enter one content area/class/subject in the field below.

Social Studies

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms
Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)
Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Section C, Continued

The purpose of this section is to gather information about combining technology, pedagogy and content knowledge in the teaching and learning process. For each item, choose only one option (Strongly Disagree, Disagree, Slightly Disagree, Neither Agree or Disagree, Slightly Agree, Agree, Strongly Agree) that best describes you. Please answer all of the questions and if you are uncertain of or neutral about your response you may always select "Undecided."

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree or Disagree	Slightly Agree	Agree	Strongly Agree
I have sufficient knowledge about the content area of Social Studies.	○	○	○	○	○	●	○
I can think about the content of my class featuring Social Studies like a subject matter expert.	○	○	○	○	○	●	○
I am able to develop a deeper understanding of the content in my Social Studies class.	○	○	○	○	○	○	●

← Previous Page   Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA
UNIVERSITY CHICAGO
Preparing people to lead extraordinary lives

Think about another content area/class/subject that you provide direct instruction for. Please enter one content area/class/subject area in the field below.

Mathematics

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms
Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)
Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA
UNIVERSITY CHICAGO
Preparing people to lead extraordinary lives

Section C, Continued

The purpose of this section is to gather information about combining technology, pedagogy and content knowledge in the teaching and learning process. Think about one of the content/subject areas that you teach. For each item, choose **only one option** (Strongly Disagree, Disagree, Slightly Disagree, Neither Agree or Disagree, Slightly Agree, Agree, Strongly Agree) that best describes you. Please answer all of the questions and if you are uncertain of or neutral about your response you may always select "Undecided."

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree or Disagree	Slightly Agree	Agree	Strongly Agree
I have sufficient knowledge about the content area of Mathematics.	○	○	○	○	○	●	○
I can think about the content of my class featuring Mathematics like a subject matter expert.	○	○	○	○	○	○	●
I am able to develop a deeper understanding of the content of my Mathematics class.	○	○	○	○	○	●	○

← Previous Page Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms
Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)
Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Section C, Continued

The purpose of this section is to gather information about combining technology, pedagogy and content knowledge in the teaching and learning process. For each item, choose **only one option** (Strongly Disagree, Disagree, Slightly Disagree, Neither Agree or Disagree, Slightly Agree, Agree, Strongly Agree) that best describes you. Please answer all of the questions and if you are uncertain of or neutral about your response you may always select "Undecided."

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree or Disagree	Slightly Agree	Agree	Strongly Agree
I am able to use technology to introduce my students to real-world scenarios.	○	○	○	○	○	●	○
I am able to facilitate my students to use technology to find more information on their own.	○	○	○	○	●	○	○
I am able to facilitate my students to use technology to plan and monitor their own learning.	○	○	○	○	○	●	○
I am able to facilitate my students to use technology to construct different forms of knowledge representation.	○	○	○	○	○	●	○

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Section C, Continued

The purpose of this section is to gather information about combining technology, pedagogy and content knowledge in the teaching and learning process. For each item, choose **only one option** (Strongly Disagree, Disagree, Slightly Disagree, Neither Agree or Disagree, Slightly Agree, Agree, Strongly Agree) that best describes you. Please answer all of the questions and if you are uncertain of or neutral about your response you may always select "Undecided."

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree or Disagree	Slightly Agree	Agree	Strongly Agree
I know about the technologies that I have to use for the research of content in my Social Studies classes.	○	○	○	○	○	●	○
I can use appropriate technologies (e.g. multimedia resources, simulation) to represent the content in my Social Studies classes.	○	○	○	○	●	○	○
I know about the technologies that I have to use for the research of content in my Mathematics classes.	○	○	○	●	○	○	○
I can use appropriate technologies (e.g. multimedia resources, simulation) to represent the content in my Mathematics classes.	○	○	○	○	●	○	○

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO
Preparing people to lead extraordinary lives

Section C, Continued

The purpose of this section is to gather information about combining technology, pedagogy and content knowledge in the teaching and learning process. For each item, choose **only one option** (Strongly Disagree, Disagree, Slightly Disagree, Neither Agree or Disagree, Slightly Agree, Agree, Strongly Agree) that best describes you. Please answer all of the questions and if you are uncertain of or neutral about your response you may always select "Undecided."

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree or Disagree	Slightly Agree	Agree	Strongly Agree
Without using technology, I know how to select effective teaching approaches to guide student thinking and learning in my Social Studies classes.	○	○	○	○	○	●	○
Without using technology, I can help my students to understand the content knowledge of my Social Studies classes in various ways.	○	○	○	○	●	○	○
Without using technology, I know how to select effective teaching approaches to guide student thinking and learning in my Mathematics classes.	○	○	○	○	○	●	○
Without using technology, I can help my students to understand the content knowledge of my Mathematics classes in various ways.	○	○	○	○	○	○	●

← Previous Page　　Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms
Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)
Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Section C, Continued

The purpose of this section is to gather information about combining technology, pedagogy and content knowledge in the teaching and learning process. For each item, choose **only one option** (Strongly Disagree, Disagree, Slightly Disagree, Neither Agree or Disagree, Slightly Agree, Agree, Strongly Agree) that best describes you. Please answer all of the questions and if you are uncertain of or neutral about your response you may always select "Undecided."

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree or Disagree	Slightly Agree	Agree	Strongly Agree
I can teach lessons that appropriately combine my Social Studies classes, technologies and teaching approaches.	○	○	○	○	○	○	●
I can teach lessons that appropriately combine my Mathematics classes, technologies and teaching approaches.	○	○	○	○	○	●	○
I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.	○	○	○	○	○	○	●
I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.	○	○	○	○	○	○	●
I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.	○	○	○	○	○	●	○

← Previous Page Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Section C, Continued

The purpose of this section is to gather information about combining technology, pedagogy and content knowledge in the teaching and learning process. For each item, choose **only one option** (No Impact, Very Little Impact, Somewhat Impactful, Quite a bit of Impact, A Great Deal of Impact) that **best** describes the extent to which various barriers impact your students' use of technology.

	No Impact (1)	Very Little Impact (2)	Somewhat Impactful (3)	Quite a Bit of Impact (4)	A Great Deal of Impact (5)
Other teachers attitudes and beliefs	○	○	○	●	○
Technology support	○	○	○	○	●
State standards	○	○	○	●	○
Money	○	○	○	○	●
Technology access	○	○	○	●	○

	No Impact (1)	Very Little Impact (2)	Somewhat Impactful (3)	Quite a Bit of Impact (4)	A Great Deal of Impact (5)
Time	○	○	○	●	○
Assessments (standardized, state)	○	○	○	○	●
Technology problems	○	○	○	●	○
Institution (administration)	○	○	○	●	○
Subject culture	○	○	○	○	●

	No Impact (1)	Very Little Impact (2)	Somewhat Impactful (3)	Quite a Bit of Impact (4)	A Great Deal of Impact (5)
Knowledge and skills (students)	○	○	○	○	●
Institution (community)	○	○	○	●	○
Your own knowledge and skills	○	○	○	○	●
Institution (parents)	○	○	○	●	○
Your own attitudes and beliefs	○	○	○	●	○

← Previous Page

Next Page →

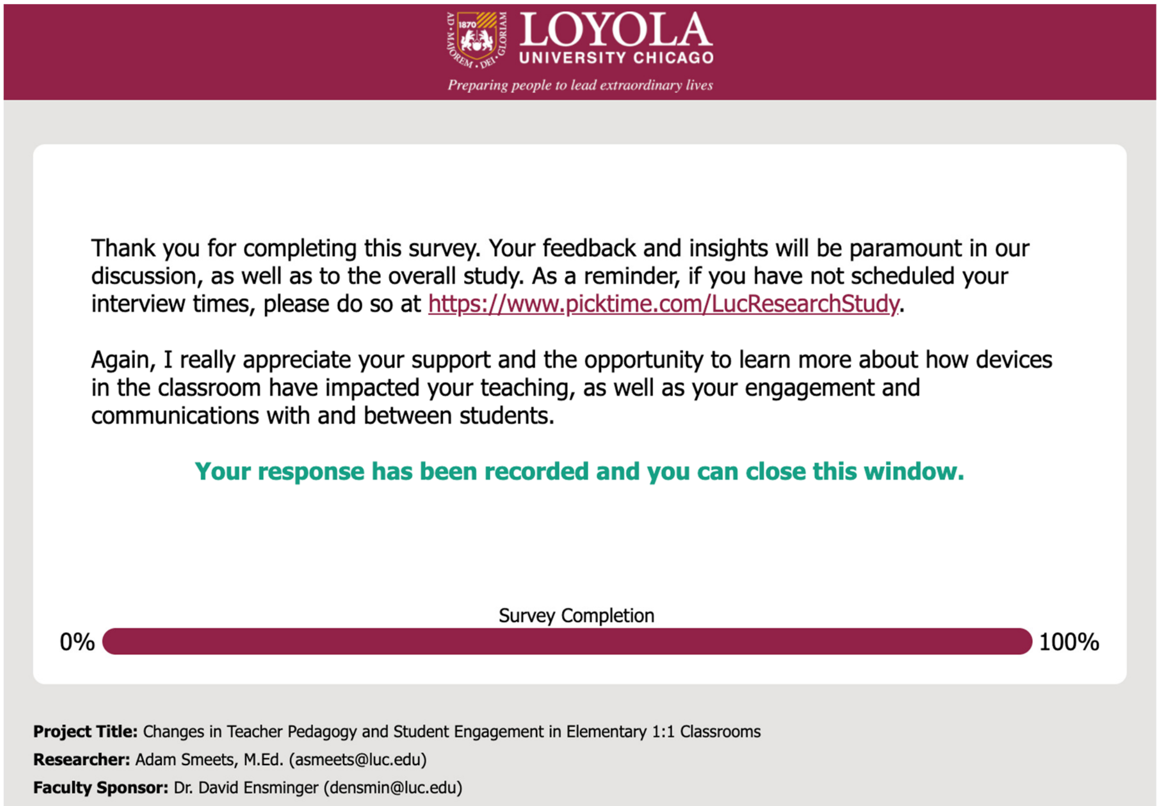
Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)


LOYOLA
UNIVERSITY CHICAGO
Preparing people to lead extraordinary lives

Thank you for completing this survey. Your feedback and insights will be paramount in our discussion, as well as to the overall study. As a reminder, if you have not scheduled your interview times, please do so at https://www.picktime.com/LucResearchStudy.

Again, I really appreciate your support and the opportunity to learn more about how devices in the classroom have impacted your teaching, as well as your engagement and communications with and between students.

Your response has been recorded and you can close this window.

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms
Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)
Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

Upon completing the survey, the participant reviewed the summary on the response page, including a closing note of appreciation. This screen provided access to a PDF document containing the completed *Consent to Participate in Survey Research* and their responses. After closing this page, participants did not have access to view their responses again.

APPENDIX I

INTERVIEW PROTOCOLS

Interview One

Introduction *(5 Minutes)*

My name is Adam Smeets, and I am a Doctoral student at Loyola University Chicago's School of Education. I am conducting this interview as part of the requirements for my dissertation in the Curriculum and Instruction program. The purpose of this research is to understand how teacher pedagogy is changed in 1:1 elementary classrooms. The secondary goal is to understand changes to student engagement and communication in the 1:1 classroom.

We will focus on instructional practices and 1:1 devices in this first interview, reflecting on when devices were first available and your current experiences with 1:1 devices.

Your responses will remain confidential and assigned a pseudonym and case number. I will only report the findings in aggregate; you will not be identified by name. Please feel free to participate and share your thoughts openly. I will also be recording and taking notes of our conversation to help develop an accurate report later. The entire interview should take about 45 minutes.

I want to note that I will not ask you to report your name or any other personally identifiable information once I have turned on the recording to keep your identity confidential. Any names or identifying information will be redacted if mentioned. Before this interview, you provided your years of service to ensure that you met the participation requirements for the study.

If you do not have any questions at this time, I will begin the recording and present the informed consent for your review. In it, you will find much of the same information I have already discussed with you and additional details regarding how any findings will be used. I will give you a few minutes to review this document. As you do so, please let me know if you have any questions.

ⓘ [BEGIN RECORDING] ⓘ

Good {morning | afternoon | evening}. Today is {date} at {time}, and this is the first interview with participant {Participant ID} for the research study being conducted by Adam Smeets. Thank you for being here today. As a reminder, this interview is being recorded without video. You previously reviewed and completed the Informed Consent document for participating in the study. I am currently displaying the Informed Consent again as it relates to the interview.

ⓘ [START SCREEN SHARE WITH INFORMED CONSENT DISPLAYED] ⓘ

Please re-review the information. You have the choice to end the interview at any time and withdraw from the study. If you would like to proceed with volunteering and the interview, please verbally reply that you agree to participate.

[AFTER VERBAL AGREEMENT, CONTINUE THE INTERVIEW]

Retrospective/Historical Perspective

1. Let's begin first with you introducing your teaching background. For example, how many years have you been teaching? What grades?
2. What are your experiences with technology in teaching and student learning in your classroom?

Training and Professional Development

3. Thinking back before the Chromebook program was introduced at the elementary level, can you describe your specific skills working with technology in the classroom?
4. Share a story about your experiences with the training provided by the District or your school?
5. After participating in that training, how did it impact your use of technology in planning or teaching?
6. What training do you wish were available?
7. In what ways did you seek out training on your own?
8. What future support would you need to continue technology integration in planning and delivery?

Adjusting Pedagogical Practices in 1:1 Classrooms

9. When considering using student Chromebooks or classroom technologies that support 1:1 in your lesson planning, what are the significant factors influencing your decision-making process?
10. How would you describe the frequency of your students using Chromebooks in class?
11. Describe your process (time, materials, planning) when you successfully integrated technology into your lesson plan.
12. Tell me a story about a time when you had difficulty integrating technology into your lesson plan.
13. Thinking of your practice as a teacher, what changes/adaptations/adjustments have you made now that Chromebooks are part of teaching and learning in your classroom?

Student Engagement and Communication

14. What benefits or behaviors have you observed for your students when using Chromebooks in the classroom?
15. What limitations or behaviors have you observed for your students when using Chromebooks in the classroom?

Closing

Thank you for taking this time to speak with me about your experiences at your school. After concluding this interview, I will begin transcribing the interview and working on a summary to share with you before our third closeout interview. Once provided via a confidential OneDrive share, please review the document as I want to ensure that I have accurately captured your great insights and experiences. Again, your responses will remain confidential and assigned a pseudonym and case number. I will only report the findings in aggregate; you will not be identified by name. If you think of additional information to share after this interview, please reach out to me at asmeets@luc.edu. Again, thank you!

Research Question Alignment

Research question	Correlating interview question
How do teachers adjust pedagogical practices in 1:1 classrooms?	2, 6, 7, 9, 13
How do 1:1 devices in classrooms influence teacher pedagogical practices, including planning and design of instruction, selecting content, and delivering instruction, including instructional strategies, assessment strategies, techniques, and procedures?	3, 5, 8, 11, 12
How do teachers describe shifts in their classrooms since implementing a 1:1 program?	
How do teachers perceive student academic engagement in a 1:1 classroom?	14, 10, 15
How do 1:1 devices in classrooms change communication for and between teachers and students?	
How do 1:1 devices in classrooms change communication for and between students?	

Interview Two

Introduction *(5 Minutes)*

Hello, and thank you again for meeting with me to discuss how teacher pedagogy is changed in 1:1 elementary classrooms. The secondary goal is to understand changes to student engagement and communication in the 1:1 classroom.

In your first interview, we focused on instructional practices and 1:1 devices, reflecting on when devices were first available and your current experiences with 1:1 devices. In today's second interview, we will discuss your perspective on using technology and pedagogical decisions in an online environment.

As a reminder, your responses will remain confidential and assigned a pseudonym and case number. I will only report the findings in aggregate; you will not be identified by name. The final report will be used for completing my dissertation defense. Please feel free to participate and share your thoughts openly. I will also be recording and taking notes of our conversation to help develop an accurate report later. The entire interview should take about 45 minutes.

I want to note that I will not ask you to report your name or any other personally identifiable information once I have turned on the recording to keep your identity confidential. Any names or identifying information will be redacted if mentioned.

If you do not have any questions at this time, I will begin the recording and present the informed consent for your review. In it, you will find much of the same information I have already discussed with you and additional details regarding how any findings will be used. I will give you a few minutes to review this document. As you do so, please let me know if you have any questions.

ⓘ [BEGIN RECORDING] ⓘ

Good {morning | afternoon | evening}. Today is {date} at {time}, and this is the second interview with participant {Participant ID} for the research study being conducted by Adam Smeets. Thank you for being here today. As a reminder, this interview is being recorded without video. You previously reviewed and completed the Informed Consent document for participating in the study. I am currently displaying the Informed Consent again as it relates to the interview.

ⓘ [START SCREEN SHARE WITH INFORMED CONSENT DISPLAYED] ⓘ

Please re-review the information. You have the choice to end the interview at any time and withdraw from the study. If you would like to proceed with volunteering and the interview, please verbally reply that you agree to participate.

[AFTER VERBAL AGREEMENT, CONTINUE THE INTERVIEW]

Classroom Technology

1. What data do you consider in determining student success in your 1:1 classroom?
2. When selecting an online resource for class, what do you consider?
   2a. How do you share these insights or tools with other teachers?
3. Describe your perception of the Chromebook program in your school?
   3a. What changes would you recommend?
4. What does digital citizenship mean for your students?
5. Using your own words, can you describe the goal of the Chromebook program in the district?
6. How do you provide equity for students in your classroom?
7. Tell me a story about when you needed to change a lesson or assessment to accommodate students who experienced difficulty using 1:1 devices in your classroom.
8. What barriers have you and your students experienced with students using Chromebooks or other technologies in the classroom?

