Leadership for Personalized Learning in a One-to-One Computing Environment

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A Capstone Project

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Doctor of Education

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Executive Summary

School and district leaders have long grappled with how new technology such as personal computing devices will change, disrupt, or revolutionize education (Christensen, Horn, & Johnson, 2008; Cuban, 2001). Increasingly, schools are providing each student a computer with which to complete academic tasks (Penuel, 2006), and some schools specify the purpose of providing those devices as personalizing learning for students (Horn, 2016; Pane, Steiner, Baird & Hamilton, 2015; Patrick, Worthen, Frost, & Gentz, 2016). Implementing personalized learning initiatives in one-to-one learning environments creates multi-faceted leadership challenges, which require significant district and school-level attention. This study investigates leadership practices in three high schools in one district, to identify what practices are key to supporting teachers as they implement personalized learning in a new one-to-one computing environment.

While studies have documented that students in one-to-one programs demonstrate increased technology proficiency and improved writing ability (Penuel, 2006; Silvernail & Gritter, 2007; Shapley, Sheehan, Maloney, & Caranikas-Walker, 2011), personalized learning remains ill-defined (Horn, 2016), with scarce evidence that it improves student outcomes (Pane et al., 2015; Penuel, 2016). Furthermore, research on leadership for technology integration provides insufficient rigorous evidence of what leadership practices effectively support the implementation of technology-based school improvement efforts (McCleod & Richardson, 2011). This study seeks to contribute to

the literature on leadership for technology integration, personalized learning, and one-to-one device integration by analyzing leadership practices from multiple perspectives in a current personalized learning initiative featuring one-to-one computing.

Using a mixed-methods multi-case study approach, I triangulated district and school leaders' qualitative focus group data with descriptive statistics and path analyses of the teacher perception survey data to investigate the leadership practices that help teachers integrate one-to-one devices to personalize learning for students. This study relies on a conceptual framework based on essential leadership practices for improving student outcomes (Leithwood, 2012a) and school-based factors related to laptop integration (Inan & Lowther, 2010). School and district leaders described their understanding of personalized learning and explained what leadership practices they had enacted to support the one-to-one initiative and personalized learning, while teachers reported their perceptions about those same leadership practices. The teacher perception data enabled me to compare teacher perceptions to what leaders described, as to replicate and build upon the path analysis conducted by Inan and Lowther (2010). The results from both levels of focus groups and the teacher perception survey informed findings, recommendations, implications, and action communication products.

The findings indicate that at the time of the study, leaders had enacted minimal leadership practices to implement personalized learning. District leaders had recently initiated collaborative efforts to determine the vision of personalized learning, but school

leaders had not yet introduced such practices. Teacher professional development for personalized learning focused primarily on technological tools such as the new devices, and there were insufficient resources available for technical and instructional support for teachers to integrate one-to-one devices for personalized learning. The path analysis confirmed the importance of teacher beliefs about technology integration and overall support for teachers implementing personalized learning with one-to-one devices.

To address these findings, I recommend creating a district-wide vision as well as district and school plans for personalized learning, developing school leaders' and teachers' capacity to implement personalized learning, and allocating sufficient resources to technical and staffing needs to support the personalized learning and one-to-one initiatives. Implications of these recommendations include budgetary requirements, additional staffing needs, possible community reaction, and the need for further research on personalized learning and leadership for technology-based school improvement efforts. Action communication products provide district and school leaders with a recommendation report and a personalized learning planning guide for use by teams to help guide leadership practices to support the continued implementation of this initiative in the three high schools and the district.

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APPROVAL OF THE CAPSTONE PROJECT

This capstone project, "Leadership for Personalized Learning in a One-to-One Computing Environment" has been approved by the Graduate Faculty of the Curry School of Education in partial fulfillment of the requirements for the degree of Doctor of Education.

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March 22, 2017

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Date of Defense

Dedication

To my incredible wife Melissa and my loving family.

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Chapter 1: Introduction

In education, new technologies frequently garner enthusiastic, but often unfounded, support for their potential to change the way students learn (Cuban, 2001). This study will investigate leadership practices supporting the implementation of a popular trend known as "Personalized Learning," which in current models usually depends on student having access to one-to-one computing devices (Pane, Steiner, Baird & Hamilton, 2015). While Horn (2016) calls personalized learning "today's most hyped phrase," many schools and school districts see it as a way to harness new technologies to bolster student achievement for learners of all backgrounds, interests, and abilities (Patrick, Worthen, Frost, & Gentz, 2016). To personalize learning, schools often provide each student one-to-one access to a computer or tablet, which can facilitate aspects of personalization (Pane et al., 2015). As these initiatives pose multifaceted and complex challenges for teachers and leaders, it is important to investigate leadership practices that help teachers implement personalized learning in a one-to-one computing environment.

While not a new concept, personalizing learning for students has recently become a popular strategy for schools to harness new technologies to support student learning (Horn, 2016; Pane et al., 2015). Personalized learning has evolved over time, donning many definitions and conceptualizations (Childress & Benson, 2014; Horn, 2016; Keefe, 2007; Lee, 2014; Sebba, Brown, Steward, Galton, & James, 2008). Schools attempting to

implement personalized learning strategies often do so differently. Much of the positive evidence supporting personalized learning is anecdotal (Childress & Benson, 2014; Clarke, 2013), or limited in its generalizability due to variations in implementation within schools of choice (Penuel & Johnson, 2016).

As one-to-one computer access is an essential component in many modern personalized learning programs (Pane et al., 2015), this study's investigation will also focus on how leaders support teachers' integration of one-to-one devices into instruction to personalize students' learning. One-to-one programs have taken firm root in schools around the world. Plan Ceibal, a country-wide Uruguayan One Laptop Per Child (OLPC) program (Romero, 2013), Maine's Learning Technology Initiative started in 2002 (Silvernail & Gritter, 2007), and nascent initiatives being launched throughout the United States (Lowther, Strahl, Inan & Bates, 2007) exemplify the proliferation of one-to-one programs. Purposes for such programs include improving academic achievement, raising student engagement, providing the foundation for success in the 21st century, engendering equity, and ensuring economic competitiveness (Lemke, Coughlin, & Reifsneider 2009; Penuel, 2006). Research has indicated that one-to-one computing substantially increases student use of technology for a variety of tasks (Bebell & Kay, 2010), and may be positively associated with student outcomes such as computer literacy, writing skills, and engagement (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2011; Silvernail & Gritter, 2007).

Leadership practices, support for teachers, and teacher learning influence teacher readiness and teacher beliefs about technology integration, which affects teachers'

integration of technology into instruction (Inan & Lowther, 2010). School and district leaders play an essential role in establishing environments where teachers can learn to integrate one-to-one technology to personalize learning for their students. This study attempts to uncover what leadership practices are essential in supporting teachers to personalize learning by harnessing the learning tools available through one-to-one device access.