Remote Teaching

9. How have your teaching practices changed since the District moved to e-Learning instead of emergency days, for example, using remote learning during COVID-19 school closures?
   9a. What is irreplaceable about the physical classroom?
   9b. Your students' learning?
   9c. What changes have been the most challenging?
      i. Have you overcome these? How?
   9d. What changes have been the most rewarding?
10. Describe a recent lesson success in remote learning using technology.
11. Describe how you build community in remote learning using student Chromebooks?

Closing

12. Tell me a story about using the Chromebooks in your classroom. What situation stands out in your experience?

13. Are there any further information or areas that we have not covered on these topics to benefit this study?

Again, thank you for taking this time to speak with me about your experiences. After concluding this interview, I will begin transcribing the interview and sharing a summary with you. I will again share a copy with you to ensure that I have accurately captured your great insights and experiences. Your responses will remain confidential and assigned a pseudonym and case number. I will only report the findings in aggregate; you will not be identified by name.

I greatly appreciate your support, time, and commitment as I complete my dissertation research and begin the process of compiling the findings and results. If you think of additional information to share after this interview, please reach out to me at asmeets@luc.edu. Again, thank you!

Research Question Alignment

Research question	Correlating interview question
How do teachers adjust pedagogical practices in 1:1 classrooms?	8, 9
How do 1:1 devices in classrooms influence teacher pedagogical practices, including planning and design of instruction, selecting content, and delivering instruction, including instructional strategies, assessment strategies, techniques, and procedures?	1, 2, 2a, 7, 10
How do teachers describe shifts in their classrooms since implementing a 1:1 program?	4, 6, 8, 9a, 12
How do teachers perceive student academic engagement in a 1:1 classroom?	9b, 9c, 9d
How do 1:1 devices in classrooms change communication for and between teachers and students?	11
How do 1:1 devices in classrooms change communication for and between students?	11

Interview Three

Introduction *(5 Minutes)*

Hello, and thank you again for meeting with me to discuss how teacher pedagogy is changed in 1:1 elementary classrooms. The secondary goal is to understand changes to student engagement and communication in the 1:1 classroom.

In your first interview, we focused on instructional practices and 1:1 devices, reflecting on when devices were first available and your current experiences with 1:1 devices. We discussed your perspective on using technology and pedagogical decisions in an online environment in the second interview. This final interview will cover a few questions to close our first two interviews, followed by an interactive activity.

As a reminder, your responses will remain confidential and assigned a pseudonym and case number. I will only report the findings in aggregate; you will not be identified by name. The final report will be used for completing my dissertation defense. Please feel free to participate and share your thoughts openly. I will also be recording and taking notes of our conversation to help develop an accurate report later. The entire interview should take about 30 minutes.

I want to note that I will not ask you to report your name or any other personally identifiable information once I have turned on the recording to keep your identity confidential. Any names or identifying information will be redacted if mentioned.

If you do not have any questions at this time, I will begin the recording and present the informed consent for your review. In it, you will find much of the same information I have already discussed with you and additional details regarding how any findings will be used. I will give you a few minutes to review this document. As you do so, please let me know if you have any questions.

ⓘ [BEGIN RECORDING] ⓘ

Good {morning | afternoon | evening}. Today is {date} at {time}, and this is the third interview with participant {Participant ID} for the research study being conducted by Adam Smeets. Thank you for being here today. As a reminder, this interview is being recorded without video. You previously reviewed and completed the Informed Consent document for participating in the study. I am currently displaying the Informed Consent again as it relates to the interview.

ⓘ [START SCREEN SHARE WITH INFORMED CONSENT DISPLAYED] ⓘ

Please re-review the information. You have the choice to end the interview at any time and withdraw from the study. If you would like to proceed with volunteering and the interview, please verbally reply that you agree to participate.

[AFTER VERBAL AGREEMENT, CONTINUE THE INTERVIEW]

Follow-Up Questions

1. How has communication changed between teacher and student in a 1:1 classroom versus a non-1:1 classroom?
2. How has communication changed between students in a 1:1 classroom versus a non-1:1 classroom?
3. Tell me a story about how you use technology to support summative assessment in the classroom? Formative assessment?

Self-Identification with TPACK

TPACK focuses on the interplay between a teacher's technical, pedagogical, and content knowledge. Please visit the URL I provided in the chat window. I will share the screen in our Zoom interview so that the process is captured.

4. On slide 2, using your mouse, how would you align the circles to represent your technical, pedagogical, and content knowledge. Please describe your representation.
5. Let's go to slide 3. Using your mouse, how would you align the circles to represent the ideal balance of a teacher's technical, pedagogical, and content knowledge? Please describe your representation.
6. Looking at slide 4, let's discuss the balance for a fifth-year teacher who is being evaluated. Using your mouse, how would you demonstrate the balance? Please describe your representation.
7. We have had several discussions regarding Social Emotional Learning (SEL) and its impact on your classroom. How would you identify how/where/if SEL should be represented in this model? Please describe your representation.

Closing

Again, thank you for taking this time to speak with me about your experiences. After concluding this interview, I will begin transcribing the interview and sharing a summary with you. I will again share a copy with you to ensure that I have accurately captured your great insights and experiences. Your responses will remain confidential and assigned a pseudonym and case number. I will only report the findings in aggregate; you will not be identified by name.

I greatly appreciate your support, time, and commitment as I complete my dissertation research and begin the process of compiling the findings and results. If you think of additional information to share after this interview, please reach out to me at asmeets@luc.edu. Again, thank you!

Research Question Alignment

Research question	Correlating interview question
How do teachers adjust pedagogical practices in 1:1 classrooms?	4, 5, 6, 7
How do 1:1 devices in classrooms influence teacher pedagogical practices, including planning and design of instruction, selecting content, and delivering instruction, including instructional strategies, assessment strategies, techniques, and procedures?	3
How do teachers describe shifts in their classrooms since implementing a 1:1 program?	
How do teachers perceive student academic engagement in a 1:1 classroom?	
How do 1:1 devices in classrooms change communication for and between teachers and students?	1
How do 1:1 devices in classrooms change communication for and between students?	2

Member Checking by Email

From: Adam Smeets <asmeets@luc.edu>
Sent: July 15, 2021 1:19pm
To: Study Participant
Subject: Research Study Follow-Up, Review Rough Draft

Hello and good afternoon, {Research Participant First Name} –

Thank you for providing such great insights and participation in each interview, completing the questionnaire, and providing example curriculum documents. I know that this was a large time commitment, but this study would not have been possible without you and your ideas.

As a reminder, in the first interview, we focused on your instructional practices and 1:1 devices. Then you reflected on when devices were first available and current experiences with 1:1 devices. In the second interview, we discussed your perspective on using technology and making pedagogical decisions online. We covered a few questions to close our first two interviews in the final interview, followed by an interactive activity examining TPACK.

As part of the final steps in this study, I am performing "member checking." The purpose of member checking is to validate the accuracy of and support the credibility of the findings. In support of this, I request that you review the interview transcripts to ensure that they accurately reflect our discussion. Also, this is an opportunity to provide additional information or clarification. Next, I am attaching a copy of the results for sections directly related to your feedback and insights. Please review these findings, provide any clarifications or additional information, and confirm that they resonate with your experiences and perspective by clicking on the "Submit My Feedback" button.

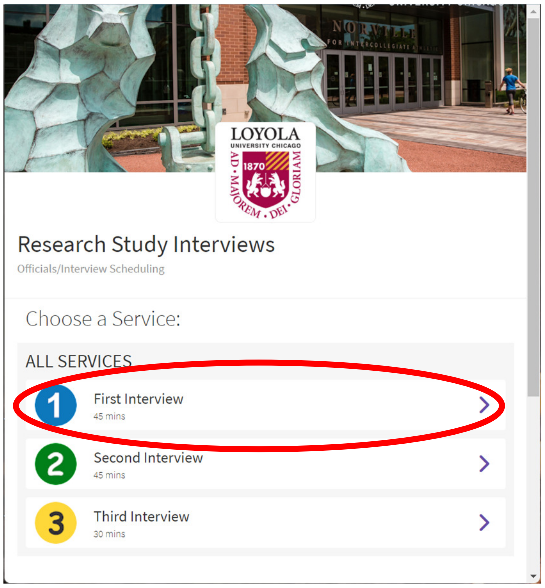
Submit My Feedback

As a reminder, any responses will remain confidential and associated with a pseudonym and case number. I will only report the findings in aggregate; you will not be identified by name. The final report will be used for completing my dissertation defense. Please feel free to participate and share your thoughts openly.

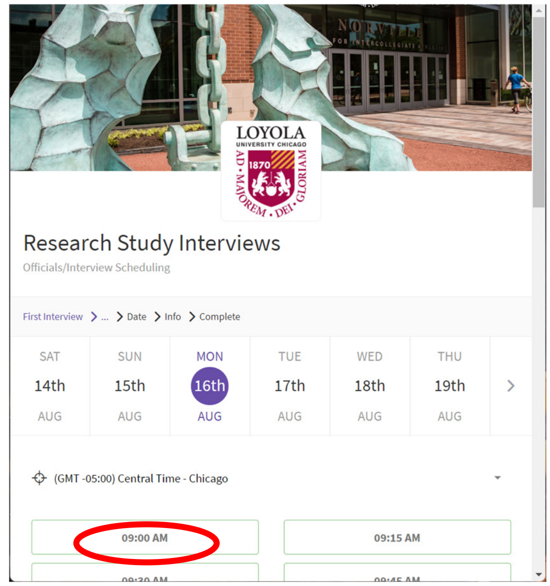
Sincerely,
Adam Smeets

APPENDIX J

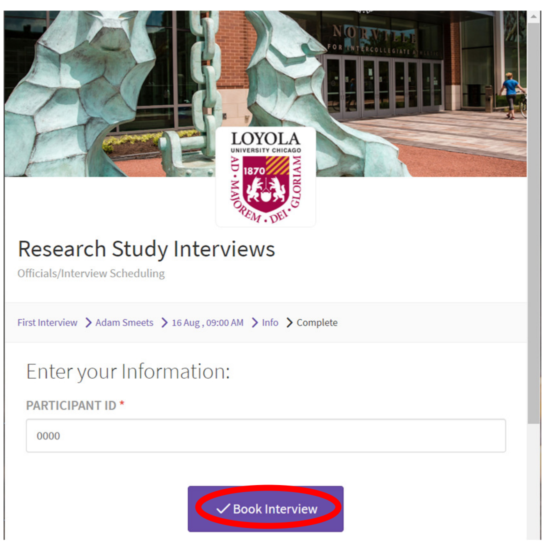
SELF-SERVICE INTERVIEW REGISTRATION SITE



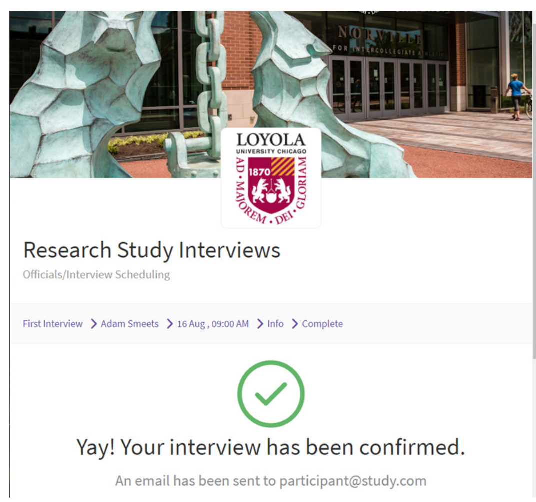
Step 1: Participants schedule each interview by clicking on the number in each available row.



Step 2: After picking an interview, they select an available date/time to complete their interview.



Step 3: After entering their Participant ID, provided during the Informed Consent process, they click "Book Interview."

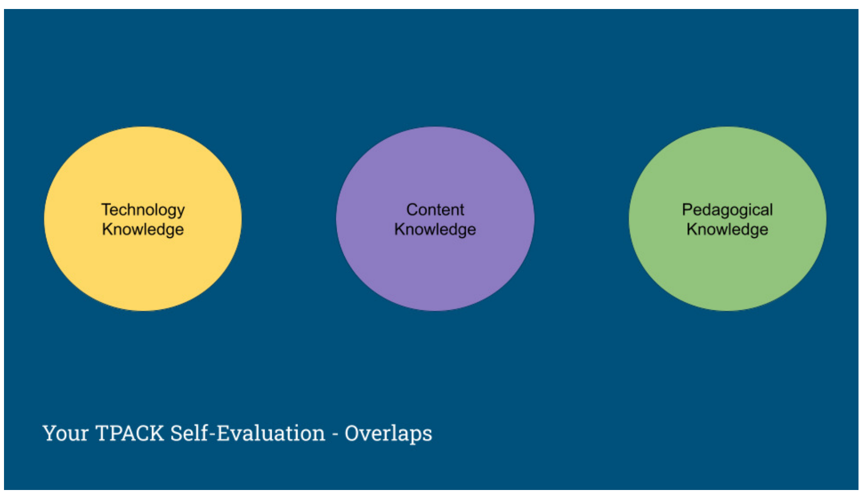


Step 4: A confirmation screen appears, and an email is sent to the researcher and participant with a link to join the interview and a calendar appointment.

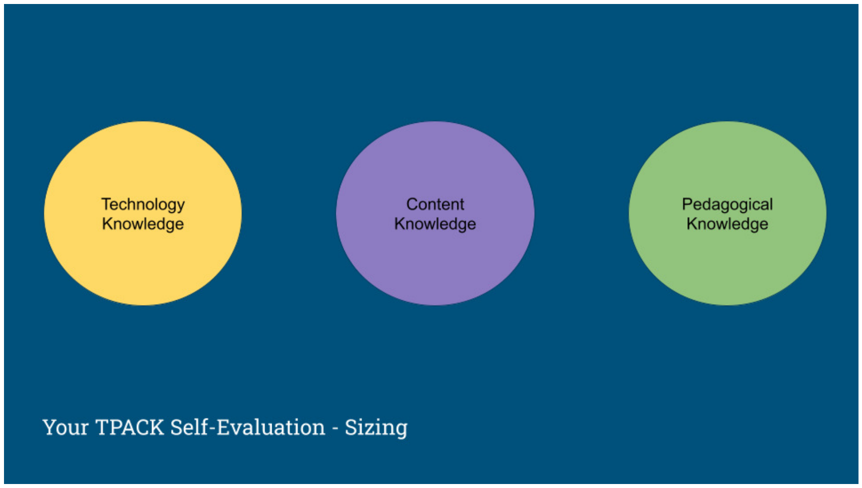
APPENDIX K

TPACK AND SOCIAL-EMOTIONAL LEARNING DOMAIN EXERCISE

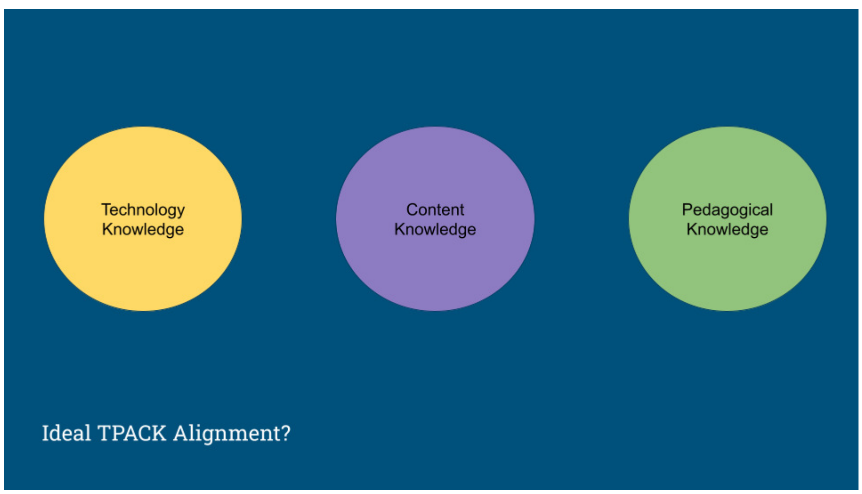
TPACK focuses on the interplay between a teacher's technical, pedagogical, and content knowledge. Please visit the URL I provided in the chat window. I will share the screen in our Zoom interview to capture your process.



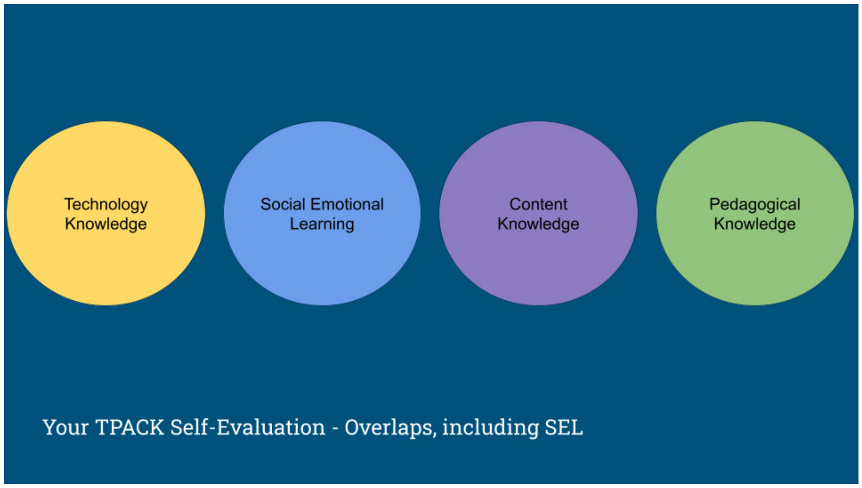
Using your mouse, how would you align each circle to represent your technical, pedagogical, and content knowledge. Please describe your representation.



Using your mouse, how would you align the circles to represent the ideal balance of a teacher's technical, pedagogical, and content knowledge? Please describe your representation.



Let us discuss the balance for a fifth-year teacher who is being evaluated. Using your mouse, how would you demonstrate the balance? Please describe your representation.



We had several discussions regarding Social Emotional Learning (SEL) and its impact on your classroom. How would you identify how/where/if SEL should be represented in this model? Please describe your representation.

APPENDIX L

EMAIL COMMUNICATION: PARTICIPANT UPDATE AND REMINDER

From: Adam Smeets <asmeets@luc.edu>
Sent: June 14, 2021 1:32pm
To: Study Participant
Subject: Research Study Follow-Up, Next Steps

Hello and good afternoon, {Research Participant First Name} –

First and foremost, thank you for signing up to be part of my research study. Without you and your ideas, this study would not be possible. To streamline your experience, I wanted to follow up with where you are in the process and any steps remaining.

1. **Complete the "Consent to Participate in Research"**
   ✔ You completed this step, bravo! If you would like to review the Consent again, please visit https://luc.co1.qualtrics.com/jfe/form/SV_88GvArfV8MUfiC2.

2. **Complete the "Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms" Survey**
   ✔ You completed this step too, way to go! As a reminder, you completed this survey at https://luc.co1.qualtrics.com/jfe/form/SV_emm7QAFE03WVB3v.

3. **Schedule your three (3) online interviews**
   ✖ Oops! When possible, please complete this step by visiting the online scheduling site at https://www.picktime.com/LucResearchStudy.

4. **Submit Your Instructional and Classroom Documents for the Research Study**
   ✖ Oops! When possible, please complete this step by submitting your documents at https://luc.co1.qualtrics.com/jfe/form/SV_8okZTwVzkyMbls2.

Thank you, again,
Adam Smeets

APPENDIX M

PARTICIPANT SUBMITTED CURRICULUM EXAMPLES SURVEY

LOYOLA
UNIVERSITY CHICAGO
Preparing people to lead extraordinary lives

Welcome back! Thank you for being an integral part of this study - it is my belief that this will have transformational opportunities for your school, other educators, and the education community. I know that you have many things on your plate at this time of year; however, your feedback and insights are **invaluable**.

To set the stage, on the next page you will see a "Consent to Participate in Survey Research." This is the same consent you reviewed previously, except that it is asking for your consent to submit the documents requested for the study.

There are <u>no</u> correct or incorrect documents. Your individual documents are not being shared with your school, other teachers, district staff or members of administration. As a reminder, all data is being stored securely and under the guidance of Loyola University Chicago.

Again, thank you for being part of this study! Please click, "Next Page" to continue.

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms
Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)
Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

CONSENT TO PARTICIPATE IN SURVEY RESEARCH

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

Introduction

You are being asked to take part in a research study being conducted by Adam Smeets for a dissertation under the supervision of Dr. David Ensminger in the School of Education at Loyola University Chicago.

You are being asked to participate because you are a teacher in a District 204 elementary school that utilizes 1:1 devices as part of classroom instruction. For this study, I am looking to interview up to ten (10) elementary teachers who worked at a District elementary school for the past three years when the 1:1 program started.

Please read this form carefully as it provides information relevant to the study. Please ask any questions you may have before deciding whether to participate in the study.

Purpose

The goal of this research is to understand how teacher pedagogy is changed in 1:1 elementary classrooms. The secondary goal is to understand changes to student engagement and communication in the 1:1 classroom. For reference, the research questions of this study are:

1. How do teachers adjust pedagogical practices in 1:1 classrooms?
    - How do 1:1 devices in classrooms influence teacher pedagogical practices, including planning and design of instruction, selecting content, and delivering instruction, including instructional strategies, assessment strategies, techniques, and procedures?
2. How do teachers describe shifts in their classrooms since implementing a 1:1 program?
    - How do teachers perceive student academic engagement in a 1:1 classroom?
    - How do 1:1 devices in classrooms change communication for and between teachers and students?
    - How do 1:1 devices in classrooms change communication for and between students and students?

Should you agree to participate in this study, you would be providing information that will be critical in understanding the changes, experiences, and negotiations of pedagogy not only in your school but potentially for other districts considering 1:1 implementations.

Procedures

The time anticipated to complete this survey is 15 minutes. You will review a series of questions and provide the answer that best represents your opinion.

Risks/Benefits

There are no foreseeable risks involved in participating in this research beyond those experienced in everyday life.

There may be no direct benefits to you from participation. However, this research will help advance our understanding of the changes that 1:1 devices can have on pedagogy, student communication, and engagement.

Confidentiality

In completing the questionnaire, confidentiality will be maintained to the degree permitted by the technology used. Your participation in this online survey involves risks similar to a person's everyday use of the Internet. Your responses will remain confidential and assigned a pseudonym and case number. We will only report the findings in aggregate; no one participant will be identified by name. The final report will be used for completing my dissertation defense. De-identified summary findings may be shared with select program administrators after this study.

No materials will be stored on or transferred to District storage or hardware. All materials stored will be maintained on a laptop dedicated to this project and secured in a locked drawer when not in use.

Voluntary Participation

There is no cost to participate in this study. Participation in this study is voluntary. If you do not want to be in this study, you do not have to participate. Even if you decide to participate, you are free not to answer any question or to withdraw from participation at any time without penalty.

You will not receive any benefits from, or any rights in any developments, inventions, or other discoveries that may come out of this research. By completing all components of the research study, you will receive a $50 gift card to Starbucks or another retailer as compensation for your time and any inconvenience. Since you can withdraw your participation, payments will be prorated at $10 increments. For example, only completing the questionnaire would result in a $10 gift card. Compensation will be delivered electronically through eGift card delivery.

As a staff member of the school district, your decision to participate or not will have no effect on your current employment or relationship with the District. Further, if you currently are or will be a student of Dr. David Ensminger, your participation will not affect your current relationship as teacher and student or the course.

Contacts and Questions

If you have questions about this research study, please feel free to contact me at asmeets@luc.edu or [redacted] or the faculty sponsor Dr. David Ensminger at densmin@luc.edu or [redacted].

If you have questions about your rights as a research participant, you may contact the Loyola University Office of Research Services at (773) 508-2689 and speak with the Compliance Manager.

Statement of Consent

By clicking the "I agree" button below, you are indicating that you have read the information provided above, have had an opportunity to ask questions, and agree to complete the following survey and participate in this research study. You will be given a copy of this form to keep for your records.

✓ Yes, I consent to participate in this survey as part of the research study.

No, I do not consent to participate in this survey as part of the research study.

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms
Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)
Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA
UNIVERSITY CHICAGO
Preparing people to lead extraordinary lives

Please enter your participant ID.
Your participant ID was included on your email communication when signing up for the study.

2437

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms
Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)
Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Please provide an example document that reflects the use of your content knowledge in the classroom.

Drop files or click here to upload

Please describe how this document reflects your content knowledge in the classroom.

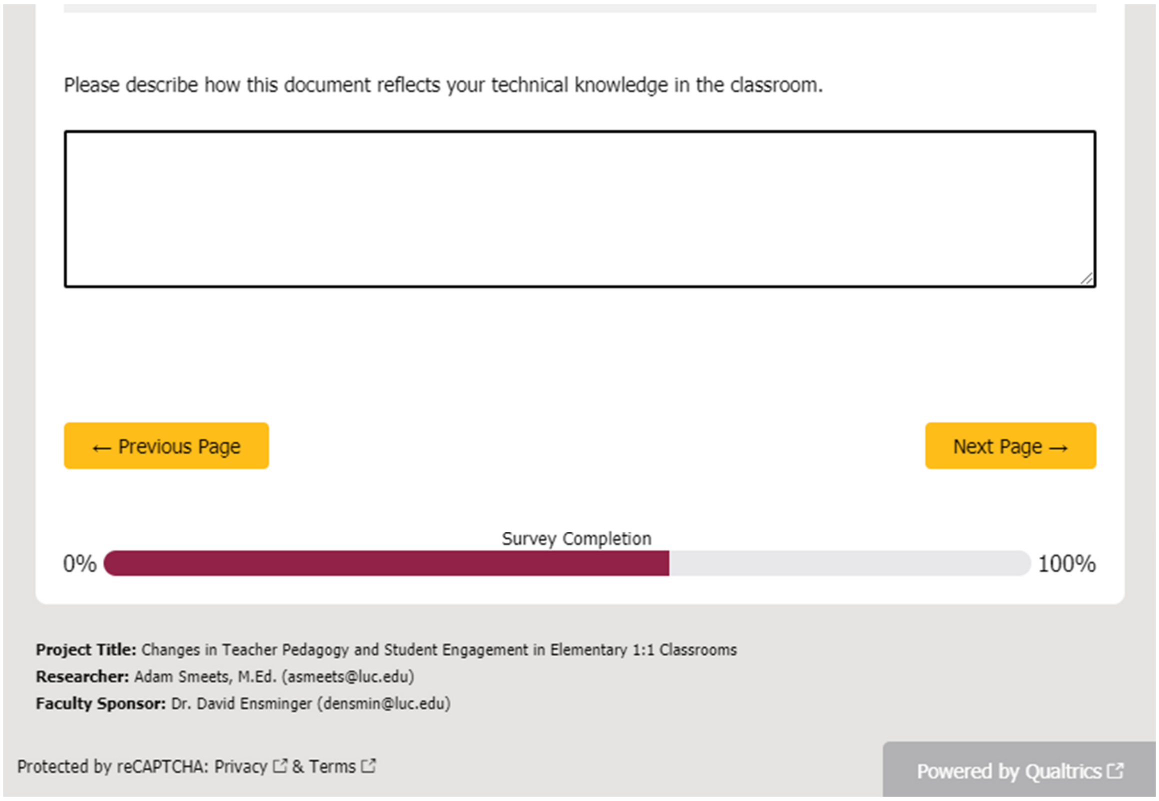
Please provide an example document that reflects the use of your pedagogical knowledge in the classroom.

Drop files or click here to upload

Please describe how this document reflects your pedagogical knowledge in the classroom.

Please provide an example document that reflects the use of your technical knowledge in the classroom.

Drop files or click here to upload


Please describe how this document reflects your technical knowledge in the classroom.

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms
Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)
Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

Protected by reCAPTCHA: Privacy & Terms

Powered by Qualtrics

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Optional, but Welcomed) Please provide any other document that may be beneficial from our discussion about 1:1 devices in the classroom.

Drop files or click here to upload

Optional, but Welcomed) Please provide any other document that may be beneficial for our discussion about teacher and/or student communication in the classroom.

Drop files or click here to upload

Optional, but Welcomed) Please provide any other document that may be beneficial from our discussion about student engagement in the classroom.

Drop files or click here to upload

← Previous Page

Next Page →

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

LOYOLA UNIVERSITY CHICAGO

Preparing people to lead extraordinary lives

Thank you for completing this survey. Your feedback and insights will be paramount in our discussion, as well as to the overall study. As a reminder, if you have not scheduled your interview times, please do so at https://www.picktime.com/LucResearchStudy.

Again, I really appreciate your support and the opportunity to learn more about how devices in the classroom have impacted your teaching, as well as your engagement and communications with and between students.

Your response has been recorded and you can close this window.

Survey Completion

0% 100%

Project Title: Changes in Teacher Pedagogy and Student Engagement in Elementary 1:1 Classrooms

Researcher: Adam Smeets, M.Ed. (asmeets@luc.edu)

Faculty Sponsor: Dr. David Ensminger (densmin@luc.edu)

APPENDIX N

ELA LESSON PLAN (TERRY)

<table>
<tr><td>Lesson Plan</td><td>Class: 4th Grade</td><td>Date: Fall</td></tr>
<tr><td colspan="3">Topic: Literature Study: Historical Fiction: <u>Sign of the Beaver</u></td></tr>
<tr><th>Learning Objectives</th><th>Standards</th><th>Materials</th></tr>
<tr>
<td>Students will interpret vocabulary words in a literature selection related to historical meanings, character relationships, character qualities, and details.

Students will create an image that appeared in their minds while reading the text (using online tools and images).

Students will summarize events from the story in sequence.

Students will understand a character in the story based on textual evidence of the character's mood, actions, or speech.</td>
<td>Key Ideas and Details
<u>CCSS.ELA-LITERACY.RL.4.1</u>
Refer to details and examples when explicitly explaining the text and drawing inferences from the text.
<u>CCSS.ELA-LITERACY.RL.4.2</u>
Determine a story's theme, drama, or poem from details in the text; summarize the text.
<u>CCSS.ELA-LITERACY.RL.4.3</u>
Describe in depth a character, setting, or event in a story or drama, drawing on specific details in the text (e.g., a character's thoughts, words, or actions).

Craft and Structure
<u>CCSS.ELA-LITERACY.RL.4.4</u>
Determine the meaning of words and phrases as they are used in a text, including those that allude to significant characters found in mythology (e.g., Herculean).

Range of Reading and Level of Text Complexity
<u>CCSS.ELA-LITERACY.RL.4.10</u>
By the end of the year, read and comprehend literature, including stories, dramas, and poetry, in the grades 4-5 text complexity band proficiently, with scaffolding as needed at the high end of the range.</td>
<td>Student copies of the novel Sign of the Beaver

Student Copies of Slide Deck for Notes, Vocabulary, Comprehension Questions, Retellings, Visualizations, and Projects (as decided through student interest or teacher choice for assessment)</td>
</tr>
<tr>
<td colspan="2">Introduction
☑ Discussion Question ❑ Media ☑ Activate Prior Knowledge

For the novel Sign of the Beaver, share with students to create slides to answer questions, show images, recall events, describe characters, etc. Some slides will be teacher-directed, and some can be student choice.</td>
<td rowspan="2">Strategies
• Think/Pair/Share
• Graphic Organizer
• PBL
• ~~Tech Integration~~
• Gamification
• ~~Task Cards~~
• Peer Teaching
• ~~Self Assessment~~
• Growth Mindset
• ~~Other:~~</td>
</tr>
<tr>
<td colspan="2">Instruction
☑ Whole Group ❑ Small Group ❑ Cooperative Learning ❑ Centers

Visualization: After reading orally and discussing the first chapter of the</td>
</tr>
</table>

<table>
<tr>
<td>
novel, students will be asked to picture a scene from the chapter (visualization) and find a representation to add to the Sign of the Beaver Slide-deck's title slide been shared with them. They will search images based on keywords in the story, like forest, garden, cabin. They will add a title with the author's name AND a text box with their name.

Vocabulary:
Based on chapters 1-2, reading and discussion, students will be given a list of vocabulary words from this part of the story. With the words listed on Slide 3, students will define the words based on their understanding of the story. If they need help, they can ask others or use an online dictionary.

Summary: After reading and discussing chapter 1, students will retell critical events in the order they happened.

For the chapter where Matt, the main character, is alone in the woods, working on the tasks told him by his father, students will construct an image showing details of Matt's day.

Character Depth and Understanding: As we get to know Matt's predicaments with living alone, students will now write a "Letter Home" from Matt's perspective.

After several chapters, Matt ends up with little food in his cabin, thanks to a bear coming in while Matt was out hunting. He later finds some honey, gets stung by bees, hurts his ankle, and passes out due to the allergic reaction to all the bee stings. Native Americans have been watching him, saving him from the river. He now owes the "friends" something, so he agrees to teach the native boy to read.

Students will make contrasting images of how Matt and Attean spend their days together and how they feel about learning and teaching.

Students will eventually show how the main character has changed throughout the story through their summary. Although many characters are affected by their new relationships, the main character changes the most. Students will develop a title for "The Change" slide and describe how the character has changed.

The final slide was from the perspective of the native boy as he returns from finding his spirit guide. The readers do not experience this part of his life in the text, so imagine what he went through. He only briefly tells the experience and appears "different" to Matt, so the reader must make assumptions.
</td>
<td></td>
</tr>
<tr>
<td colspan="2">
Assessment
☑ Observation ❑ Worksheet ❑ Test ☑ Project ☑ Presentation ❑ Published Work ❑ Rubric
</td>
</tr>
</table>

Through the summarizing, retellings, images, student understandings, and recall of details, student comprehension of the text can be seen in these projects.			
Differentiation			
Approaching	*On Level*	*Enrichment*	*Individual*
Some rereading text may be necessary for some students to find and recall the details. Some assistance may be needed for finding appropriate clipart. Keywords from the story help a lot.	Students should respond appropriately and expressively through deep discussion and thorough questioning during readings. They will enjoy making their images and backgrounds go with these exciting parts.	Extra slides can be added through student choice. Images can be enhanced with a clipart to fit the topic. Students can play-act parts of the story to retell certain scenes.	Use a sequence of events list to aid students with recall. Post vocabulary that can be used for image searches.

Follow Up ❏ Re-teaching ❏ Homework	**Reflection**
Continue the Slide-deck throughout the book. Change the topics and outcomes to fit your class discussion of the story.	These ongoing activities and projects related to the book led to continued visual notes for the students resulting in a respectful representation of their understandings. It also made a sequential retelling of significant events in the story. All students can be successful due to the visual and written experiences, as some are better at visuals and some are better at writing.
My knowledge of student learning standards (after nine years teaching 4th grade) and student comprehension, through these and many ELA lessons, shows in the details of the lesson and the outcomes shown in the student work sample. Through the oral reading of the text, deep discussion of the historical nature of the novel, the characterizations, and the details of the story shared in the projects made online with slides, students became engrossed in the book, remembered small and oversized details, and showed better understandings in their project than they would on a written test. The format of their work samples offered choice and variation, covered both the learning standards so crucial for fourth graders, and also was open to student variances and work styles.	

APPENDIX O

SURVEY SUMMARY REPORT

Section A – Background Information

How many years of experience do you have serving as a teacher in a District 204 school?