Background

During the 2014-2015 school year, three high schools in a suburban school district that will be referred to as Park Gables Public Schools implemented a new one-to-one laptop initiative, which was initially launched with the title "Personalized Learning." The district planned to distribute laptop computers to high school students over four years, one grade per year starting with ninth grade students. Up to that point, each school procured and managed their computer labs, laptop and iPad carts, and classroom technology, with teachers and students accessing technology on a shared basis.

Problem Statement

The literature provides little evidence that personalized learning (Horn, 2016; Pane et al., 2015; Penuel & Johnson, 2016) or the availability of computing devices significantly alters teacher practices or improves student achievement in core academic areas (Bebell & Kay, 2010; Cuban, 2013; Higgins, Xiao & Katsipataki, 2012; Zucker & Light, 2012). Despite a study by Pane et al. (2015) claiming promising outcomes related to personalized learning, Penuel and Johnson (2016) caution that those results are not generalizable due to the sample of schools and variability of strategies employed by the

schools in the study.

As it relates to one-to-one integration, while studies have shown that teachers integrate technology more often in one-to-one environments (Bebell & Kay, 2010; Penuel, 2006), there remains significant evidence that teachers have adapted technologies to fit traditional teacher-centered instruction, leaving most teaching practices unaltered (Cuban, 2013). Shapley et al. (2011) found that teachers used technology more often for teacher-centered tasks than for their students. Also, there is scant evidence that one-to-one programs impact learning in core academic areas outside writing ability (Bebell & Kay, 2010; Shapley et al. 2011).

Given the significant investment in one-to-one technology and the eagerness of schools to implement personalized learning, combined with the lack of empirical evidence that these programs significantly improve student outcomes, there is a critical need for more research on these programs. Also, it is imperative that school leaders understand how to support teachers in learning to integrate one-to-one technology into their instruction to personalize learning for their students**.** Desired student outcomes will be unlikely unless educators' instructional strategies evolve to harness one-to-one computing capabilities. The proposed research will investigate the problem of practice of how school and district leaders enact leadership practices to foster support for personalized learning in a one-to-one computing environment.

Research Questions

This study will examine, using a mixed-methods multi-case approach, the leadership practices enacted to implement a personalized learning initiative in a new one-

to-one computing environment. The study will explore the implementation of a personalized learning initiative and one-to-one program paying particular attention to leadership actions supporting the conditions in which teachers learn to integrate this technology in ways that personalize learning for students. The research questions include:

1. How have district and school leaders defined personalized learning?
2. What leadership practices have district and school leaders employed to help teachers prepare for and implement personalized learning in a one-to-one computing environment?
3. What learning opportunities or other support elements do teachers report as key to helping them to integrate one-to-one laptops for personalized learning?

Methods

The overarching question driving this research is how leaders supported the implementation of personalized learning for students in a one-to-one computing environment. The first two research questions sought to help the researcher identify what leaders considered personalized learning, and what key leadership practices supported the implementation of the program. I conducted one focus group with district leaders involved with implementing personalized learning, and focus groups with each school's leadership team. These school-based focus groups included the school principal and assistant principals and other school leaders including teacher-leaders, and one school included their Instructional Technology Coordinator (ITC). I analyzed and coded these focus groups with a coding scheme developed from the conceptual framework.

To answer research questions two and three, I administered an online survey to

teachers in each high school to investigate teachers' perceptions of leadership practices such as setting directions and providing support, as well as their readiness and beliefs about one-to-one technology integration and personalizing learning. I analyzed the teacher survey data using descriptive statistics, as well as path analysis based on the conceptual framework adapted from a study by Inan and Lowther (2010). The findings reveal teachers' perceptions about what leadership practices most influence their ability to integrate one-to-one technology and personalize learning.

Conceptual Framework

The conceptual framework for this study includes key leadership domains, school-based factors known to influence teachers' integration of laptops into instruction, and a contemporary application of personalized learning. Each of these components is described briefly here and then elaborated upon in the literature review. Leadership plays a major role in impacting student learning, and also in how effectively technology is integrated within the school (Leithwood, Seashore-Louis, Anderson, & Wahlstrom, 2004; Dexter, 2008). This study draws upon a theoretical leadership framework (Leithwood et al., 2004; Leithwood, 2012a), which organizes leadership practices for implementing the personalized learning and one-to-one initiatives. This framework identifies three core leadership domains of setting directions, developing people, and redesigning the organization. Also, conceptualizations of distributed leadership and leadership for technology are essential to effective technology integration (Spillane, 2006; Leithwood, Seashore-Louis, Anderson, & Wahlstrom, 2010; Dexter, Anderson, & Ronnkvist, 2002; Inan & Lowther, 2010). Inan and Lowther (2010) developed a model of how three

school-based factors, overall support, technical support, and professional development influence teacher beliefs and readiness, which then impact teachers' integration of laptops into instruction. In the conceptual framework for this study, the school-based factors are subsumed by Leithwood's (2004) aforementioned leadership practices, constructing a leadership-oriented foundation for the study.

The two teacher-level variables, teachers' beliefs about technology and teachers' readiness to integrate one-to-one devices into instruction, emerged from the literature and were significantly related to teacher use of laptops (Inan & Lowther, 2010). Howard, Chan, and Caputi (2015) further elaborated that teachers' beliefs and readiness differ by subject area, an important consideration for secondary school leaders and educators. While the Inan and Lowther (2010) model features an outcome variable indicating the frequency with which teachers' integrate laptops, this study also relates the exogenous variables in the model to teachers' perceptions of their ability to personalize learning for their students using one-to-one devices. Thus this model explicitly links leadership practices to school-based factors related to teacher factors influencing laptop use, but also incorporates a measure related to teachers' perceived ability to personalize learning.

Essential Literature

Current models of personalized learning describe a learning process where technology helps facilitate instruction that is tailored to each student based on student learning characteristics and interests (Pane et al., 2015). Despite a lack of clarity on what constitutes personalized learning (Horn, 2016), the strategy persists due to many market-based and technology-related claims that lack sufficient empirical support (Hartley, 2007;

Penuel & Johnson, 2016). While some evidence points to the potential of personalized learning strategies (Pane et al., 2015) and closely related blended learning strategies (Horn & Staker, 2015; Murphy, Snow, Mislevy, Gallagher, Krum, & Wei, 2014), the literature lacks sufficient evidence that such programs positively influence student outcomes.