Years	N[1]
4	2
22	2
23	1
27	1

How many years of experience do you have serving as a teacher at your current school?

Years	N
4	2
7	2
8	1
22	1

What grade level(s) do you teach?

Grade Level	N
Preschool (PK)	0
Kindergarten	2

[1] Six total responses were received for the study; however, one participant withdrew before starting the interview process. The participant's results are included in the tables.

Grade Level	N
1st Grade	2
2nd Grade	2
3rd Grade	2
4th Grade	3
5th Grade	5

What content areas do you teach?

- Art
- Physical Education
- ELA, Math, Science, Social Studies, Social-Emotional Learning.
- Social/Emotional Learning, Science, Social Studies, Mathematics, Language Arts.
- ELA, Math, Social Studies, Science
- All

What technology resources are available in your classroom?

- I am two schools .... both schools have a document camera, projector, and computer. One school has a smartboard, which I do not use
- Chromebooks, LED projector, speakers, portable mic, portable camera, external (clip-on/tripod) HD PC camera.
- Chromebooks, iPads, Gizmos.

- iPads, Chromebooks, Laptops, Cell Phones, Ziggy Cameras, Jabra Speakers.
- Computer, Smart Board, Document Camera, On-screen Microscope, Jabra microphone, Room camera on tripod.
- Laptop, smartboard, data projector, document camera, webcam – speakers – Jabra, student Chromebooks (1:1)

What is your age?

Age	N
Under 21	0
22-28	0
29-35	2
36-42	0
43-49	1
50-56	1
57-63	2
64-70	0
71-77	0
78-84	0

To which gender do you most identify?

Gender	N
Female	4

Gender	N
Male	2
Transgender Female	0
Transgender Male	0
Gender Variant / Non-Conforming	0
Prefer Not to Answer	0
Not Listed Please use the text box below to specify the gender you most identify.	0

Section B

Thinking about your classroom before COVID-19 school closures and remote learning, please respond to the following statements in terms of your uses of technology resources in the classroom using the scale provided.

	N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
Our classroom’s digital tools and resources are used exclusively for classroom management and professional communication (e.g., accessing the Internet, communicating with colleagues or parents, grading student work, and/or planning instructional activities).	6	7.00	0	0	0	0

	N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
My students and I use the digital tools and resources (e.g., interactive whiteboard, digital student response system, online tutorials) primarily to supplement the curriculum and reinforce specific content standards.	6	6.67	0.516	0.267	-0.968	-1.875
I model for my students the safe and legal use of digital tools and resources while I am delivering content and/or reinforcing their understanding of pertinent concepts using multimedia resources (e.g., PowerPoint, Keynote), web-based tools (e.g., Google Presentations), or an interactive whiteboard.	6	5.67	2.805	7.867	-2.345	5.557
I use the digital tools and resources in my classroom to promote student creativity and innovative thinking (e.g., thinking outside the box, exploring multiple solutions).	6	6.50	0.837	0.700	-1.537	1.429

	N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
I engage students in learning activities that require them to analyze information, think creatively, make predictions, and/or draw conclusions using the digital tools and resources (e.g., Inspiration/Kidspiration, Excel, InspireData) available in my classroom.	6	5.17	2.639	6.967	-2.030	4.367
I assign web-based projects (e.g., web collaborations, WebQuests) to my students that emphasize complex thinking strategies (e.g., problem-solving, decision-making, experimental inquiry) aligned to the content standards.	6	4.17	2.483	6.167	-0.871	0.735
My students use the classroom digital tools and resources to engage in relevant, challenging, self-directed learning experiences that address the content standards.	6	4.83	2.639	6.967	-1.494	2.290

	N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
Problem-based learning occurs in my classroom because it allows students to use the classroom digital tools and resources for higher-order thinking (e.g., analyzing, evaluating, creating) and personal inquiry.	6	4.33	2.422	5.867	-1.215	2.111
My students apply their classroom content learning to real-world problems within the local or global community using the digital tools and resources at our disposal.	6	4.33	2.658	7.067	-0.728	0.158
My students propose innovative ways to use our school's advanced digital tools (e.g., digital media authoring tools, graphics programs, probeware with GPS systems) and resources (e.g., publishing software, media production software, advanced web design software) to address challenges/issues affecting their local and global communities.	6	2.67	3.077	9.467	0.778	-1.680

	N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
My students use all forms of the most advanced digital tools (e.g., digital media authoring tools, graphics programs, handheld devices) and resources (e.g., publishing software, media production software, advanced web design software) to pursue collaborative problem-solving opportunities surrounding issues of personal and/or social importance.	6	2.33	3.266	10.667	0.951	-1.654
My students identify important real-world issues or problems (e.g., environmental pollution, elections, health awareness), then use collaborative tools and human resources beyond the school building (e.g., partnerships with business professionals, community groups) to solve them.	6	2.33	3.266	10.667	0.951	-1.654

Standard Error of Skewness = 0.845; Standard Error of Kurtosis = 1.741

Section C

The purpose of this section is to gather information about combining technology, pedagogy and content knowledge in the teaching and learning process. For each item, choose only one option (Strongly Disagree, Disagree, Slightly Disagree, Neither Agree or Disagree, Slightly Agree, Agree, Strongly Agree) that best describes you. Please answer all of the questions and if you are uncertain of or neutral about your response you may always select "Undecided."

Domain		N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
TK	I have the technical skills to use computers effectively.	6	6.50	0.50	0.25	0	-3.333
TK	I can learn technology easily.	6	6.17	0.69	0.47	-0.313	-0.104
TK	I know how to solve my own technical problems when using technology.	6	5.67	0.47	0.22	-0.968	-1.875
TK	I keep up with important new technologies.	6	5.00	1.15	1.33	-0.889	-0.781
TK	I am able to create web pages.	6	4.83	1.67	2.81	-1.095	-1.115
TK	I am able to use social media (e.g. Blog, Wiki, Facebook).	6	6.17	0.69	0.47	-0.313	-0.104

Domain		N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
PK	I am able to stretch my students' thinking by creating challenging tasks for them.	6	4.67	0.75	0.56	0.857	-0.300
PK	I am able to guide my students to adopt appropriate learning strategies.	6	4.83	0.69	0.47	0.313	-0.104
PK	I am able to help my students to monitor their own learning.	6	5.00	0.58	0.33	0	2.500
PK	I am able to help my students to reflect on their learning strategies.	6	4.50	0.50	0.25	0	-3.333
PK	I am able to plan group activities for my students.	6	4.67	0.47	0.22	-0.968	-1.875
PK	I am able to guide my students to discuss effectively during group work.	6	4.33	0.47	0.22	0.968	-1.875
CK1	I have sufficient knowledge about the content area of [Subject Area 1].	6	6.83	0.37	0.14	-2.449	6.000

Domain		N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
CK1	I can think about the content of my class featuring [Subject Area 1] like a subject matter expert.	6	6.33	0.47	0.22	0.968	-1.875
CK1	I am able to develop a deeper understanding of the content in my [Subject Area 1] class.	6	6.67	0.47	0.22	-0.968	-1.875
CK2	I have sufficient knowledge about the content area of [Subject Area 2].	6	6.83	0.37	0.14	-2.449	6.000
CK2	I can think about the content of my class featuring [Subject Area 2] like a subject matter expert.	6	6.50	0.50	0.25	0	-3.333
CK2	I am able to develop a deeper understanding of the content in my [Subject Area 2] class.	6	6.67	0.47	0.22	-0.968	-1.875
TPK	I am able to use technology to introduce my students to real-world scenarios.	6	6.50	0.76	6.50	-1.537	1.429

Domain		N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
TPK	I am able to facilitate my students to use technology to find more information on their own.	6	6.33	0.75	6.33	-0.857	-0.300
TPK	I am able to facilitate my students to use technology to plan and monitor their own learning.	6	6.33	0.75	6.33	-0.857	-0.300
TPK	I am able to facilitate my students to use technology to construct different forms of knowledge representation.	6	6.00	1.00	6.00	-1.369	2.500
TCK	I know about the technologies that I have to use for the research of content in my [Subject Area 1] classes.	6	6.00	1.00	1.00	-1.369	2.500
TCK	I can use appropriate technologies (e.g. multimedia resources, simulation) to represent the content in my [Subject Area 1] classes.	6	6.00	0.58	0.33	0	2.500

Domain		N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
TCK	I know about the technologies that I have to use for the research of content in my [Subject Area 2] classes.	6	6.00	0.58	0.33	0	2.500
TCK	I can use appropriate technologies (e.g. multimedia resources, simulation) to represent the content in my [Subject Area 2] classes.	6	6.00	0.58	0.33	0	2.500
PCK	Without using technology, I know how to select effective teaching approaches to guide student thinking and learning in my [Subject Area 1] classes.	6	5.67	1.70	2.89	-2.066	4.649
PCK	Without using technology, I can help my students to understand the content knowledge of my [Subject Area 1] classes in various ways.	6	5.67	1.70	2.89	-2.066	4.649

Domain		N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
PCK	Without using technology, I know how to select effective teaching approaches to guide student thinking and learning in my [Subject Area 2] classes.	6	5.83	1.34	1.81	-1.840	3.912
PCK	Without using technology, I can help my students to understand the content knowledge of my [Subject Area 2] classes in various ways.	6	5.50	2.06	4.25	-2.188	5.063
TPACK	I can teach lessons that appropriately combine my [Subject Area 1] classes, technologies and teaching approaches.	6	6.33	0.75	0.56	-0.857	-0.300
TPACK	I can teach lessons that appropriately combine my [Subject Area 2] classes, technologies and teaching approaches.	6	6.50	0.50	0.25	0	-3.333

Domain		N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
TPACK	I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.	6	6.33	0.75	0.56	-0.857	-0.300
TPACK	I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.	6	6.33	0.47	0.22	0.968	-1.875
TPACK	I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.	6	5.83	0.69	0.47	0.313	-0.104

Standard Error of Skewness = 0.845; Standard Error of Kurtosis = 1.741

TPACK Calculation Summary

	N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
TK	6	34.33	3.77	14.22	-0.330	-1.865
CK	6	39.83	2.03	4.14	-0.991	1.142
CK-1	6	19.83	1.07	1.14	-0.668	-0.446
CK-2	6	20.00	1.15	1.33	-0.889	-0.781
PK	6	38.50	3.25	10.58	-0.616	-0.784
PCK	6	22.67	6.80	46.22	-2.066	4.649
TCK	6	24.00	2.65	7.00	-0.739	2.500
TPK	6	25.17	2.79	7.81	-0.549	-1.924
TPACK	6	31.33	2.87	8.22	-0.228	-1.760

Standard Error of Skewness = 0.845; Standard Error of Kurtosis = 1.741

For each item, choose only one option (No Impact, Very Little Impact, Somewhat Impactful, Quite a bit of Impact, A Great Deal of Impact) that best describes the extent to which each barrier impacts your students' use of technology.

	N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
Other teachers attitudes & beliefs	6	2.67	1.11	1.22	-0.75	-1.550
Technology support	6	3.50	1.26	1.58	1.375	2.355
State standards	6	2.50	0.76	0.58	1.537	1.429
Money	6	2.83	0.69	0.47	0.313	-0.104

	N	Mean (μ)	SD (σ)	Variance (σ^2)	Skewness	Kurtosis
Technology access	6	3.83	1.21	1.47	0.440	1.335
Time	6	3.33	1.49	2.22	0.857	-0.300
Assessments (standardized, state)	6	3.00	1.53	2.33	1.537	1.429
Technology problems	6	4.00	1.00	1.00	1.369	2.500
Institution (administration)	6	2.50	0.76	0.58	1.537	1.429
Subject culture	6	2.50	0.76	0.58	1.537	1.429
Knowledge and skills (students)	6	3.33	1.25	1.56	1.934	4.554
Institution (community)	6	2.83	1.46	2.14	2.148	4.640
Your own knowledge and skills	6	3.33	1.37	1.89	1.270	1.531
Institution (parents)	6	2.83	0.69	0.47	0.313	-0.104
Your own attitudes and beliefs	6	3.67	1.70	2.89	0.723	-1.875

Standard Error of Skewness = 0.845; Standard Error of Kurtosis = 1.741

APPENDIX P

A PRIORI CODEBOOK

Portrait of a Graduate
Bear Rapids School District

Portrait of a Graduate is a series of competencies that value rigorous academics. It is seated in a community understanding that today's educational experience must be intentional about fostering the skills that young people need to thrive in a complex, rapidly changing world (Bear Rapids School District, 2018b).

The competencies identified by the District should be articulated and present in the instructional goals and activities in the classroom. By coding these values in participant responses, the researcher was able to detail the depth at which teachers understood, explain the program's goals, and connect them to the 1:1 classroom experience(s).

Concept (code label)	Concept definition	Code definition for coding process
Citizenship	Activities and actions that inform and guide others in civic processes, including in the service of others locally and globally.	Represented how teachers integrated global mindedness and civic responsibility in their technology-connected lessons.
Communication	Activities and actions that encourage the expression of thoughts and ideas collaboratively using different mediums, environments, forms, and contexts.	Represented how teachers developed resources and assessments that intentionally fostered communication, engagement, and student group collaboration.
Creativity & Innovation	Activities and actions that use idea-generating techniques to improve, analyze and evaluate ways to develop creative efforts, including empathy, challenging constraints, and new perspectives.	Represented how teachers facilitated conversations and lessons by introducing different perspectives, creativity, and elements of digital citizenship.

Concept (code label)	Concept definition	Code definition for coding process
Critical Thinking & Problem Solving	Activities and actions collect and assess information for practical reasoning while considering different perspectives, ideas, and solutions.	Represented how teachers created opportunities for problem-based learning and other challenges for students using technology.
Flexibility & Adaptability	Activities and actions that support adjustment to changing conditions, roles, and unpredictability by managing ambiguity and adjusting to changes in priority.	Represented how teachers exhibited grace and opportunity in their classrooms in the face of technology challenges or district changing priorities.
Resilience	Activities and actions that represent overcoming obstacles, adaptation, and persistence toward goals regardless of setbacks.	Represented how teachers created space and supported students in solving their problems, rather than just answering.

TPACK Domains
Mishra and Kohler

Concept (code label)	Concept definition	Code definition for coding process
Content knowledge (CK)	A teacher's knowledge about the subject matter that is being taught.	Represented how teachers exhibited their understanding of the content area (i.e., Math)
Pedagogical content knowledge (PCK)	The practice of teaching and learning in a specific content area.	Represented how teachers exhibited their understanding of approaches to teaching

Concept (code label)	Concept definition	Code definition for coding process
		content areas (i.e., Math pedagogy)
Pedagogical knowledge (PK)	The processes and practices of teaching and learning.	Represented the craft of teaching with practices that teachers used in the classroom.
Technological content knowledge (TCK)	How technology and content influence and restrict each other.	Represented how teachers reinforced content material with technological tools.
Technological knowledge (TK)	Knowledge of working with technology, tools, and resources.	Represented how teachers exhibited their understanding of how technology functions.
Technological pedagogical knowledge (TPK)	The interplay between teaching and learning when using technology.	Represented how teachers used technology in pedagogically appropriate ways.
Technological pedagogical content knowledge (TPACK)	Deeply skilled teaching with technology – the basis of effective teaching with technology infusing technology, content, and pedagogical knowledge.	Represented how and when teachers found synergy in teaching with technology.

APPENDIX Q

LoTi FRAMEWORK

Level of Teaching Innovation (LoTi) Framework

Reprinted with permission from the LoTi Connection

LoTi Level	Description of the Level
0: Non-use	At a Level 0 (Non-Use), the instructional setting—including the use of digital and/or environmental resources—does not support or promote purposeful learning aligned to academic standards/expectations.
1: Awareness	At a Level 1 (Awareness), the instructional focus is exclusively direct instruction. Student learning focuses on lower levels of cognitive processing (e.g., Bloom Levels - remembering, understanding, applying; Webb's Levels – recall & reproduction, working with skills & concepts). Digital and/or environmental resources are either (1) non-existent or (2) used by the classroom teacher to enhance teacher presentations.
2: Exploration	At a Level 2 (Exploration), the instructional focus emphasizes content understanding and supports mastery learning and direct instruction. Student learning focuses on lower levels of cognitive processing (e.g., Bloom Levels - remembering, understanding, applying; Webb's Levels – recall & reproduction, working with skills & concepts). Digital and/or environmental resources are used by students for extension activities, enrichment exercises, information gathering assignments, or presentations that reinforce lower cognitive skill development relating to the content under investigation.
3: Infusion	At a Level 3 (Infusion), the instructional focus emphasizes student higher-order thinking (e.g., Bloom Levels – analyzing, evaluating, creating; Webb's Levels – short-term strategic thinking) and teacher-directed problems. Though specific learning activities may lack authenticity, the instructional emphasis is, nonetheless, placed on

LoTi Level	Description of the Level
	higher levels of cognitive processing and in-depth treatment of the content using a variety of thinking skill strategies (e.g., problem-solving, decision-making). The concept attainment, inductive thinking, and scientific inquiry models of teaching are the norm and guide the types of products generated by students. Digital and/or environmental resources are used by students and/or the teacher to execute teacher-directed tasks that emphasize higher levels of student cognitive processing relating to the content standards.
4a: Integration (Mechanical)	At a Level 4a (Integration: Mechanical), students are engaged in exploring real-world issues and solving authentic problems using the available digital and/or environmental resources; however, the teacher may experience classroom management (e.g., disciplinary problems) or school climate issues (lack of support from colleagues) that restrict full-scale integration. Heavy reliance is placed on prepackaged materials and/or outside resources (e.g., assistance from a peer coach) that aid the teacher in sustaining student-directed learning. Emphasis is placed on the constructivist, problem-based models of teaching that require higher levels of student cognitive processing (e.g., Bloom Levels – analyzing, evaluating, creating; Webb's Levels – short-term strategic thinking, extended strategic thinking) and in-depth examination of the content standards. Student use of digital and/or environmental resources is inherent and motivated by the drive to answer student-generated questions that dictate the content, process, and/or products embedded in the learning experience.

LoTi Level	Description of the Level
4b: Integration (Routine)	At a Level 4b (Integration: Routine), students are fully engaged in exploring real-world issues and solving authentic problems using the available digital and/or environmental resources. The teacher is within their comfort level with promoting an inquiry-based model of teaching that involves students applying their learning to the real world (e.g., Webb's Levels – extended strategic thinking). Emphasis is placed on learner-centered strategies and the constructivist, problem-based models of teaching that promote personal goal setting and self-monitoring, student action, and issues resolution. Students' use of digital and/or environmental resources is inherent and motivated by the drive to answer student-generated questions that dictate the content, process, and products embedded in the learning experience.
5: Expansion	At a Level 5 (Expansion), student collaborations extending beyond the classroom are employed for authentic problem-solving and issues resolution. Emphasis is placed on learner-centered strategies that promote personal goal setting and self-monitoring, student action, and collaborations with other groups (e.g., another school, different cultures, business establishments, governmental agencies). Student use of digital and/or environmental resources is inherent and motivated by the drive to answer student-generated questions that dictate the content, process, and products embedded in the learning experience. The complexity and sophistication of the digital and environmental resources and collaboration tools used are commensurate with (1) the inventiveness and spontaneity of the teacher's experiential-based approach to teaching and learning and (2) the

LoTi Level	Description of the Level
	students' level of complex thinking (e.g., problem-solving, decision-making, experimental inquiry) and in-depth understanding of the content standards.
6: Refinement	At a Level 6 (Refinement), student collaborations extending beyond the classroom that promote authentic student problem-solving and issues resolution are the norm. The instructional curriculum is entirely learner-based involving the content, process, and product of instruction. The content emerges based on the needs of the learner according to their interests and/or aspirations and is supported by ubiquitous access to the most current digital tools and resources. The pervasive use of and access to advanced digital tools and resources provides a seamless medium for information queries, creative problem-solving, student reflection, and/or product development. Students have ready access to and a complete understanding of a vast array of online collaboration tools and related digital resources to accomplish learning outcomes beyond conventional strategies.

APPENDIX R

CITI CERTIFICATIONS

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)
COMPLETION REPORT - PART 1 OF 2
COURSEWORK REQUIREMENTS*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Adam Smeets [redacted]
- **Institution Affiliation:** Loyola University Chicago (ID: 460)
- **Institution Email:** asmeets@luc.edu
- **Institution Unit:** School of Education
- **Phone:** [redacted]

- **Curriculum Group:** Human Research
- **Course Learner Group:** Group 1 Lakeside investigator
- **Stage:** Stage 1 - Basic Course
- **Description:** Select Group 1 if you are a Lakeside investigator unless you are conducting research that is purely biological/medical in nature.

- **Record ID:** 24797109
- **Completion Date:** 17-Sep-2019
- **Expiration Date:** 16-Sep-2022
- **Minimum Passing:** 80
- **Reported Score*:** 100

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Belmont Report and Its Principles (ID: 1127)	17-Sep-2019	3/3 (100%)
History and Ethical Principles - SBE (ID: 490)	11-Oct-2017	5/5 (100%)
Defining Research with Human Subjects - SBE (ID: 491)	17-Sep-2019	5/5 (100%)
The Federal Regulations - SBE (ID: 502)	17-Sep-2019	5/5 (100%)
Assessing Risk - SBE (ID: 503)	17-Sep-2019	5/5 (100%)
Informed Consent - SBE (ID: 504)	17-Sep-2019	5/5 (100%)
Privacy and Confidentiality - SBE (ID: 505)	17-Sep-2019	5/5 (100%)
Research with Prisoners - SBE (ID: 506)	17-Sep-2019	5/5 (100%)
Research with Children - SBE (ID: 507)	17-Sep-2019	5/5 (100%)
Research in Public Elementary and Secondary Schools - SBE (ID: 508)	17-Sep-2019	5/5 (100%)
International Research - SBE (ID: 509)	17-Sep-2019	5/5 (100%)
Internet-Based Research - SBE (ID: 510)	17-Sep-2019	5/5 (100%)
Vulnerable Subjects - Research Involving Workers/Employees (ID: 483)	17-Sep-2019	4/4 (100%)
LOYOLA UNIVERSITY CHICAGO (ID: 537)	17-Sep-2019	No Quiz

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

[redacted].

Collaborative Institutional Training Initiative (CITI Program)
Email: support@citiprogram.org
Phone: 888-529-5929
Web: https://www.citiprogram.org

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COMPLETION REPORT - PART 2 OF 2
COURSEWORK TRANSCRIPT**

** NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- **Name:** Adam Smeets [redacted]
- **Institution Affiliation:** Loyola University Chicago (ID: 460)
- **Institution Email:** asmeets@luc.edu
- **Institution Unit:** School of Education
- **Phone:** [redacted]

- **Curriculum Group:** Human Research
- **Course Learner Group:** Group 1 Lakeside investigator
- **Stage:** Stage 1 - Basic Course
- **Description:** Select Group 1 if you are a Lakeside investigator unless you are conducting research that is purely biological/medical in nature.

- **Record ID:** 24797109
- **Report Date:** 26-Aug-2021
- **Current Score**:** 100

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT	SCORE
Defining Research with Human Subjects - SBE (ID: 491)	17-Sep-2019	5/5 (100%)
LOYOLA UNIVERSITY CHICAGO (ID: 537)	18-Jun-2021	No Quiz
Belmont Report and Its Principles (ID: 1127)	17-Sep-2019	3/3 (100%)
The Federal Regulations - SBE (ID: 502)	17-Sep-2019	5/5 (100%)
Assessing Risk - SBE (ID: 503)	17-Sep-2019	5/5 (100%)
Informed Consent - SBE (ID: 504)	17-Sep-2019	5/5 (100%)
Privacy and Confidentiality - SBE (ID: 505)	17-Sep-2019	5/5 (100%)
Research with Prisoners - SBE (ID: 506)	17-Sep-2019	5/5 (100%)
Research with Children - SBE (ID: 507)	17-Sep-2019	5/5 (100%)
Research in Public Elementary and Secondary Schools - SBE (ID: 508)	17-Sep-2019	5/5 (100%)
International Research - SBE (ID: 509)	17-Sep-2019	5/5 (100%)
Internet-Based Research - SBE (ID: 510)	17-Sep-2019	5/5 (100%)
History and Ethical Principles - SBE (ID: 490)	11-Oct-2017	5/5 (100%)
Vulnerable Subjects - Research Involving Workers/Employees (ID: 483)	17-Sep-2019	4/4 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

[redacted].

Collaborative Institutional Training Initiative (CITI Program)
Email: support@citiprogram.org
Phone: 888-529-5929
Web: https://www.citiprogram.org

REFERENCES

Abell Foundation. (2008). *One-to-one computing in public schools: Lessons from "Laptops for All" programs* (ED505074). ERIC. http://files.eric.ed.gov/fulltext/ED505074.pdf

Abelson, H., Goodman, N., & Rudolph, L. (1974). *LOGO manual*. Massachusetts Institute of Technology Artificial Intelligence Laboratory. https://dspace.mit.edu/handle/1721.1/6226

Ackerman, W. C. (1945). The dimensions of American broadcasting. *Public Opinion Quarterly*, *9*(1), 1. https://doi.org/10.1086/265716

Adelsberger, H., Kinshuk, D., Pawlowski, J., & Sampson, D. (2008). *Handbook on information technologies for education and training* (2nd ed.). Springer. https://doi.org/10.1007/978-3-540-74155-8

Airasian, P., Cruikshank, K., Mayer, R., Pintrich, P., Raths, J., & Wittrock, M. (2001). *Taxonomy for learning, teaching, and assessing: Revision of Bloom's taxonomy of educational objectives* (L. Anderson & D. Krathwohl (Eds.). Pearson.

Algozzine, B., Campbell, P., & Wang, A. (Eds.) (2009). *63 Tactics for teaching diverse learners, Grades 6-12*. Corwin Press.

American Association of School Librarians. (2009). *Standards for the 21st-century learner in action*. American Association of School Librarians.

Ansary, T. (2007, March 9). *Education at risk: Fallout from a flawed report*. Edutopia. https://www.edutopia.org/landmark-education-report-nation-risk

Apple, M. W. (2014). *Official knowledge: Democratic education in a conservative age* (3rd ed.). Routledge. https://doi.org/10.4324/9780203814383

Archambault, L., & Crippen, K. (2009). Examining TPACK among K-12 online distance educators. *Contemporary Issues in Technology and Teacher Education*, *9*(1). http://www.citejournal.org/vol9/iss1/general/article2.cfm

Assessment., O. of T. (1995). Teachers and technology: Making the connection. In *Washington, DC: U.S. Government Printing Office* (Vol. 1).

Aziz, H. (2010, September). *The 5 Keys to Educational Technology*. THE Journal. https://thejournal.com/Articles/2010/09/16/The-5-Keys-to-Educational-Technology.aspx/?p=1

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall.

Barker, J. A. (1992). *Paradigms: The business of discovering the future*. Harper Collins.

Barkley, E. F., Major, C. H., & Cross, K. P. (2014). *Collaborative learning techniques* (2nd ed.). Jossey-Bass.

Bear Rapids School District. (2013). *Device focus group feedback - chromebooks*.

Bear Rapids School District. (2016). *Parent FAQ on 1:1 technology plan*. http://ipsdweb.ipsd.org/uploads/1to1/OneOnOneParentFAQ.pdf

Bear Rapids School District. (2017a). *January 2017 1:1 implementation plan update board presentation*.

Bear Rapids School District. (2017b, May). *Staff laptop feedback (middle school)*. https://docs.google.com/forms/d/1WUFwXA6XfgQNjlyVVhEjKF-REmHpH_7ojLJZb8DL9n4/edit

Bear Rapids School District. (2018a). *Bear rapids educational association agreement (2018-2022)*. http://ipsdweb.ipsd.org/uploads/HR/IPEAContract1822.pdf

Bear Rapids School District. (2018b, December 10). *Portrait of a graduate*. https://www.ipsd.org/Subpage.aspx/PortraitOfAGraduate

Bear Rapids School District. (2019a). *Fast facts*. http://www.ipsd.org/Subpage.aspx/204FastFacts

Bear Rapids School District. (2019b, January 24). *Flea market: Flip your classroom*. https://www.youtube.com/watch?v=P3j1-_85v1Q

Bear Rapids School District Board of Education. (2019). *District policy 5:170 copyright*.

Bebell, D., & Kay, R. (2010). One-to-one computing: A summary of the quantitative results from the Berkshire wireless learning initiative. *Journal of Technology, Learning, and Assessment*, *9*(2), 1–60.

Bebell, D., & O’Dwyer, L. M. (2010). Educational outcomes and research from 1:1 computing settings. *Journal of Technology, Learning, and Assessment*, *9*(1), 1–16.

Belanger, Y. (2002). Laptop computers in the K-12 classroom. *Teacher Librarian*, *29*(4), 31.

Bielefeldt, T. (2005). Computers and student learnings. *Journal of Research on Technology in Education*, *37*(4), 339–347. https://doi.org/10.1080/15391523.2005.10782441

Bitner, N., & Bitner, J. (2002). Integrating technology into the classroom: Eight keys to success. In *Jl. of Technology and Teacher Education* (Vol. 10, Issue 1).

Bloom, B. (1956). *Taxonomy of educational objectives, handbook I: The cognitive domain* (2nd ed.). Addison-Wesley Longman.

Bloom, B. (1968). Learning for mastery. *UCLA Evaluation Comment*, *1*, 1–12.

Bowles, N. (2018, October 26). *The digital gap between rich and poor kids is not what we expected*. The New York Times. https://www.nytimes.com/2018/10/26/style/digital-divide-screens-schools.html

Brand, G. A. (1997). What research says: Training teachers for using technology. *Journal of Staff Development*, *19*(1).

Brandon, P. R. (1988). Recent developments in instructional hardware and software. *Educational Technology*, *28*(10), 7–12. http://www.jstor.org/stable/44427650

Breakstone, J., Smith, M., Wineburg, S., Rapaport, A., Carle, J., Garland, M., & Saavedra, A. (2019). *Students' civic online reasoning: A national portrait*. https://purl.stanford.edu/gf151tb4868

Brenoff, A. (2017, August 24). There's no such thing as "digital natives." *Huffington Post*. https://www.huffingtonpost.com.au/entry/digital-natives-dont-actually-exist_n_599c985de4b0a296083a9e8a

Brickner, D., & Russell, J. (1995). *The effects of first- and second-order barriers to change on the degree and nature of computer usage of secondary mathematics teachers: A case study* [Purdue University]. https://doi.org/AAI9540219

Brush, T., Glazewski, K., Rutowski, K., Berg, K., Stromfors, C., Hernandez Van-Nest, M., Stock, L., & Sutton, J. (2003). Integrating technology in a field-based teacher training program: The PT3@ASU project. *Educational Technology Research and Development*, *51*(1), 57–72. https://doi.org/10.1007/BF02504518

Buglio, J. (2020). *Communications department update*. https://go.boarddocs.com/il/ipsd/Board.nsf/files/BTWNQK610CB6/$file/Comm Dept Board Update 10.05.20 - FINAL.pdf

Burbules, N. C., & Callister, T. A. (2018). *Watch it: The risks and promises of information technologies for education*. Routledge. https://doi.org/10.4324/9780429503153

Byers, T., Imms, W., & Hartnell-Young, E. (2014). Making the case for space: The effect of learning spaces on teaching and learning. *Curriculum and Teaching*, *29*(1), 5–19. https://doi.org/10.7459/ct/29.1.02

Cakir, R. (2012). Technology integration and technology leadership in schools as learning organizations. *Turkish Online Journal of Educational Technology*, *11*(4), 273–282.

Calhoun Williams, K. (2019). *Top five strategic technologies impacting K-12 education in 2017*. Gartner. https://www.gartner.com/document/3899966

Carpenter, J. (2019, May 24). Federal jury: HISD staff repeatedly violated copyright laws, owe company $9.2M. *The Houston Chronicle*. https://www.houstonchronicle.com/news/education/article/Federal-jury-HISD-staff-repeatedly-violated-13895634.php

Chai, C. S., & Koh, J. H. L. (2017). Changing teachers' TPACK and design beliefs through the scaffolded TPACK lesson design model (STLDM). *Learning: Research and Practice*, *3*(2), 114–129. https://doi.org/10.1080/23735082.2017.1360506

Channel One News. (2012). *Frequently asked questions*. https://www.channelone.com/frequently-asked-questions/

Chickering, A. W., & Gamson, Z. F. (1987). The seven principles for good practice in undergraduate education. *AAHE Bulletin*, 3–7. https://files.eric.ed.gov/fulltext/ED282491.pdf

Churches, A. (2008). *Bloom's digital taxonomy*. http://burtonslifelearning.pbworks.com/f/BloomDigitalTaxonomy2001.pdf

Cipriano, C., & Brackett, M. (2020, April 7). *Teachers are anxious and overwhelmed: They need SEL now more than ever*. EdSurge. https://www.edsurge.com/news/2020-04-07-teachers-are-anxious-and-overwhelmed-they-need-sel-now-more-than-ever

Collis, B. (1996). The internet as an educational innovation: Lessons from experience with computer implementation. *Educational Technology*, *36*(6), 21–30. http://www.jstor.org/stable/44428370

COMOSAConnect. (2018, February 12). *Radio education*. https://comosaconnect.org/radio-education/

Confrey, J., Makar, K., & Kazak, S. (2004). Undertaking data analysis of student outcomes as professional development for teachers. *Zentralblatt Für Didaktik Der Mathematik*, *36*(1), 32–40. https://doi.org/10.1007/BF02655755

CoSN, AASA, T. S. S. A., MDR, & Forecast5. (2017). *2017 Annual infrastructure Survey*. https://nces.ed.gov/pubs2016/2016076/tables/table_04.asp.

CoSN, AASA, T. S. S. A., MDR, & Forecast5. (2019a). *2018 Annual infrastructure Report*.

CoSN, AASA, T. S. S. A., MDR, & Forecast5. (2019b). *CoSN's 2019 K-12 IT leadership survey report*.

Creswell, J. W. (2005). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (2nd ed.). Pearson. https://www.pearson.com/us/higher-education/product/Creswell-Educational-Research-Planning-Conducting-and-Evaluating-Quantitative-and-Qualitative-Research-2nd-Edition/9780131127906.html

Creswell, J. W. (2013). *Qualitative inquiry and research design: choosing among five approaches* (3rd ed.). SAGE Publications.

Crichton, S., Pegler, K., & White, D. (2012). Personal devices in public settings: Lessons learned from an iPod touch / iPad project. *The Electronic Journal of E-Learning*, *10*(1), 23–31. https://files.eric.ed.gov/fulltext/EJ969433.pdf

Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Harvard University Press.

Davenport, A., Gorbatkin, S., Pease, K., & Hillman, B. (2015). *Device plan recommendation: School board workshop presentation*.

Dawson, K., Pringle, R., & Lott Adams, T. (2003). Providing links between technology integration, methods courses, and school-based field experiences. *Journal of Computing in Teacher Education*, *20*(1), 41–47. https://doi.org/10.1080/10402454.2003.10784482

Dewey, J. (1916). *Democracy and education: An introduction to the philosophy of education*. The Macmillan Company.