In considering the effectiveness of one-to-one initiatives, it is paramount to consider how leadership for technology supports environments where teachers learn about integrating one-to-one technology. Leadership for technology builds upon the foundational research on effective school leadership (Hallinger & Heck, 1996), leadership associations with student achievement outcomes (Leithwood, Seashore Louis, Anderson, & Wahlstrom, 2004), and notions of distributed leadership (Spillane, 2001). This paper will draw from the leadership framework established by Leithwood et al. (2004) identifying three core leadership practices associated with improved student outcomes: setting directions, developing people and redesigning the organization. Furthermore, school leadership for technology integration commonly involves the distribution of leadership throughout a variety of individuals including administrators, specialists, teacher leaders, and teachers (Dexter, 2011). Spillane (2006) describes distributed leadership as stretched over leaders, followers and the situation, where leaders' practices involve tools and routines that are enacted over time to achieve common goals. Harris (2008) extends this conception to practical applications by leaders seeking to distribute leadership purposefully throughout an organization. This research will incorporate the notion of leadership practices enacted by several school leaders to

foster environments where teachers learn to personalize learning using one-to-one technology.

Within these environments, teachers learn to improve instructional practice by first assimilating new knowledge into existing knowledge, beliefs and teacher practices (Spillane, 2004). Building new knowledge of how to integrate one-to-one technology to personalize learning requires restructuring existing technological and pedagogical knowledge, a process that is enhanced through sustained grappling with new ideas (Strike & Posner, 1985; Carey, 1985, as cited in Spillane, 2004, p. 8). Research shows that effective professional development is relevant, incorporates active learning, provides opportunities for collaboration with teachers from the same school, department or grade, is ongoing in nature, and is coherent with other school and district initiatives and goals (Garet, Porter, Desimone, Birman, & Yoon 2001).

In addition to building new knowledge structures to support effective one-to-one technology integration, teacher beliefs about technology integration influence their integration of laptops into instruction (Inan & Lowther, 2010). As such, developing teachers' self-efficacy by enabling mastery experiences (Bandura, 1997), building opportunities for teachers to communicate and observe advantages of technology (Rogers, 1995), and building formal, informal, and independent opportunities for teachers to learn about, implement, and reflect on one-to-one technology integration (Jones & Dexter, 2014) are essential to supporting the effective implementation of a one-to-one computing program.

The literature presents evidence that one-to-one computing leads to significantly

more integration of technology in instruction (Penuel, 2006), improvements in students' technology proficiency (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2011), and stronger student writing and English Language Arts achievement (Bebell & Kay, 2010; Silvernail & Gritter, 2007). In one-to-one environments, students use computers more often for meaningful learning tasks, such as researching information on the Internet and problem solving (Lowther, Inan, Ross, & Strahl, 2012), and are more likely to undertake student-centered work and technology-enhanced tasks (Shapley et al., 2011). Students and teachers report overwhelmingly positive perceptions of the educational opportunities afforded by increased use of educational technology (Bebell & Kay, 2010). Despite such positive evidence, there is scant support for the notion that one-to-one computing enhances achievement in core areas as measured by standardized assessments (Penuel, 2006; Lowther et al., 2012; Shapley et al., 2011). Thus evidence supports positive outcomes related to the integration of one-to-one computing in schools, yet fails to provide convincing support for improved student learning in core academic areas.

Limitations

This study presents several limitations, including its limited scope. By only examining three high schools in a single mid-sized, middle socioeconomic status school district, the proposed research will suffer in its generalizability. However, it is the correct scale of context to address the problem of practice described here. Another limitation is that the research was conducted only two years into a four-year implementation of the personalized learning initiative and one-to-one program, which meant that not all teachers, administrators, or students had access to new devices. Additionally, teachers

and leaders' responses indicated their perceptions after two years of this initiative. Hence administrators and educators had limited experience with implementing personalized learning in a one-to-one environment. Also, response rates to the survey were relatively low, especially in two of the three schools in the study. This implies that average survey results may be skewed towards the highest responding school and limits the confidence in the results. Finally, the leaders who participated in the district-level focus group were newly hired, and thus had not participated in activities during the first two years of the one-to-one and personalized learning initiatives.

Summary

To summarize, the purpose of this study was to gain insight about and support an ongoing personalized learning initiative associated with a one-to-one device program by improving leaders' ability to foster environments where teachers learn to implement personalized learning by harnessing effective one-to-one technology integration. This study will provide leaders in the school and district an in-depth evaluative analysis of the leadership practices associated with conditions for teachers' integration of one-to-one technology to personalize learning. Ultimately, the proposed research may also contribute to other schools or districts seeking to implement personalized learning or one-to-one initiatives, policy makers considering personalized learning programs, as well as the broader literature on technology leadership in the context of school leadership for improved student achievement.

Chapter 2: Literature Review

The current study attempts to link how leadership practices create conditions for teachers to personalize student learning using one-to-one devices. The literature review opens with definitions and evidence related to personalized learning, laying the foundations to investigate research questions one and two related to conceptualizations of personalized learning and leadership practices to foster personalized learning in a one-to-one computing environment. Next, the researcher will detail the theoretical and empirical underpinnings of leadership for student learning and technology integration.

The review of literature then provides the foundation for research question three, which seeks to investigate learning opportunities and support elements that are essential to helping teachers integrate one-to-one technology for personalized learning. The researcher considers relevant empirical studies and theory on teacher learning and professional development. Finally, the literature review provides evidence about teacher- and student-related findings in one-to-one computing environments, a structure Fleischer (2012) utilized in a literature review of one-to-one programs.

Personalized Learning

Background. Personalized learning has been around at least 50 years, but remains largely ill-defined, evolving based upon context and purpose (Sebba, Brown, Steward, Galton, & James, 2008). Keefe (2007) traces the first use of the term personalized learning to Fred Keller's Personalized System of Instruction (PSI) at the

University of Brasilia in 1962. PSI featured self-pacing, mastery requirements before moving on to new material and the use of proctors to foster testing, tutoring, and personal interaction (Keefe, 2007). Later variations in personalized learning include work by Anne Welsh Carroll (1975, as cited in Keefe, 2007) who sought to connect general and special education by using individualized education plans (IEPs) to match learner characteristics to the learning environment. In support of personalization, Patrick, Kennedy, and Powell (2013) cite Bloom's (1984) studies of students who received one-on-one instruction and achieved at much higher rates than students in a traditional classroom.

Differentiating instruction. Other notions related to personalized learning build upon what Tomlinson (as cited in Prain, Cox, & Deed, 2015) promotes as differentiation of instruction by task demand, pace, type of learning experience, and forms of assessment based on student characteristics. Also, some personalization advocates cite Gardner's (1983) theory of multiple intelligences, which postulates that individuals possess distinct domains of intelligence, as an impetus for teachers to tailor instruction to the various forms of intelligence or learning styles of their students. While cognitive scientists including Willingham (2009) have debunked the practice of identifying and teaching to specific intelligences or learning styles, this belief remains popular in educational arenas.