Dewey, J. (1986). Experience and education. *The Educational Forum*, *50*(3), 241–252. https://doi.org/10.1080/00131728609335764

Dogan, S., Dogan, N. A., & Celik, I. (2021). Teachers' skills to integrate technology in education: Two path models explaining instructional and application software use. *Education and Information Technologies*, *26*(1), 1311–1332. https://doi.org/10.1007/s10639-020-10310-4

Donovan, L., & Green, T. (2009). Two-way mirror: Technology-rich K–8 and teacher education programs. *Action in Teacher Education*, *30*(4), 45–55. https://doi.org/10.1080/01626620.2009.10734451

Donovan, L., Green, T., & Hartley, K. (2010). An examination of one-to-one computing in the middle school: Does increased access bring about increased student engagement? *Journal of Educational Computing Research*, *42*(4), 423–441. https://doi.org/10.2190/EC.42.4.d

Donovan, L., Hartley, K., & Strudler, N. (2007). Teacher concerns during initial implementation of a one-to-one laptop initiative at the middle school level. *Journal of Research on Technology in Education*, *39*(3), 263–286. https://doi.org/10.1080/15391523.2007.10782483

Dresing, T., & Pehl, T. (2015). *Manual (on) transcription: Transcription conventions, software guides and practical hints for qualitative researchers* (3rd ed.). https://books.google.com/books/about/Manual_on_Transcription.html?id=XRjUuQEACAAJ

Duncan-Howell, J., & Lee, K.-T. (2007). M-Learning: Finding a place for mobile technologies within tertiary educational settings. *ICT: Providing Choices for Learners and Learning, Proceedings - Australian Society for Computers in Learning in Tertiary Education*, *1*, 223–231.

Dunleavy, M., Dexter, S., & Heinecke, W. F. (2007). What added value does a 1:1 student to laptop ratio bring to technology-supported teaching and learning? *Journal of Computer Assisted Learning*, *23*(5), 440–452. https://doi.org/10.1111/j.1365-2729.2007.00227.x

Erickson, F. (1986). Qualitative methods in research on teaching. In M. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed.). Macmillan.

Ertmer, P. (2003). Transforming teacher education: Visions and strategies. *Educational Technology Research and Development*, *51*(1), 124–128. https://doi.org/10.1007/BF02504522

Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development*, *47*(4), 47–61. https://doi.org/10.1007/BF02299597

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development*, *53*(4), 25–39. https://doi.org/10.1007/BF02504683

Ertmer, P. A., & Hruskocy, C. (1999). Impacts of a university-elementary school partnership designed to support technology integration. *Educational Technology Research and Development*, *47*(1), 81–96. https://doi.org/10.1007/BF02299478

Ertmer, P. A., & Ottenbreit-Leftwich, A. (2013). Removing obstacles to the pedagogical changes required by Jonassen's vision of authentic technology-enabled learning. *Computers & Education*, *64*, 175–182. https://doi.org/10.1016/j.compedu.2012.10.008

Fairman, J. (2004). *Trading roles: Teachers and students learn with technology*. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.123.7986&rep=rep1&type=pdf

Fang, Z. (1996). A review of research on teacher beliefs and practices. *Educational Research*, *38*(1), 47–65. https://doi.org/10.1080/0013188960380104

Farsaci, D. (2021, April 1). *Chromebook 1:1 technology*. Liverpool Central School District. https://www.liverpool.k12.ny.us/departments/technology/chromebook-1-1

Fernandes, G. W. R., Rodrigues, A. M., & Ferreira, C. A. (2020). Professional development and use of digital technologies by science teachers: A review of theoretical frameworks. *Research in Science Education*, *50*(2), 673–708. https://doi.org/10.1007/s11165-018-9707-x

Ferrer, F., Belvís, E., & Pàmies, J. (2011). Tablet PCs, academic results and educational inequalities. *Computers & Education*, *56*(1), 280–288. https://doi.org/10.1016/j.compedu.2010.07.018

Fiester, H., & Green, T. (2016). Student use of backchannels. *TechTrends*, *60*(4), 404–408. https://doi.org/10.1007/S11528-016-0069-9

Flake, L. H. (2017). E-Learning and the iNtegrating Technology for inQuiry (NTeQ) Model Lesson Design. *Journal of Education and E-Learning Research*, *4*(2), 72–80. https://doi.org/10.20448/journal.509.2017.42.72.80

Florida Center for Instructional Technology. (2019). *The technology integration matrix*. https://fcit.usf.edu/matrix/matrix/

Foulger, T. S., & Foulger, T. S. (2015). Graphic Assessment of TPACK Instrument (GATI) As a Professional Development Tool. *Society for Information Technology & Teacher Education International Conference*, *2015*(1), 3157–3168. http://www.learntechlib.org/noaccess/150413

Fox News. (2012, August 11). *Nonprofit urges schools to ban channel one newscast over onslaught of commercials*. https://www.foxnews.com/us/nonprofit-urges-schools-to-ban-channel-one-newscast-over-onslaught-of-commercials

Frawley, J. K. (2017, February 27). *The myth of the 'digital native'* . The University of Sydney. https://educational-innovation.sydney.edu.au/teaching@sydney/digital-native-myth/

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, *111*(23), 8410–8415. https://doi.org/10.1073/pnas.1319030111

Frieden, J., & Elliott, D. (2019, June 10). *Cesar Chavez: Respect for all learning guide*. Teach with Movies. http://teachwithmovies.org/cesar-chavez-respect-for-all/

Fry, M. (2015). Education, classification, and military strength: A look at the development of the U. S. Army during World War II. *Army Historians Training Symposium*.

Fullan, M. (1993). *Change forces: Probing the depths of educational reform* (1st ed.). Routledge.

Gagné, R. M. (1983). Some issues in the psychology of mathematics instruction. *Journal for Research in Mathematics Education*, *14*(1), 7. https://doi.org/10.2307/748793

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences* (1st ed.). Basic Books.

Gardner, H. (1999). *Intelligence reframed: Multiple intelligences for the 21st century*. Basic Books. https://psycnet.apa.org/record/1999-04335-000

Gates, B. (2005). America's high schools are obsolete. *National Education Summit on High Schools*. https://www.wsfcs.k12.nc.us/cms/lib/NC01001395/Centricity/ModuleInstance/17582/Bill_Gates_on_Education.pdf

Gibbs, G. (1988). *Learning by doing: A guide to teaching and learning methods* (FEU (Ed.)).

Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Sociology Press.

Goktas, Y., Yildirim, Z., & Yildirim, S. (2008). A review of ICT related courses in pre-service teacher education programs. *Asia Pacific Education Review*, *9*(2), 168–179. https://doi.org/10.1007/BF03026497

Goldsmith, R. E., & Foxall, G. R. (2003). *The measurement of innovativeness*. https://doi.org/10.1016/B978-008044198-6/50022-X

Goodman, W. (1990, March 14). Critic's notebook; tv news in the schools: Which channel, if any? *The New York Times*, 20. https://www.nytimes.com/1990/03/14/arts/critic-s-notebook-tv-news-in-the-schools-which-channel-if-any.html

Goos, M. (2005). A sociocultural analysis of the development of pre-service and beginning teachers? Pedagogical identities as users of technology. *Journal of Mathematics Teacher Education*, *8*(1), 35–59. https://doi.org/10.1007/s10857-005-0457-0

Gorbatkin, S. (2011). *Bring your own technology (BYOT) visit*.

Gray, L., Thomas, N., & Lewis, L. (2010). Teachers' use of educational technology in U.S. public schools: 2009. *National Center for Education Statistics, Institute of Educational Sciences*.

Groff, J. (2013). Technology-rich innovative learning environments. In *OCED CERI Innovative Learning Environment Project*. https://www.oecd.org/education/ceri/Technology-rich Innovative Learning Environments by Jennifer Groff.pdf

Grundmeyer, T. (2013). Adopting technology: Using student qualitative data and Gartner's hype cycle. *Journal of Education and Training Studies*, *2*(1). https://doi.org/10.11114/jets.v2i1.228

Guba, E. G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. *Educational Communication & Technology*, *29*(2), 75–91. https://doi.org/10.1007/BF02766777

Gulek, J. C., & Demirtas, H. (2004). Learning with technology: The impact of laptop use on student achievement. *Journal of Technology, Learning, and Assessment*, *3*(2).

Gustafson, K. L., & Branch, R. M. (2002). Survey of instructional development models. In *Trends and issues in instructional design and technology* (4th ed.). ERIC Clearinghouse on Information and Technology.

Hamilton, L., Halverson, R., Jackson, S., Mandinach, E., Supovitz, J., & Wayman, J. (2009). *Using student achievement data to support instructional decision making using student achievement data to support instructional decision making*. https://ies.ed.gov/ncee/wwc/Docs/PracticeGuide/dddm_pg_092909.pdf

Hammerman, J. K., & Rubin, A. (2004). Strategies for managing statistical complexity with new software tools. *Statistics Education Research Journal*, *3*(2), 17–41.

Hamre, B. K., & Pianta, R. C. (2001). Early teacher-child relationships and the trajectory of children's school outcomes through eighth grade. *Child Development*, *72*(2), 625–638. http://www.jstor.org/stable/1132418

Hannafin, M. J., & Land, S. M. (1997). The foundations and assumptions of technology-enhanced student-centered learning environments. *Instructional Science*, *25*(3), 167–202. https://doi.org/10.1023/A:1002997414652

Hannon, V. (2012). *Learning futures: Can we redesign schools into relevance?* Centre for Strategic Education.

Harrell, S., & Bynum, Y. (2018). Factors affecting technology integration the classroom. *Alabama Journal of Educational Leadership*, *5*(8), 12–18. https://eric.ed.gov/?id=EJ1194723

Hatton, N., & Smith, D. (1995). Reflection in teacher education: Towards definition and implementation. *Teaching and Teacher Education*, *11*(1), 33–49.

Haworth, M., & Hopkins, S. (2009, October 26). *On the air: Educational radio, its history and effect on literacy and educational technology*. https://blogs.ubc.ca/etec540sept09/2009/10/28/on-the-air-educational-radio-its-history-and-effect-on-literacy-and-educational-technology-by-michael-haworth-stephanie-hopkins/

Hazen, M. W. (1903). *Hazen's elementary history of the United States: A story and a lesson* (1st ed.). The Morse Company. http://hdl.handle.net/2027/nyp.33433012110429

Hedman, J., & Gimpel, G. (2010). The adoption of hyped technologies: A qualitative study. *Information Technology and Management*, *11*(4), 161–175. https://doi.org/10.1007/s10799-010-0075-0

Herrington, J., & Kervin, L. (2007). Authentic learning supported by technology: Ten suggestions and cases of integration in classrooms. *Educational Media International*, *44*(3), 219–236. https://doi.org/10.1080/09523980701491666

Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. *Educational Technology Research and Development*, *55*(3), 223–252. https://doi.org/10.1007/s11423-006-9022-5

Hill, J. R., Reeves, T. C., & Grant, M. M. (2002). *The Impact of portable technologies on teaching and learning: Year three report*. https://d1wqtxts1xzle7.cloudfront.net/30758308/Year3ReportFinalVersion.pdf

Hoffman, D. L., & Novak, T. P. (1998). *Bridging the digital divide: The impact of race on computer access and internet use*. https://files.eric.ed.gov/fulltext/ED421563.pdf

Hokanson, B., & Hooper, S. (2000). Computers as cognitive media: examining the potential of computers in education. *Computers in Human Behavior*, *16*, 537–552. www.elsevier.com/locate/comphumbeh

Howard, S. K. (2011). Affect and acceptability: exploring teachers' technology-related risk perceptions. *Educational Media International*, *48*(4), 261–272. https://doi.org/10.1080/09523987.2011.632275

Howard, S. K. (2013). Risk-aversion: understanding teachers' resistance to technology integration. *Technology, Pedagogy and Education*, *22*(3), 357–372. https://doi.org/10.1080/1475939X.2013.802995

Hu, W. (2007, May 4). Seeing no progress, some schools drop laptops. *The New York Times*. https://www.nytimes.com/2007/05/04/education/04laptop.html

Hutchison, A., Beschorner, B., & Schmidt-Crawford, D. (2012). Exploring the use of the ipad for literacy learning. *The Reading Teacher*, *66*(1), 15–23. https://doi.org/10.1002/TRTR.01090

Illinois State Board of Education. (2019). *Bear rapids school district report card*. https://www.illinoisreportcard.com/District.aspx?source=studentcharacteristics&source2=enrollment&Districtid=19022204026

Illinois State Board of Education. (2020a). *2019 summative designations - elementary / middle schools*. https://www.isbe.net/Documents/Elementary-Middle-Designations.pdf

Illinois State Board of Education. (2020b, January 27). *Summative designations*. https://www.isbe.net/summative

Ingram, D., Willcutt, J., & Jordan, K. (2008). *Laptop initiative: Evaluation report.* http://oakland2.stillwater.k12.mn.us/sites/f1c1a073-106e-4552-82a3-3b75eff284c3/uploads/CAREI_Report.pdf

International Society for Technology in Education. (2020a). *Essential conditions*. https://www.iste.org/standards/essential-conditions

International Society for Technology in Education. (2020b). *ISTE standards*. https://www.iste.org/standards

International Society for Technology in Education. (2021). *Essential conditions*. Essential Conditions. https://www.iste.org/standards/essential-conditions

Iscioglu, E. (2011). Perceived computer self-efficacy of secondary education teachers. *The New Educational Review*, *23*(1), 189–198.

Islam, M. S., & Andersson, A. (2016). Investigating choices of appropriate devices for one-to-one computing initiatives in schools worldwide. *International Journal of Information and Education Technology*, *6*(10), 817–825. https://doi.org/10.7763/IJIET.2016.V6.799

Islam, M. S., & Grönlund, Å. (2016). An international literature review of 1:1 computing in schools. *Journal of Educational Change*, *17*(2), 191–222. https://doi.org/10.1007/s10833-016-9271-y

Jacobs, L. (1967). World War II and the American film. *Cinema Journal*, *7*, 1. https://doi.org/10.2307/1224874

Johnson, D. W., Johnson, R. T., & Smith, K. A. (1991). *Cooperative learning: Increasing college faculty instructional productivity. ASHE-ERIC Higher Education Report, No. 4.* https://files.eric.ed.gov/fulltext/ED343465.pdf

Jones, C., & Czerniewicz, L. (2010). Describing or debunking? The net generation and digital natives. *Journal of Computer Assisted Learning*, *26*(5), 317–320. https://doi.org/10.1111/j.1365-2729.2010.00379.x

Kamler, B., & Comber, B. (2005). Turn-around pedagogies: improving the education of at-risk students. *Improving Schools*, *8*(2), 121–131. https://doi.org/10.1177/1365480205057702

Katz, K. B., & Kratcoski, A. (2005). Teacher–student interactions in a ubiquitous computing environment: Learning within dyads & triads of interaction. *Journal of the Research Center for Educational Technology*, *1*.

Kelly, F., McCain, T., & Jukes, I. (2009). Teaching the digital generation: no more cookie-cutter high schools. *Choice Reviews Online*, *47*(02), 47-1000-47–1000. https://doi.org/10.5860/CHOICE.47-1000

Kemeny, J., & Kurtz, T. (1964). *BASIC*. http://bitsavers.trailing-edge.com/pdf/dartmouth/BASIC_Oct64.pdf

Kerr, S. T. (1996). Visions of sugarplums: The future of technology, education and the schools. In *95th Yearbook of the National Society for the Study of Education, Part II*. University of Chicago Press. http://faculty.washington.edu/stkerr/sugrplum.htm

Kim, B. (2001). *Social constructivism*. Orey, M. (Ed.), Emerging Perspectives on Learning, Teaching, and Technology. http://www.coe.uga.edu/epltt/SocialConstructivism.htm

Kingston Community Schools. (2019). *Intermediate school 1:1 classroom management*. http://www.kingstonk12.org/uploads/2/4/8/8/24886671/1-1-classroom-management-intermediate-schools1.pdf

Kirschner, P. A., & De Bruyckere, P. (2017). The myths of the digital native and the multitasker. *Teaching and Teacher Education*, *67*, 135–142. https://doi.org/10.1016/j.tate.2017.06.001

Kirst, M. (1983). *A new school finance for a new era of fiscal constraint*. https://files.eric.ed.gov/fulltext/ED235565.pdf

Kivunja, C. (2014). Do you want your students to be job-ready with 21st century skills? change pedagogies: A pedagogical paradigm shift from Vygotskyian social constructivism to critical thinking, problem solving and Siemens' digital connectivism. *International Journal of Higher Education*, *3*(3). https://doi.org/10.5430/ijhe.v3n3p81

Klein, A. (2020, January 21). Flexible seating: Collaboration catalyst or classroom disaster? *Education Week*. https://www.edweek.org/teaching-learning/flexible-seating-collaboration-catalyst-or-classroom-disaster/2020/01

Klieger, A., Ben-Hur, Y., & Bar-Yossef, N. (2010). Integrating laptop computers into classroom: Attitudes, needs, and professional development of science teachers—a case study. *Journal of Science Education and Technology*, *19*(2), 187–198. https://doi.org/10.1007/s10956-009-9191-1

Knapp, M. S., Swinnerton, J. A., Copland, M. A., & Monpas-Huber, J. (2006). *Data-informed leadership in education*. www.wallacefoundation.org.

Koehler, M., & Mishra, P. (2005a). Teachers learning technology by design. *Journal of Computing in Teacher Education*, *21*(3), 94–102.

Koehler, M., & Mishra, P. (2005b). What happens when teachers design educational technology? The development of technological pedagogical knowledge. *Journal of Educational Computing Research*, *32*(2), 131–152.

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60–70.