Personalization as co-constructed learning. Personalization has been used in the United States and abroad to describe learning environments that feature personal connections through advising or mentoring, small learning communities, or collegial school cultures, processes to diagnose relevant student learning characteristics, interactive learning environments, and flexible scheduling and pacing (Jenkins & Keefe,

2007). These features are designed to connect students to mentors who help design instructional experiences around students' interests and learning characteristics in small, interactive environments. Also, authentic assessment, curriculum entitlement, and student choice permeate conceptualizations and research about this form of personalized learning (Clarke, 2012; Jenkins & Keefe, 2002; Sebba et al., 2008). In these environments, personalizing learning can be achieved through relational agency between teachers and students who co-create learning experiences based on the expertise of the teacher, and the students' ability to develop independence as a learner (Prain, Cox, Deed, Dorman, Edwards, Farrelly, … Yager, 2013). Miliband (2006), UK School Standards Minister, described his vision for reforming British education by personalizing learning through tailoring instruction to student aptitudes and interests with the following five key elements:

- Using assessment for learning, data, and dialogue to diagnose every student's learning needs;
- developing the competence and confidence of each learner through teaching and learning strategies, which build on individual needs;
- fostering curriculum choice, which engages and respects students;
- demanding a radical approach to school organization and class organization based around student progress; and
- personalized learning means the community, local institutions and social services supporting schools to drive forward progress in the classroom.

Such versions of personalized learning feature communities of learners supported by

teachers acting as advisors and mentors to co-create learning environments based on students needs, interests, and curriculum, and where the learner maintains significant control over her or his learning.

While these conceptualizations of personalized instruction provide hope for educators who believe that personalizing instruction can help bolster student achievement, there is no consensus on what is personalized learning and limited evidence that personalized learning improves student outcomes. Anecdotal evidence from one high school's personalized learning program (Clarke, 2012), and evidence from Boston Pilot Schools (Tung, Ouimette, & Feldman, 2004) suggest that when students are empowered to undertake authentic and meaningful learning experiences tailored by educators around their interests and strengths, they are intrinsically motivated and engaged in learning. Tung et al. (2004) found that students in Boston pilot schools where efforts to personalize learning were present had higher attendance rates, higher graduation rates, and standardized test scores that were at or above district averages.

In the personalized learning program described by Clarke (2012), participating students could design their learning pathways in collaboration with a teacher and progress through authentic, interest-based learning experiences that earned them credits towards graduation. Clarke (2012) shared that students, especially those who had disengaged with the traditional program, found this learning environment engaging, and were more likely to demonstrate deep learning. Another study by Friedlaender, Burns, Lewis-Charp, Cook-Harvey, and Darling-Hammond (2014) investigated student outcomes in four small charter high schools engaging in some personalized learning strategies including

fostering relationships, engaging in student-driven, rigorous, and relevant instruction, and completing mastery-focused, inquiry-based assessments. They found that students in these small charter high schools outperformed students in other schools on state assessments, graduation rates, and preparing students for college (Friedlaender et al., 2014). Despite the seemingly promising evidence, the types of schools in the study limit their generalizability, and many other factors contributed to the successes of these programs. Thus, the empirical evidence available provides limited evidence that personalized learning strategies will improve student outcomes.

Current conceptualizations of personalized learning. The International Association for K-12 Online Learning (iNACOL) defines personalized learning as "tailoring learning for each student's strengths, needs, and interests – including enabling student voice and choice in what, how, when, and where they learn - to provide flexibility and supports to ensure mastery of the highest standards possible" (Patrick, Worthen, Frost, & Gentz. 2016). Technology features prominently in definitions and current implementations of personalized learning, with schools often providing students one-to-one devices (Horn, 2016; Pane et al., 2015; Patrick et al., 2016). In a Rand Corporation study commissioned by the Bill and Melinda Gates Foundation of schools implementing a variety of personalized learning strategies, Pane et al. (2015) featured the following essential features of personalized learning:

- Learner profiles that provide teachers up-to-date information about students' strengths, needs, interests, and motivation to inform teaching and learning;
- flexible personal learning paths that students take through content;

- competency-based progression allowing students to progress through content at their pace demonstrating mastery when ready;
- flexible learning environments with staff, classroom spaces, and time tailored to support personalization; and
- an emphasis on college and career readiness.

This definition differs slightly from another recent iteration of personalized learning by Lee (2014) who, in addition to personalized learning plans and competency-based progression, calls for project-based or problem-based learning, criterion-referenced assessment for ensuring student learning, and multi-year mentoring of students by a teacher. Technology such as learning management systems, student information systems, blended learning platforms, adaptive learning software, and online learning can now be used to deliver content, track student progress and provide teachers with real-time data on student learning (Herold, 2016). Advocates of such personalized learning models argue that new technologies, facilitated by access to one-to-one computing devices enable access to real-time learning data, flexible paths through learning, competency-based progression, and flexible learning environments (Herold, 2016; Pane et al., 2015).

Another framework for personalized learning was designed by LEAP Innovations (2016), a Chicago-based nonprofit organization focused on defining, implementing, and growing personalized learning. LEAP (2016) defines four features of personalization:

- Learner connected, or connecting learning beyond school and with the community;
- learner focused, or tailoring learning experiences to students' needs, strengths,

and interests;

- learner demonstrated, or allowing students to progress to mastery at their own pace; and
- learner-led, or taking ownership of learning and co-constructing the learning experience with teachers and peers.

This model seeks to design the learning process around the student, and relies on teachers as well as technology tools to co-design the learning experience, assess progress, and obtain support (LEAP, 2016). This vision for education stands in stark contrast with traditional age-graded, seat-time based instructional units where students progress in lock step along a predetermined learning path. This model emphasizes personalizing the learning experience around the learner, with technology serving as a tool facilitating certain aspects of personalization.

Complexity in defining personalized learning. The current educational technology arena is complex, with one-to-one programs, blended learning, individualized learning, and competency-based education often associated with personalized learning. While one-to-one programs provide students access to a personal computing device to accomplish academic tasks (Penuel, 2006), blended learning is defined as a formal education program in which a student learns in part through online delivery of content, and in part at a brick-and-mortar location away from their home (Staker & Horn, 2012). In blended learning environments, students maintain some element of control over time, place, path, and pace of learning with the reliance on one-to-one computer access. However, blended learning models may or may not personalize instruction for a student's

interests or learning needs.

Individualization implies that work is designed by adults for the individual student, but does not mean that it personalizes learning for a student's interests, skills, or needs (Clarke, 2012). Competency-based education allows students to progress through content at their pace, and move on when they achieve mastery, but may not allow for personalization of content. The models are conceptually distinct but can overlap, causing confusion. Formats of blended learning seem more congruent with individualization than with personalized learning. However, some consider blended learning and competency-based learning as tools to foster personalization (Patrick, Kennedy, & Powell 2013). Despite this complexity and seeming incoherence, personalized learning is becoming a common strategy and repeated buzz-phrase for schools integrating one-to-one technology (Herold, 2016; Horn, 2016).

Common characteristics of current personalized learning models. There are common characteristics within current iterations of personalized learning. These include using "learner profiles", or relevant student learner characteristics and interests to inform what and how students learn. These profiles allow educators to tailor students' learning experiences to their abilities, needs, and interests, and use timely student learning data to inform instruction (LEAP, 2016; Lee, 2014; Pane et al., 2015). Current models for personalized learning also feature mastery or competency-based learning where students progress at their pace through content as they demonstrate competency in learning standards (LEAP, 2016; Lee, 2014; Norford & Marzano, 2016; Pane et al., 2015). Experts agree that teachers play a prominent role in personalizing learning by diagnosing

students' needs, guiding or co-constructing learning experiences, and monitoring student progress (Clarke, 2012; Jenkins & Keefe, 2007; Norford & Marzano, 2016; Pane et al., 2015; Prain, et al., 2013). The models also concur that students should have significant control over learning paths, learning process, and how to demonstrate mastery of learning (LEAP 2016; Pane et al., 2015). Finally, the learning environment, physical school and classrooms, technology, and staff must be able to support personalized learning through flexible spaces that transcend the classroom walls and schedules (Pane et al., 2015). Such learning extends beyond the school day and building into student networks, families, and the global community (Jenkins & Keefe, 2007; LEAP, 2016; Pane et al., 2015) These commonalities are features in the current literature and models of personalized learning, however the models vary, and there is no definitive consensus around key features of personalized learning.

Competency-based education. Advocates of personalized learning often cite competency-based education, (also referred to as mastery-based or proficiency-based education) as a cornerstone of personalizing content for students (LEAP, 2016; Norford & Marzano, 2016; Pane et al., 2015; Sturgis, 2016). The International Association for K-12 Online Learning (iNACOL) as well as well-known education consultants such as Norford and Marzano (2016) advocate for personalized competency-based education. Sturgis, Patrick, and Pittenger (2011) described a working definition of competency-based learning established by a group of educators as:

- Students advance upon mastery;
- competencies include explicit, measurable, transferable learning objectives

that empower students;

- assessment is meaningful and a positive learning experience;
- students receive differentiated support based on learning needs; and
- learning outcomes emphasize competencies that include application and creation of knowledge, along with the development of important skills and dispositions.

Advocates of competency-based education offer this model as an alternative to traditional school models where seat-time, pacing, standards, and assessments are all standardized, and student achievement varies significantly, with many students being unsuccessful (Sturgis, 2016).

Competency-based learning enables the personalization of content delivery based on learning pace and student learning needs. However it does not explicitly include student interests or a learning experience that is co-constructed with a teacher or peers. Hence competency-based instruction facilitates personalized learning by allowing students to progress at their pace through multiple pathways to demonstrate learning (Patrick et al., 2016). Norford and Marzano (2016) argue that competency-based education systems shift learning from a teacher-centered to a student-centered environment that facilitates the development of student agency.

Blended and online learning support personalization. Recent iterations of personalized learning emphasize the use of technology as a key aspect of a personalized learning environment, with schools often providing a device to each student (Pane et al., 2015; Patrick, Kennedy & Powell, 2013). Advocates claim that technology can support

the implementation of elements of personalized learning such as learner profiles, learner paths, competency-based progression, and flexible learning environments (Horn & Staker, 2015; Pane et al., 2015; Patrick, Kennedy & Powell, 2013). While distinct from the concept of personalized learning, Horn and Staker (2015) advocate for a related concept called "blended learning," defined as students receiving instruction online partly in a supervised, brick-and-mortar school, and having control over time, path, pace, and place. Versions of blended learning that Christensen (2008) describes as "disruptive" of the traditional age- and ability- grouping model of instruction allow students to work at their pace, through curriculum adapted to their learning needs and interests, and using technology in an environment that is flexible and nurturing. These models of instruction allow each student a tailored, individualized learning environment, which may or may not be personalized (Horn & Staker, 2015).

Some charter schools like Rocketship Education and Summit, Alliance and Knowledge is Power Program (KIPP), have espoused blending learning environments, claiming that they allows student to progress at their rate, offer cost savings over traditional models, and harnesses staffing to provide more small group and individual support to students (Murphy, Snow, Mislevy, Gallagher, Krum, & Wei, 2014). While blended learning is primarily a model of delivering instruction, it shares with recent conceptualizations of personalized learning the characteristics of mastery-based progression, tailoring instruction based on learner data, and flexible learning environments featuring technology-based instruction. Patrick et al., 2013 view blended learning as a way to support personalization for students.

Research on blended and online learning. Quality research on blended learning, as with many new and innovative instructional models, is scarce. One study by SRI International of five charter high schools and seven charter elementary schools that used blended learning to personalize learning through self-paced programs, adaptive online instructional content, and small group instruction for students with the greatest academic needs used surveys and virtual comparison group (VCG) to analyze student outcomes (Murphy et al., 2014). In this study, student outcome data varied by school, providing little evidence that blended learning improves student outcomes. Teachers reported that blended learning benefited students' procedural skills more than their higher order thinking. In addition, outcome measures in the five high schools in two charter organizations showed no statistical differences between the high schools in the study and VCGs (Murphy et al., 2014). The pursuit of blended learning integrates efforts to individualize instruction based on student needs, student assessment data, learning path, and learning environment, further contributing to the lack of clarity around the notion of personalized learning.

The research on online learning is similarly limited, with a recent review of literature identifying only five K-12 studies meeting search criteria, with mixed effects in these studies (Means, Toyama, Murphy, Bakia, & Jones, 2010). This review of literature from 1996-2008 found that online students did modestly better than students in face-to-face instruction, and that blended environments performed better in comparison to online only, but features like extended learning time and support were related to more effective blended environments (Means et al., 2010). Only one study by O'Dwyer, Carey, and

Kleiman (2007, as cited in Means et al., 2010) found a positive effect size (.37) of a blended algebra class over traditional face-to-face instruction. In a meta-analysis, Hattie (2012) found a low effect size (.18) for web-based learning and a slightly higher effect size (.37) for computer-assisted instruction. The current research on online instruction is insufficient to draw broader conclusions about its effectiveness, beyond the conclusion that students tend to perform better in blended environments with teacher support than in a solely online environment.