Koh, J. H. L., Chai, C. S., Hong, H.-Y., & Tsai, C.-C. (2015). A survey to examine teachers' perceptions of design dispositions, lesson design practices, and their relationships with technological pedagogical content knowledge (TPACK). *Asia-Pacific Journal of Teacher Education*, *43*(5), 378–391. https://doi.org/10.1080/1359866X.2014.941280

Kolodner, J. L., Camp, P. J., Crismond, D., Fasse, B., Gray, J., Holbrook, J., Puntambekar, S., & Ryan, M. (2003). Problem-based learning meets case-based reasoning in the middle-school science classroom: putting learning by design into practice. *Journal of the Learning Sciences*, *12*(4), 495–547. https://doi.org/10.1207/S15327809JLS1204_2

Kozma, R. B. (1991). Learning with media. *Review of Educational Research*, *61*(2), 179–211. https://doi.org/10.3102/00346543061002179

Krauskopf, K., Foulger, T. S., & Williams, M. K. (2018). Prompting teachers' reflection of their professional knowledge. A proof-of-concept study of the Graphic Assessment of TPACK Instrument. *Teacher Development*, *22*(2), 153–174. https://doi.org/10.1080/13664530.2017.1367717

Kuckartz, U., Dresing, T., Rädiker, S., & Stefer, C. (2008). *Qualitative evaluation: Der einstieg in die praxis* (2nd (English Transl)). VS Verlag für Sozialwissenschaften. https://link.springer.com/book/10.1007/978-3-531-91083-3

Lambert, J., & Gong, Y. (2010). 21st century paradigms for pre-service teacher technology preparation. *Computers in the Schools*, *27*(1), 54–70. https://doi.org/10.1080/07380560903536272

Lawson, T. J., Bodle, J. H., Houlette, M. A., & Haubner, R. R. (2006). Guiding questions enhance student learning from educational videos. *Teaching of Psychology*, *33*(1), 31–33. https://doi.org/10.1207/s15328023top3301_7

Le Fevre, D. M. (2014). Barriers to implementing pedagogical change: The role of teachers' perceptions of risk. *Teaching and Teacher Education*, *38*, 56–64. https://doi.org/10.1016/j.tate.2013.11.007

LeCompte, M. D., Preissle, J., & Tesch, R. (1993). *Ethnography and qualitative design in educational research* (2nd ed.). Emerald Publishing Limited. https://www.amazon.com/Ethnography-Qualitative-Design-Educational-Research/dp/0124405754

Lei, J., & Zhao, Y. (2008). One-to-one computing: what does it bring to schools? *Journal of Educational Computing Research*, *39*(2), 97–122. https://doi.org/10.2190/EC.39.2.a

Lemke, C., Coughlin, E., Gunn, C., Burkhardt, G., Monsour, M., Valdez, G., Dawson, M., Thadani, V., & Martin, C. (2003). *enGauge 21st century skills for 21st century learners: Literacy in the digital age*. www.metiri.com

Leung, C. (2004). Developing formative teacher assessment: Knowledge, practice, and change. *Language Assessment Quarterly*, *1*(1), 19–41. https://doi.org/10.1207/s15434311laq0101_3

Lim, C. S., Tang, K. N., & Kor, L. K. (2012). Drill and practice in learning (and beyond). In *Encyclopedia of the Sciences of Learning* (pp. 1040–1042). Springer US. https://doi.org/10.1007/978-1-4419-1428-6_706

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. SAGE Publications, Inc. https://us.sagepub.com/en-us/nam/naturalistic-inquiry/book842

Livingston, K. (2017). The complexity of learning and teaching: Challenges for teacher education. *European Journal of Teacher Education*, *40*(2), 141–143. https://doi.org/10.1080/02619768.2017.1296535

LoTi Connection. (n.d.). *LoTI framework review*. Retrieved August 30, 2021, from https://drive.google.com/file/d/1h1L6Kz0qJQpQhySIbKuw5qQPReJsXQ-c/edit

LoTi Connection. (2012). *Validity and reliability*. https://www.loticonnection.com/index.php/assessment/validating-research/44-validity-reliability

Loughran, J. J. (1996). *Developing reflective practice: Learning about teaching and learning through modeling*. Falmer Press.

Lowther, D. L., Inan, F. A., Strahl, J. D., & Ross, S. M. (2012). Do one-to-one initiatives bridge the way to 21st century knowledge and skills? *Journal of Educational Computing Research*, *46*(1), 1–30. https://doi.org/10.2190/EC.46.1.a

Luterbach, K. J., & Brown, C. (2011). Education for the 21st century. *International Journal of Applied Educational Studies*, *11*(1), 14–32. https://link.gale.com/apps/doc/A270618198/AONE

Mager, R. (1962). *Preparing instructional objectives* (1st ed.). Fearon Publishers.

Maine, G., & Project, S. (2004). One-to-one laptops in a high school environment. *Computing*, *February*.

Mainelli, T., & Marden, M. (2015, September). The economic value of chromebooks for educational institutions. *International Data Corporation*. https://webobjects.cdw.com/webobjects/media/pdf/google/CB-EconomicValue-Whitepaper.pdf

Maloy, R. W., Verock-O'Loughlin, R.-E., Edwards, S. A., & Woolf, B. P. (2010). *Transforming learning with new technologies* (2nd ed.). https://www.pearson.com/us/higher-education/product/Maloy-Transforming-Learning-with-New-Technologies-2nd-Edition/9780133155716.html

Malterud, K. (2001). Qualitative research: Standards, challenges and guidelines. *The Lancet*, *358*, 483–488.

Maninger, R. M., & Holden, M. E. (2009). Put the textbooks away: Preparation and support for a Middle school one-to-one laptop initiative. *American Secondary Education*, *38*.

Marie Neaves, A. (2015). *The perceived impact of 1:1 ipad implementation on teaching and learning: A pedagogical case study*. https://digitalcommons.gardner-webb.edu/education_etd

Marshall, D. T., Shannon, D. M., & Love, S. M. (2020). How teachers experienced the COVID-19 transition to remote instruction. *Phi Delta Kappan*, *102*(3), 46–50. https://doi.org/10.1177/0031721720970702

Martino, J. (2009). *One laptop per child and Uruguay's Plan Ceibal: Impact on special education.* [University of Guelph]. https://hdl.handle.net/10214/19483

Martorella, P. H. (1997). Technology and the social studies—or: Which way to the sleeping giant? *Theory & Research in Social Education*, *25*(4), 511–514. https://doi.org/10.1080/00933104.1997.10505828

McFarlane, A. (2003). Information technology and authentic learning. In *Information Technology and Authentic Learning: Realising the Potential of Computers in the Primary Classroom*. Routledge. https://doi.org/10.4324/9780203440674

McGuinn, P. (2006). *No child left behind and the transformation of federal education policy, 1965-2005*. University Press of Kansas.

Means, B., Chen, E., DeBarger, A., & Padilla, C. (2011). *Teachers' ability to use data to inform instruction: Challenges and supports*.

Means, B., & Olson, K. (1995). *Technology's role in education reform: Findings from a national study of innovating schools*. http://www.ed.gov/PDFDocs/techrole.pdf

Means, B., & Olson, K. (1997). *Technology & education reform: Studies of education reform*. DIANE Publishing.

Mehta, V. (2011). *Structural validity and item functioning of the LoTi digital-age survey* [University of North Texas]. https://digital.library.unt.edu/ark:/67531/metadc68014/m2/1/high_res_d/dissertation.pdf

Merriam-Webster Online. (n.d.). *Digital divide [Def. 1]*. Merriam-Webster. Retrieved November 12, 2020, from https://www.merriam-webster.com/dictionary/digital divide

Merriam, S. (2009). *Qualitative research: A guide to design and implementation* (3rd ed.). Jossey-Bass.

Mezzacappa, D., & Hangley Jr, B. (2020). Online equity would require more than Chromebooks. *The Notebook*. https://thenotebook.org/articles/2020/04/07/online-equity-means-more-than-chromebooks/

Microsoft. (2006). *Turtle logo for kids*. CodePlex Archive. https://archive.codeplex.com/?p=logo

Miles, M. B., Huberman, A. M., & Saldaña, J. (2020). *Qualitative data analysis: A methods sourcebook* (4th ed.). SAGE Publications.

Miller, L. (2007, July 9). NBC news to provide content for Channel One. *The New York Times*. https://www.nytimes.com/2007/07/09/business/media/09channel.html

Millis, B. J., & Cottell Jr., P. G. (1997). *Cooperative learning for higher education faculty*. American Council on Education, Series on Higher Education. The Oryx Press.

Mills, A. (2013a). Instrumental Case Study. In A. Mills, G. Durepos, & E. Wiebe (Eds.), *Encyclopedia of case study research* (2nd ed.). SAGE Publications, Inc. https://doi.org/10.4135/9781412957397.N175

Mills, A. (2013b). Retrospective case study. In A. Mills, G. Durepos, & E. Wiebe (Eds.), *Encyclopedia of Case Study Research* (2nd ed.). SAGE Publications, Inc. https://doi.org/10.4135/9781412957397.N303

Mills, A., Durepos, G., & Wiebe, E. (2013). Naturalistic generalization. In *Encyclopedia of Case Study Research*. SAGE Publications, Inc. https://doi.org/10.4135/9781412957397.n224

Ministry of Primary and Secondary Education. (2020). *ZBC radio lessons programme schedule eight primary school (ECD-Grade 6)*. https://www.unicef.org/zimbabwe/media/3071/file/week 15 and 16 radio lesson schedule.pdf

Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Moersch, C. (1995). Levels of technology implementation (LoTi): A framework for measuring classroom technology use. *Learning and Leading with Technology*, *23*, 40.

Moersch, C. (1999). Levels of technology implementation: An inventory for measuring classroom technology use. *Learning and Leading with Technology*, *26*(8), 59–63.

Moersch, C. (2010). LoTi turns up the heat! *Learning and Leading with Technology*, *37*(1), 20–23.

Moersch, C. (2011). *Digital age best practices: teaching and learning refocused*. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.800.5887&rep=rep1&type=pdf

Mondale, S. (2001). *As American as public school: 1900–1950*. Films Media Group. https://films.com/id/1540/As_American_as_Public_School_1900

Moore, G. (1965, April). Cramming more components onto integrated circuits. *Journal of Electronics and Control*, *38*(8). https://drive.google.com/file/d/0By83v5TWkGjvQkpBcXJKT1I1TTA/view

Morrison, G., & Lowther, D. (2005). *Integrating computer technology into the classroom* (3rd ed.). Pearson. https://www.pearson.com/us/higher-education/program/Morrison-Integrating-Computer-Technology-into-the-Classroom-3rd-Edition/PGM6851.html

Morrison, J. (2008). Why teachers must be data experts. *Educational Leadership*, *66*(4), 1–5. http://www.ascd.org/publications/educational-leadership/dec08/vol66/num04/Why-Teachers-Must-Be-Data-Experts.aspx

Mouza, C. (2008). Learning with laptops. *Journal of Research on Technology in Education*, *40*(4), 447–472. https://doi.org/10.1080/15391523.2008.10782516

Munkittrick, P. (n.d.). *The digital disconnect*. Retrieved November 1, 2020, from https://web.archive.org/web/20120412194646/http://www.digitaldisconnect.net/?p=20

NASA. (2007). *Sputnik: The beep heard round the world, the birth of the space age*. NASA.

National Commission on Excellence in Education. (1983). *A Nation at risk: The imperative for educational reform. A report to the nation and the Secretary of Education United States Department of Education* (Vol. 26). US Department of Education. http://eric.ed.gov/?id=ED226006

National Education Technology Plan Update. (2017). https://tech.ed.gov/files/2017/01/NETP17.pdf

New York Times News Service. (1985, December 15). Toymakers search for expandable "concepts." *The Tuscaloosa News*, 44A. https://news.google.com/newspapers?id=nTYdAAAAIBAJ&sjid=o6UEAAAAIBAJ&pg=6875

Niederhauser, D. ., & Stoddart, T. (2001). Teachers' instructional perspectives and use of educational software. *Teaching and Teacher Education*, *17*(1), 15–31. https://doi.org/10.1016/S0742-051X(00)00036-6

Nisanci, M., & Nisanci, M. (2000). Instructional software evaluation criteria used by the teachers: implications. *Society for Information Technology & Teacher Education International Conference*, *2000*(1), 1548–1552.

Norton, J. (2011, April 20). Education week teacher: Passion-based learning for the 21st century. *Education Week American Education News*. http://www.edweek.org/tm/articles/2011/04/20/interview_nussbaumbeach.html

Novak, J., & Gowin, D. B. (1984). *Learning how to learn*. Cambridge University Press.

O'Sullivan, R. G. (1991). Improving evaluation design and use through the "evaluation crosswalk" method. *National Forum of Applied Education Research Journal*, *4*, 43–49.

Ofsted. (2008). *Mathematics: understanding the score Improving practice in mathematics teaching at primary level*. www.ofsted.gov.uk/publications

Okri, B. (1997). *A Way of Being Free* (1st ed.). Weidenfeld & Nicholson.

Oppenheimer, T. (1997, July). *The computer delusion*. The Atlantic. https://www.theatlantic.com/magazine/archive/1997/07/the-computer-delusion/376899/

Otter.ai Privacy Officer. (2020, May 20). *Otter.ai privacy policy*. https://blog.otter.ai/privacy-policy/

Painter, S. R. (2001). Issues in the observation and evaluation of technology integration in K-12. *Journal of Computing in Teacher Education*, *17*(4), 21–25. https://www.tandfonline.com/doi/abs/10.1080/10402454.2001.10784421

Papanastasiou, E., Zembylas, M., & Vrasidas, C. (2003). Can computer use hurt science achievement? The USA Results from PISA. *Journal of Science Education and Technology*, *12*(3), 325–332. https://doi.org/10.1023/A:1025093225753

Paraskeva, F., Bouta, H., & Papagianni, A. (2008). Individual characteristics and computer self-efficacy in secondary education teachers to integrate technology in educational practice. *Computers & Education*, *50*(3), 1084–1091. https://doi.org/10.1016/j.compedu.2006.10.006

Partelow, L. (2018, July 29). *Curriculum reform in the nation's largest school districts*. Center for American Progress. https://www.americanprogress.org/issues/education-k-12/reports/2018/08/29/454705/curriculum-reform-nations-largest-school-districts/

Patton, M. Q. (1990). *Qualitative evaluation and research methods* (2nd ed.). Sage Publications, Inc. https://legacy.oise.utoronto.ca/research/field-centres/ross/ctl1014/Patton1990.pdf

Pease, K., & Lee, L. (2018). *What is #FUTUREREADY204?* http://engage204.org/uploads/IPSD204CommunityEngagementSession3.pdf

Peck, K., & Sprenger, K. (2008). One-to-one educational computing: Ten lessons for successful implementation. In J Voogt & G. Knezek (Eds.), *International Handbook of Information Technology in Primary and Secondary Education* (pp. 935–942). Springer US. https://doi.org/10.1007/978-0-387-73315-9_58

Pellegrino, J., Chudowsky, N., & Glaser, R. (Eds.). (2001). *Knowing what students know*. National Academy Press. https://www.nap.edu/read/10019/chapter/1

Penuel, W. R. (2006). Implementation and effects of one-to-one computing initiatives. *Journal of Research on Technology in Education*, *38*(3), 329–348. https://doi.org/10.1080/15391523.2006.10782463

Perillo, S. (2007). Reaching generation Y: To be or not to be relevant. *Australian Anglican Schools Network*, 17–19.

Pink, D. (2006). *A whole new mind: Moving from the information age to the conceptual age* (Paperback). Penguin Publishing Group.

Pithers, R. T., & Soden, R. (2000). Critical thinking in education: a review. *Educational Research*, *42*(3), 237–249. https://doi.org/10.1080/001318800440579

Polikoff, M., & Dean, J. (2019). *The supplemental curriculum bazaar: Is what's online any good?* https://fordhaminstitute.org/national/research/supplemental-curriculum-bazaar

Prensky, M. (2001). Digital natives, digital immigrants part 1. *On the Horizon*, *9*(5), 2–6.

Prensky, M. (2005). "Engage me or enrage me" What today's learners demand. *Educause Review*, *40*(October), 60–65. http://net.educause.edu/ir/library/pdf/erm0553.pdf

Price, J. H., & Murnan, J. (2004). Research limitations and the necessity of reporting them. *American Journal of Health Education*, *35*, 66–67.

Provenzo, E. F., & Cuban, L. (1986). Teachers and machines: The classroom use of technology since 1920. *History of Education Quarterly*, *26*(4), 647. https://doi.org/10.2307/369036

Reid, S. (1942). Radio in the schools of Ohio. *Educational Research Bulletin*, *21*(5), 115–148. https://doi.org/10.2307/1473784

Reid, S., & Day, D. (1942). Radio and records in education. *Review of Educational Research*, *12*(3), 305. https://doi.org/10.2307/1168714

Reiser, R. (2001). A history of instructional design and technology part 1: A history of instructional media. *Educational Technology Research and Development*, *49*(1), 53–64.

Reiser, R., & Dempsey, J. J. (2001). *Trends and issues in instructional design and technology*. Pearson.

Rekimoto, J., Ayatsuka, Y., Uoi, H., & Arai, T. (1998). *Adding another communication channel to reality*. 271–272. https://doi.org/10.1145/286498.286752

Richey, R. C., Silber, K. H., & Ely, D. P. (2008). Reflections on the 2008 AECT definitions of the field. *TechTrends*, *52*(1), 24–25.

Roblyer, M. D., & Hughes, J. (2019). *Integrating educational technology into teaching* (8th ed.). Pearson Education.