Student outcomes in schools implementing personalized learning. Research on current iterations of personalized learning is sparse and provides limited evidence that the strategy can help improve student outcomes. In the Rand Corporation study, Pane et al. (2015) investigated the implementation and impact of personalized learning strategies in 62 public charter and district schools that had received funding from the Bill & Melinda Gates Foundation or through the Next Generation Learning Challenge (NGLC). Researchers conducted site visits at 7 schools, interviewed principals and instructional staff, conducted focus groups with educators and students, observed in math and English classes, collected teacher logs of two- to 10-day period, surveyed educators and students, and compared survey and assessment data utilizing a virtual comparison group (VCG) composed of students with similar characteristics as the students in the schools being studied (Pane et al., 2015). While students in these schools overall showed positive effects on their mathematics and reading performance with the lowest performing students making substantial gains relative to their peers, especially in mathematics, students in high schools showed no statistically significant effects compared to VCGs

(Pane et al., 2015). This finding was despite the fact that high schools made up half of the sample for the implementation analysis (Penuel, & Johnson, 2016). In addition, Pane et al. (2015) found that the small sample of district public schools in aggregate showed no positive effects. Thus, student performance in public charter schools may be related to other characteristics of the students and their schools, 90% of which were selected competitively for grants by the Charter School Growth Fund (Pane et al., 2015; Penuel, & Johnson, 2016).

Perhaps unexpectedly, in the studied schools, students reported enjoying and feeling comfortable less, were less engaged in schoolwork, and sensed that there was less connectivity and accessibility to out-of-school work than their peers in the national VCG sample (Pane et al., 2015). While the study title claims continued progress and promising evidence, the study's authors as well as study reviewers Penuel and Johnson (2016) caution that there is insufficient evidence that such novel forms of personalized learning can improve student learning outcomes due to limitations of the small sample of schools that are not representative of the general population of schools. While students in a personalized learning program called Teach to One: Math showed positive outcomes compared to national averages in non-experimental studies (Ready, 2014), there is limited empirical evidence that personalized learning programs improve students' learning outcomes.

Implementation of personalized learning. Evidence suggests that schools implement personalized learning differently, and are least likely to operationalize strategies that represent the largest departure from traditional instruction (Pane et al.,

2015). The Rand Corporation study indicated that the adoption of personalized learning practices in the schools studied varied substantially, with few schools using student data for personalized goals, implementing competency-based learning, or adpoting project-based learning (Pane et al., 2015). Most personalized learning strategies were extensions of traditional practices such as additional time for learning through an extended school day or year to individualize math and English instruction. Also, if schools offered opportunities for flexibility and choice, they were mostly teacher-driven and not student-driven (Pane et al., 2015). Through a qualitative comparative analysis, researchers discovered that the schools that were most successfully implementing personalized learning utilized student grouping, designed learning spaces to support personalized learning, and ensured that students discussed learning data (Pane et al., 2015). Even in schools purportedly implementing forms of personalized learning, the strategies that represent the largest departures from current practice were seldom found (Penuel & Johnson, 2016), illustrating the challenge of implementing personalized learning.

Further, Hyslop and Mead (2015) describe the tension between the standards and accountability movement and efforts to personalize learning, as standards determine what students learn and standardized tests establish fixed time frames for student learning. Standards and standardized assessments impose rather strict guidelines on curriculum and pace of instruction, which make it difficult for educators to implement personalized learning with fidelity (Hyslop & Mead, 2015). Hyslop and Mead (2015) argue for flexibility within standards and testing to foster efforts to personalize learning while maintaining accountability for student learning. Patrick and Worthen (2016) recommend

that states implement flexible assessment policies to make room for personalized learning approaches that enable students to progress through material at their pace and adaptation of content to student interests and learning needs. They further state that the newly passed December 2015 Every Student Succeeds Act (ESSA) provides flexibility in assessment, accountability, and educator development that may help states shift to more personalized competency-based models of education (Sturgis, 2016). Many states have begun to shift policies to support efforts to personalize instruction for students, but are still far from broadly altering existing school structures (Patrick et al., 2016; Sturgis, 2016). The current state of personalized learning illustrates the variability of strategies used as well as the constraints imposed by standards and standardized assessments on implementing more challenging forms of personalized learning in today's schools.

Criticisms of personalized learning. Various early representations of personalization include tailoring instruction to the needs, interests, and abilities of students, mastery learning, and personal interaction, but no consistent definition emerges from these conceptualizations. Critiques of personalized learning include conceptual fuzziness, suspect ideological underpinnings, failure to address equity concerns (Sebba et al., 2008), lack of clear definitions, and excessive hype (Horn, 2016). Despite these concerns, personalized learning remains a novel and popular approach to improving educational experiences for students (Patrick et al., 2016).

Some critics have questioned the purpose and effectiveness of personalized learning through relationships, small learning communities, co-construction of learning, authentic instruction and assessment, and diagnoses of student learning characteristics.

For example, Hartley (2009) claims that what the British Department of Education promotes as personalized learning features market-based strategies that adapt education to a consumerist society and harkens back to progressive child-centered education strategies while failing to change pedagogy or curriculum. Campbell, Robinson, Neelands, Hewston, and Massoli (2007) criticize the British conceptualization of personalized learning as a repackaging of constructivist learning with limited conceptual clarity. They go on to share concerns that the self-motivation and self-regulation essential in personalized learning are not equally distributed across society, leading to concerns that this approach could increase disadvantage for some cohorts of students (Campbell et al., 2007).

Stockhill (2011) goes as far as labeling personalized learning as jargon that will quickly fade away as other fads have done in the past. Horn (2016) adds that personalized learning has reached the peak of inflated expectations, claiming that personalized learning lacks clarity and should be investigated based on research about how students learn.

Conclusion. Personalized learning is not a new educational strategy to foster student learning, and it has become a popular strategy in many schools and districts (Horn, 2016; Patrick et al., 2016). While still ill-defined, common modern forms of personalized learning feature student-driven learning in a small school with many personal connections (Clarke, 2012; Jenkins & Keefe, 2002; Tung et al., 2004) to a model of education where students use technology to access customized instruction based on their needs, interests, and learning pace (LEAP, 2016; Norford & Marzano, 2016; Pane et

al., 2015; Patrick et al., 2013). Current iterations of personalized learning are often intertwined with or related to other models such as blended learning and competency-based education (Horn & Staker, 2015; Patrick et al., 2013). The conceptual fuzziness around personalized learning creates challenges to policy makers designing policy, districts, and schools implementing personalized learning, as well as scholars researching the effects of such models. Implementation of personalized learning varies widely (Jenkins & Keefe, 2007; Pane et al., 2015) and scarce empirical evidence limits any conclusions about whether personalized learning influences student outcomes (Penuel & Johnson, 2016). While there is anecdotal evidence (Clarke, 2012) and limited evidence that personalized learning environments may contribute positively to student learning (Pane et al., 2015), it is not possible to draw conclusions about the effectiveness of personalized learning based on the current research available.

Technology Leadership

Essential to any school improvement or reform effort is quality leadership, without which, little change is likely to happen. Northouse (2013) defines leadership as a process whereby an individual influences a group of individuals to achieve a common goal. In the literature, leadership has throughout history been researched in terms of leaders' traits such as intelligence or self-confidence; emotional intelligence; leaders' styles; or the nature of interactions between leaders and subordinates, and is described in terms of the ability of leaders to inspire and motivate a group to accomplish common goals (Northouse, 2013). In addition, recent research of leadership have demonstrated its impact on student achievement (Hallinger & Heck, 2010; Leithwood & Jantzi, 2012) and

on technology integration (Anderson & Dexter, 2005; Wong & Li, 2011; Baylor & Ritchie, 2002) in terms of seeing it as a collective property, distributed throughout a school community (Spillane, 2006). This research has framed effective leadership as not always looking the same in each context, but rather maintaining certain core practices that apply not only to leadership for student achievement, but also to leadership for the effective integration of personalized learning with one-to-one technology.

Foundations of leadership. A robust body of literature supports leadership practices that are linked to improved student achievement (Hallinger & Heck, 2010; Leithwood et al., 2004; Leithwood, Harris, & Hopkins, 2008). This study will organize its analysis using the core leadership practices established by Leithwood et al. (2004), which are also congruent with reviews by Hallinger and Heck (1996) of a large body of empirical evidence on school leadership stemming from case studies of high performing and improving schools and districts, large-scale quantitative overall leadership studies between 1980 and 1998, and large-scale quantitative studies examining specific leadership practices (Waters, Marzano & McNulty, 2003). Leadership explains about one-quarter of the total variation explained by all school-level variables after controlling for student factors (Creeemers & Reezigt, 1996, as cited in Leithwood, 2004). Waters et al. (2003) found that leaders improving their abilities on 21 leadership "responsibilities" would improve student test scores by 10 percent, although such improvement on all 21 items at once would be inherently challenging. While being second only to classroom teaching as an influence on student learning, evidence indicates that school leadership improves teaching and learning indirectly and most powerfully through their influence on

staff motivation, commitment, and working conditions (Leithwood, 2008).

Leadership is not just an essential component of improving schools but is also key to supporting teachers in integrating technology to foster personalized learning. It contributes to increased use of technology in classrooms by teachers and students alike (Anderson & Dexter, 2005). In their investigation of 21 Technology Immersion Schools, Shapley et al. (2010) found that "respondents at higher implementing schools reported that committed leaders, thorough planning, teacher buy-in, preliminary professional development for teachers, and a commitment to the transformation of student learning were critical to their successful implementation of [their one-to-one laptop program] (p. 46)." Furthermore, Digital Promise Global (2016), an organization focusing on personalized learning, argues that personalized learning is most effective when guided by educators and supported by administrators and networks that extend educators' capacity. Leadership is essential to school-improvement efforts as well as technology integration programs.

Set directions. Leithwood (2004) identified one core leadership practice, setting directions, meaning helping to develop a shared and commonly espoused vision or a sense of purpose, often attributed to motivation and sense of working towards common goals (Leithwood 2004). Within the category of set directions, Leithwood shares core leadership practices including building a shared vision, fostering the acceptance of group goals, creating high performance expectations, and communicating the direction (Leithwood, 2012b). Kouzes and Posner (1987) claim that key elements of transformational leadership theory include cultivating a shared vision and modeling the

way, which inspire people to become transformed and motivated to achieve common organizational goals. Along with establishing a compelling vision, establishing common goals and communicating the direction are part of the inspirational motivation component of transformational leadership theory, which inspires followers to be committed to, and part of the shared vision of the organization (Northouse, 2013, p. 193). Fostering a shared vision and commitment to group goals is essential to improving student outcomes and also to implementing one-to-one programs that can lead to positive outcomes.

In addition to being a key component of leadership for school improvement, setting directions is key to effective implementation of technology-based education reforms such as one-to-one programs. Dexter's (2011) cross-case analysis of five middle schools with laptop programs suggested that schools with instruction-oriented visions for their laptop program created a more compelling setting for technology integration, which in turn helped determine the form and function of technology leadership. The quality of the school's technology vision influenced the tools and routines put in place, and how leaders and followers interact around integrating technology (Dexter, 2011). Shapley et al. (2010) found that teachers in higher technology implementing schools had leaders who set the direction for change and had high expectations for technology use while allowing time for teachers to get comfortable with technology. Setting directions is a key transformational leadership practice that motivates teachers, administrators, parents, and ultimately students to work towards common goals for school improvement and technology integration programs.

Develop people. In addition to building shared, widely accepted vision and

accompanying goals, leaders must address the task of developing people, which includes the leadership practices of providing individualized support and consideration, offering intellectual stimulation, and modeling appropriate values and practices (Leithwood, 2012b). The primary aim of these practices is capacity building, which is understood to include not only the knowledge and skills that staff members need to accomplish organizational goals, but also the disposition that educators need to persist in applying such knowledge and skills (Leithwood, 2012b, p. 60). The change associated with implementing personalized learning using one-to-one technological tools is daunting for many teachers. Rogers (1995) coined the phrase diffusion of innovations, where innovators and early adopters precede the early and late majority and finally the laggards in implementing innovative technologies. Teachers often fall into these patterns, with enthusiastic teachers innovating and finding ways to integrate one-to-one technology meaningfully, while others integrate new strategies little by little, and others resist any change. To support educators in implementing new programs such as personalizing learning using one-to-one devices, teachers will need help in creating new models of knowledge and understanding of teaching with one-to-one technology.

Fostering teachers' ability to integrate technology to personalize learning requires providing teachers with individualized technical support and instructional support (Inan & Lowther, 2010). Technical assistance for teachers' and students' computers, equipment, and software, is a major contributor to the success and failures of laptop computing programs (Dexter & Anderson, 2005b; Dexter, 2011; Inan & Lowther, 2010; Penuel, 2006). In a study of 9 exceptional technology-integrating schools, Dexter et al.

(2009) noted that technical support was excellent, meaning that technology was readily available and reliably working for students and teachers in the classroom. While technical assistance for teachers and students must be strong to maintain levels of access to computers and associated tools, instructional support for integrating technology is equally if not more important, and often comes from many formal and informal channels including administrators, instructional technology specialists, teacher leaders, colleagues, and professional learning networks (PLNs) (Dexter et al., 2009; Inan & Lowther, 2010; Jones & Dexter, 2014). Dexter et al. (2009) found that in schools engaged in technology-related school improvement, individualized support was a powerful change agent exerted by technology specialists who were members of technology leadership teams, and who responded directly to teachers' needs to learn about how to integrate technology. Leaders must support the development of teachers' capacity for personalizing learning in one-to-one environments by providing individualized support and ongoing job-embedded professional development where teachers can learn, work together, share strategies and resources, and build new models of instruction that align with models of personalization (Patrick, Worthen, Frost & Gentz, 2016b).