Rockman, S., Walker, L., & Chessler, M. (2000). A more complex picture: Laptop use and impact in the context of changing home and school access–the third in a series of research studies on Microsoft's anytime anywhere learning program. *San Francisco, CA: Microsoft*. www.rockman.com

Rosen, Y., & Beck-Hill, D. (2012). Intertwining digital content and a one-to-one laptop environment in teaching and learning: Lessons from the time to know program. *Journal on Research on Technology in Education*, *44*(3), 225–241. https://files.eric.ed.gov/fulltext/EJ976467.pdf

Ross, S. (2005). *2004-2005 Evaluation report of michigan's freedom to learn program (FTL)*.

Ruggiero, D., & Mong, C. (2013). Improving understanding of pre-service teacher experience with technology integration. *The International Journal of Multimedia & Its Applications*, *5*(5), 1–15. https://doi.org/10.5121/ijma.2013.5501

Russell, M. (2006). *Technology and assessment: The tale of two interpretations*. Information Age Publishing.

Russell, Michael, Bebell, D., & Higgins, J. (2004). Laptop learning: A comparison of teaching and learning in upper elementary classrooms equipped with shared carts of laptops and permanent 1:1 laptops. *Journal of Educational Computing Research*, *30*(4), 313–330. https://doi.org/10.2190/6E7K-F57M-6UY6-QAJJ

Saavedra, A. R., & Opfer, V. D. (2012). Learning 21st-century skills requires 21st-century teaching. *Phi Delta Kappan*, *94*(2), 8–13. https://doi.org/10.1177/003172171209400203

Saettler, P. (2004). *The evolution of american educational technology*. Information Age Publishing. https://www.kobo.com/us/en/ebook/the-evolution-of-american-educational-technology

Sandholtz, J. H., Ringstaff, C., & Dwyer, D. (1997). *Creating student-centered classrooms* (1st ed.). Teachers College Press.

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological Pedagogical Content Knowledge (TPACK). *Journal of Research on Technology in Education*, *42*(2), 123–149. https://doi.org/10.1080/15391523.2009.10782544

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action* (1st ed.). Temple Smith.

Schön, D. A. (1987). *Educating the reflective practitioner*. Jossey-Bass.

Schoppek, W., & Tulis, M. (2010). Enhancing arithmetic and word-problem solving skills efficiently by individualized computer-assisted practice. *The Journal of Educational Research*, *103*(4), 239–252. https://doi.org/10.1080/00220670903382962

Schutt, R. (2019). *Investigating the social world* (9th ed.). SAGE Publications.

Schwartz, S. (2020, June 2). *It was a bumpy ride, but virtual schooling during the coronavirus boosted teachers' tech skills*. Education Week. https://www.edweek.org/technology/it-was-a-bumpy-ride-but-virtual-schooling-during-the-coronavirus-boosted-teachers-tech-skills/2020/06

Seay, S. (2014). Faculty and librarian partnerships: Avenues for providing information literacy and critical thinking instruction to student breadwinners and others. *Conference on Higher Education Pedagogy*. https://www.slideshare.net/DrLendySpires/conference-on-higher-education-pedagogy

Severin, E., & Capota, C. (2011). *One-to-one laptop programs in Latin America and the Caribbean: Panorama and perspectives*.

Shade, D. (2001). Introduction. *Information technology in childhood education annual*, 1–3.

Shapley, K., Sheehan, D., Sturges, K., Caranikas-Walker, F., Huntsberger, B., & Maloney, C. (2009). *Evaluation of the Texas technology immersion pilot: Final outcomes for a four-year study (2004–05 to 2007–08)*. http://www.tcer.org/research/etxtip/documents/y4_etxtip_final.pdf

Sheneman, D. (2013, March 25). And now a word from our sponsor... *The Star-Ledger*. https://www.nj.com/njv_shenemans_sketchpad/2013/03/and_now_a_word_from_our_sponso.html

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15*(2), 4–14. https://doi.org/10.2307/1175860

Silvernail, D. L., & Buffington, P. J. (2009). *Improving mathematics performance using laptop technology: The importance of professional development for success*. http://www2.umaine.edu/mepri/sites/default/files/Mathematics_Final_cover.pdf

Smeets, A. (2018). *Technology services annual update, 2017-2018 school year*. https://go.boarddocs.com/il/ipsd/Board.nsf/files/B456PM763642/$file/2018.9.4 - Board Presentation.pdf

Smeets, A. (2019, May). *Bear Rapids School District technology plan*. http://tech.ipsd.org/Subpage.aspx?id=1439

Smeets, A. (2020). *Technology services annual update, 2019-2020 school year*. https://go.boarddocs.com/il/ipsd/Board.nsf/files/BTNUT27D88F6/$file/Board of Education - Tech Update - September 21%2C 2020.pdf

Smith, F. J. (1913, July 9). The evolution of the motion picture: VI – Looking into the future with Thomas A. Edison. *The New York Dramatic Mirror*, 24. https://quoteinvestigator.com/2012/02/15/books-obsolete/

Smith, K. A. (1996). Cooperative learning: Making “groupwork” work. *New Directions for Teaching and Learning*, *1996*(67), 71–82. https://doi.org/10.1002/tl.37219966709

Snyder, T., Dillow, S., & Hoffman, C. (2007). *Digest of Education Statistics, 2006*. https://nces.ed.gov/pubs2007/2007017.pdf

Solomon, G. (2015, February 25). *In the 1980s, it was all about the software*. Tech & Learning. https://www.techlearning.com/resources/in-the-1980s-it-was-all-about-the-software

Song, H., & Kidd, T. (2009). Handbook of research on human performance and instructional technology. In *Handbook of Research on Human Performance and Instructional Technology*. Information Science Reference. https://doi.org/10.4018/978-1-60566-782-9

Stake, R. (1995). *The art of case study research*. Sage.

Stake, R., & Trumbull, D. (1982). Stake, Robert E., and Deborah J. Trumbull, “Naturalistic Generalizations,” Review Journal of Philosophy and Social Science, 7(Nos. 1 & 2, 1982), 1-12.

Stein, P. (2020, August 24). D.C. public schools trying to close a big digital divide - The Washington Post. *Washington Post*. https://www.washingtonpost.com/local/education/dc-had-a-summer-to-connect-with-students-and-close-the-digital-divide-did-it/2020/08/24/3b533112-de22-11ea-8051-d5f887d73381_story.html

Stein, R. E., Colyer, C. J., & Manning, J. (2016). Student accountability in team-based learning classes. *Teaching Sociology*, *44*(1), 28–38. https://doi.org/10.1177/0092055X15603429

Stobaugh, R. R., & Tassell, J. L. (2011). Analyzing the degree of technology use occurring in pre-service teacher education. *Educational Assessment, Evaluation and Accountability*, *23*(2), 143–157. https://doi.org/10.1007/s11092-011-9118-2

Stoltzfus, J. (2006). *Determining educational technology and instructional learning skill sets (DETAILS): A New Approach to the LoTi Framework for the 21 st Century*.

Stoltzfus, J. (2009). *Criterion-related validation of the core LoTi levels: An Exploratory analysis*.

Storz, M. G., & Hoffman, A. R. (2013). Examining response to a one-to-one computer initiative: Student and teacher voices. *RMLE Online*, *36*(6), 1–18. https://doi.org/10.1080/19404476.2013.11462099

Strang, J., Davenport, A., Gorbaktin, S., Grinstead, B., Kreiter, M., & Vanderploeg, K. (2011). *Strategic planning July 25, 2011 school board presentation*.

Sufka, K. J., & George, M. D. (2000). Setting clear and mutual expectations. *Liberal Education*, *86*(1), 48. https://wakonse.org/content/pdf/Sufka and George.pdf

Sullivan, K., Pease, K., Gorbatkin, S., Hillman, B., Davenport, A., & Gamboa, P. (2017). A journey to future ready: Getting it done thru vision, collaboration & leadership. *ICE Conference*.

Sultan, W. H., Woods, P., & Koo, A. C. (2011). A constructivist approach for digital learning: Malaysian schools case study. *Educational Technology & Society*, *14*(4), 149–163. https://www.researchgate.net/publication/220374085_A_Constructivist_Approach_for_Digital_Learning_Malaysian_Schools_Case_Study

Sumsion, J. J. (1997). *Early childhood student teachers' reflection on their professional development and practice: a longitudinal study* [University of Sydney]. http://setis.library.usyd.edu.au/~thesis/adt-NU/public/adt-NU1999.0027/

Suter, W. (2014). Qualitative data, analysis, and design. In *Introduction to Educational Research: A Critical Thinking Approach* (pp. 342–386). SAGE Publications, Inc. https://doi.org/10.4135/9781483384443.n12

Swan, K., Kratcoski, A., Mazzer, P., & Schenker, J. (2005). Bringing mohamed to the mountain: Situated professional development in a ubiquitous computing classroom. *Journal of Educational Computing Research*, *32*(4), 353–365. https://doi.org/10.2190/2GMU-AG3T-Q3CC-GE5D

Swan, M. (2006). *Collaborative learning in mathematics: A challenge to our beliefs and practices*.

Tapscott, D. (1999). *Growing up digital: The rise of the net generation* (1st ed.). McGraw-Hill Trade.

Tapscott, D. (2010). Grown up digital: how the net generation is changing your world. *Choice Reviews Online*, *47*(06), 47-3242-47–3242. https://doi.org/10.5860/CHOICE.47-3242

Toffler, A. (1984). *Future shock*. Bantam. https://www.amazon.com/Future-Shock-Alvin-Toffler/dp/0553277375

Tom, A. (1997). *Redesigning teacher education* (1st ed.). State University of New York Press.

Tomassini, J. (2012, May 8). Educators weigh e-textbook cost comparisons. *Education Week*. https://www.edweek.org/ew/articles/2012/05/09/30etextbooks_ep.h31.html

Tucker, D., Soundy Unwin, P., & Unwin, G. (1999). *History of publishing - Spread of education and literacy*. Britannica. https://www.britannica.com/topic/publishing/Spread-of-education-and-literacy

U.S. Copyright Office. (1990). *Chapter 1 - Circular 92 | U.S. Copyright Office*. Library of Congress U.S.A. https://www.copyright.gov/title17/92chap1.html#107

Urbani, J., Roshandel, S., Michaels, R., & Truesdell, E. (2017). Developing and modeling 21st-century skills with preservice teachers. *Teacher Education Quarterly*, *44*(Fall), 27–50. https://eric.ed.gov/?id=EJ1157317

Valente, A. (2012). Changes in print paper during the 19th century. *Anything Goes*, 182–187. https://doi.org/10.5703/1288284314836

Vamvakitis, J. (2019). *Around the world and back with Google for education*. https://www.blog.google/outreach-initiatives/education/around-the-world-and-back/

Van de Wall, J. A., Karp, K. S., & Bay-Williams, J. M. (2012). *Elementary and middle school mathematics: Teaching developmentally*. Pearson.

Van de Wall, J. A., & Lovin, L. H. (2006). *Teaching student-centered mathematics: Grades 3-5*. Pearson.

van der Laan, J. M. (2004). Neil Postman and the critique of technology. *Bulletin of Science, Technology & Society*, *24*(2), 145–150.

Van Tonder, J., Woite, N., Strydom, S., Mahomed, F., & Swanepoel, D. W. (2016). Effect of visual feedback on classroom noise levels. *South African Journal of Childhood Education*, *5*(3). https://doi.org/10.4102/sajce.v5i3.265

Vannatta, R. A., & Nancy, F. (2004). Teacher dispositions as predictors of classroom technology use. *Journal of Research on Technology in Education*, *36*(3), 253–271. https://doi.org/10.1080/15391523.2004.10782415

Vigdor, J., & Ladd, H. (2010). *Scaling the digital divide: Home Computer technology and student achievement*. https://doi.org/10.3386/w16078

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & van Braak, J. (2013). Technological pedagogical content knowledge - a review of the literature. *Journal of Computer Assisted Learning*, *29*(2), 109–121. https://doi.org/10.1111/j.1365-2729.2012.00487.x

Voogt, Joke, & McKenney, S. (2017). TPACK in teacher education: are we preparing teachers to use technology for early literacy? *Technology, Pedagogy and Education*, *26*(1), 69–83. https://doi.org/10.1080/1475939X.2016.1174730

Walker, J. D., Brooks, D. C., & Baepler, P. (2011, December 15). *Pedagogy and space: Empirical research on new learning environments | EDUCAUSE*. EDUCAUSE Review. https://er.educause.edu/articles/2011/12/pedagogy-and-space-empirical-research-on-new-learning-environments

Walther, J. B., Anderson, J. F., & Park, D. W. (1994). Interpersonal effects in computer-mediated interaction. *Communication Research*, *21*(4), 460–487. https://doi.org/10.1177/009365094021004002

Ware, J., & Stein, S. (2014). Teachers' critical evaluations of dynamic geometry software implementation in 1:1 classrooms. *Computers in the Schools*, *31*(3), 134–153. https://doi.org/10.1080/07380569.2014.931779

Warschauer, M. (2008). Laptops and literacy: A multi-site case study. *Pedagogies: An International Journal*, *3*(1), 52–67. https://doi.org/10.1080/15544800701771614

Welsh, J. L. (n.d.). *Technology integration matrix*. Retrieved December 7, 2020, from https://fcl.eun.org/documents/10180/404247/FCL+SL_Promethean_TIM_Introduction+v4.pdf/43fe763d-1fa9-445c-b24d-4dcf6f575ddd

Wharton School of the University of Pennsylvania. (2008, June 11). *Bridging the global digital divide, one laptop at a time*. Knowledge @ Wharton. https://knowledge.wharton.upenn.edu/article/bridging-the-global-digital-divide-one-laptop-at-a-time/

Wilkerson, M. H., Andrews, C., Shaban, Y., Laina, V., & Gravel, B. E. (2016). What's the technology for? Teacher attention and pedagogical goals in a modeling-focused professional development workshop. *Journal of Science Teacher Education*, *27*(1), 11–33. https://doi.org/10.1007/s10972-016-9453-8

Wood, E., Mueller, J., Willoughby, T., Specht, J., & Deyoung, T. (2005). Teachers' perceptions: Barriers and supports to using technology in the classroom. *Education, Communication & Information*, *5*(2), 183–206. https://doi.org/10.1080/14636310500186214

World Economic Forum. (2016). The future of jobs employment, skills and workforce strategy for the fourth industrial revolution. In *Growth Strategies* (Issue january). http://search.proquest.com/docview/1776113790?accountid=26646%5Cnhttp://link.periodicos.capes.gov.br/sfxlcl41

World Economic Forum. (2020). The future of jobs report 2020. In *The Future of Jobs Report* (Issue October). https://www.weforum.org/

Wylie, C. D. (2012). Teaching manuals and the blackboard: accessing historical classroom practices. *History of Education*, *41*(2), 257–272. https://doi.org/10.1080/0046760X.2011.584573

Yildirim, S. (2000). Effects of an educational computing course on preservice and inservice teachers. *Journal of Research on Computing in Education*, *32*(4), 479–495. https://doi.org/10.1080/08886504.2000.10782293

Yin, R. K. (2014). *Case study research: Design and methods* (5th ed.). Sage.

Yin, R. K. (2017). *Case study research and applications: Design and methods 6th Edition* (L. Fargostein, C. Neve, K. DeRosa, & G. Dickens (Eds.); 6th ed., Issue 6e). Sage Publishing.

Zuber, E. N., & Anderson, J. (2013). The initial response of secondary mathematics teachers to a one-to-one laptop program. *Mathematics Education Research Journal*, *25*(2), 279–298. https://doi.org/10.1007/s13394-012-0063-2

Zucker, A. A., & Hug, S. T. (2007). *A study of the 1:1 laptop program at the Denver school of science & technology*. Denver School of Science and Technology.

Zucker, A. A., & McGhee, R. (2005). *A study of one-to-one computer use in mathematics and science instruction at the secondary level in Henrico County Public Schools*. SRI International

VITA

Adam Smeets is the son of Krislette and Doug Smeets. He is the grandson of Arlene and Dominic Vota and Caroline and William Smeets. A native of Elwood, Illinois, Adam was raised along with his sister Arianne. He resides in Chicago with his husband (Justin), three children (Collins, Emmett, and Harper), and two dogs (Henry and Cooper).

Adam attended Elwood School for K-8 and Joliet Central for high school in Illinois. He graduated from Loyola University Chicago with a Bachelor of Arts in English with Honors and Secondary Education. In 2002, Adam was inducted into the English Honor Society, Sigma Tau Delta. In 2006, he earned a Master of Education in Educational Technology from the School of Education at the University of Delaware. Adam's thesis examined eXtensible Markup Language (XML) and Shareable Content Object Model (SCORM) integration for open-source and proprietary learning management systems. In 2014, during his doctoral work at Loyola University Chicago, Adam was inducted into the Jesuit Honor Society, Alpha Sigma Nu.

From 2006 to 2018, Adam was an adjunct instructor for courses highlighting quantitative research, cybersecurity, computer science, and educational technology for pre-service teachers. Adam is currently an Education Industry Solutions Architect at Microsoft. He works with Microsoft's largest education customers to help them accelerate towards their business goals, take advantage of digital transformation, improve the business value and innovate in their students, faculty, and staff. Prior to Microsoft, he served in escalating technology leadership roles in K-12 and Higher Education with his most recent K-12 role as Chief Technology Officer for Indian Prairie School District 204 and Higher Education as Assistant Vice President and Deputy Chief Information Officer at Dominican University.

DISSERTATION COMMITTEE

The Dissertation submitted by Adam Smeets has been read and approved by the following committee:

David Ensminger, Ph.D., Director
Associate Professor, School of Education
Loyola University Chicago

Dr. Kelly Ferguson
Clinical Assistant Professor, School of Education
Loyola University Chicago

Kate Marek, Ph.D.
Director and Professor, School of Information Studies
Dominican University