Redesign the organization. Leithwood's (2012b) third core leadership category is redesigning the organization, comprised of building collaborative cultures, restructuring the organization to support collaboration, building productive relationships with families and communities, and connecting the school to the wider community. Leaders must foster collaborative organizational configurations and tools to enable teachers to collaborate on integrating technology, solving problems around effective teaching with one-to-one

technology, and focusing on the main elements of personalizing learning with one-to-one technology. Anderson and Dexter (2005b) note that schools that exhibit higher levels of the professional community have higher levels of technology integration, primarily due to the de-privatization of practice and communication around technology integration. Establishing the organizational conditions for teaming, collaboration, and participation in leadership decisions creates environments where teachers can develop knowledge, skills, and dispositions necessary for effective integration of one-to-one technology.

Technology integration for enhanced teaching and learning requires frequent opportunities for teachers to communicate about technology (Anderson & Dexter, 2005b), independently experiment with new tools (Jones & Dexter, 2014), and forge new understandings of how to integrate technology into their established beliefs and practices (Inan & Lowther, 2010). Dexter (2011) analyzed five middle schools in a cross-case analysis of team-based leadership practices contributing to the efficacy of laptop programs. Key artifacts of such leadership practices included staffing to provide instructional and technical support, the means for teacher sharing of materials, and participation and input at technology leadership meetings (Dexter 2011). Rogers (1995) describes the diffusion of innovations as a social process, where the structure of the social system and levels of communication between change agents, opinion leaders, and other individuals help drive the innovation. Opportunities for teachers to communicate about and plan for technology integration in structured teams within a broader professional learning community are essential to changing teacher behavior (Jones & Dexter, 2014). Beyond structured opportunities for collaboration and communication, teachers may

benefit from intentional leadership support for informal teacher experimentation and exploration with technology tools, as these opportunities may help teachers process new ideas and integrate them into instruction (Jones & Dexter, 2014). Collaborative structures and cultures can support teacher sharing and discussion about technology, helping cultivate organizational capabilities to forge effective new modes of teacher and student learning in one-to-one computing environments.

Leadership for integrating technology. Implementing a one-to-one initiative for the purpose of personalizing learning for students produces complex and multifaceted leadership challenges. Unfortunately, as indicated by two recent reviews of literature on technology leadership, the scholarship on the topic remains sparse, with insufficient high-quality research to inform best practice (McCleod & Richardson, 2011; Richardson, Bathon, Flora, & Lewis, 2012). School technology leadership has been conceptualized in various ways including as grounded in technology standards with constructs based on organizational indicators of technology leadership such as the presence of a technology committee, technology planning days, staff development, and school technology budgets (Anderson & Dexter, 2005a), and as a team-based approach including administrators, instructional technology leaders, and teacher-leaders (Dexter, Seashore Louis & Anderson, 2009; Dexter, 2011). The notion of team-based technology leadership is most appropriate for modern one-to-one technology initiatives as many teachers, administrators, support staff, and even students are involved in leading some aspect of the implementation of one-to-one programs.

Anderson and Dexter (2005) conducted perhaps the most robust empirical

investigation of leadership for technology. Using a nationally representative sample of U.S. schools, they found that a technology leadership variable composed of eight possible indicators was more important than technology infrastructure or expenditures in predicting technology outcomes such as student use of Internet or technology tools, and teachers' technology integration. Multiple regressions determined the technology leadership variable was a statistically significant indicator of all three of these outcome measures. Anderson and Dexter (2005) also found significant differences in technology leadership between schools of high and low socio-economic status (SES). Despite the now outdated survey instruments and data used in their analysis, this empirical investigation of technology leadership suggests the importance of technology leadership in influencing key factors such as student use of technology tools for learning and teacher integration of technology.

Other studies have illustrated the importance of leadership for technology in creating conditions where teachers integrate technology into instruction to influence student learning outcomes. Baylor and Ritchie (2002) conducted a mixed methods investigation of 94 classrooms in 12 high technology integrating schools and found that the strength of technology leadership positively influenced technology impact on students' content acquisition. The authors found that a measure of technology leadership practices such as modeling, acknowledging and incentivizing technology use, articulating a vision for technology use, and sharing leadership was positively associated with teachers perceiving that the use of technology added to student performance in content acquisition. In a study by Wong and Li (2011), structural equation modeling confirmed

the critical role of transformational leadership and pedagogy in the capability of information and communication technology (ICT) to contribute to improved student learning. They found that transformational leadership shaped the climate for collaboration and experimentation necessary to facilitate the pedagogical changes, which mediated the effects of the ICT intervention on student achievement. Congruent with other leadership studies, these studies support the indirect nature of the influence leadership wields on the conditions experienced by teachers in integrating technology to enhance instruction and engender stronger student learning.

Distributed leadership. An implementation of personalized learning in a one-to-one computing environment involves many leaders including district leaders such as the superintendent and chief technology officer, as well as school leaders such as the principal, assistant principals, instructional technology coordinators, technical support staff, department leaders, and other informal teacher leaders (Dexter et al., 2009). As such, leadership for technology integration is often congruent with a distributed leadership perspective, which acknowledges that leadership stretches across leaders and followers within a social and situational context (Spillane, Halverson & Diamond, 2004). In a distributed leadership perspective, leadership is composed of the activities and routines engaged in by leaders and focuses particularly upon leaders' interaction with others while enacting those leadership tasks (Spillane et al., 2004). Spillane (2006), who developed this theory of distributed leadership based on a multi-year, mixed-methods study of schools in Chicago, emphasizes looking to the tools and routines used by leaders and followers to work toward common goals in a particular situation. This perspective

supports exploring leadership practice as distributed among formal and informal leaders as they enact specific tasks, and how those leadership tasks are socially distributed in an organization (Spillane et al., 2004).

A distributed leadership perspective begs inquiry into practical applications such as among who is the leadership distributed and what patterns of distribution are most effective (Harris & Spillane, 2008). Distinct from the distributed leadership perspective theorized by Spillane (2006) is the idea that leaders should intentionally distribute leadership throughout an organization to ensure that the organization has sufficient leadership capability to implement new initiatives and be responsive to unpredictable change (Harris, 2013). Harris (2013) advocates that through careful planning and design and by actively seeking ways to support those with the expertise to lead, formal leaders can build the leadership capacity within their school to support productive change and continuous improvement. Though not a panacea or "one-size-fits-all," through active formation and facilitation of leadership activity throughout a school, distributed leadership can be a contributor to positive change and transformation (Harris, 2008).

Researchers have found that when leadership is distributed over multiple individuals, it has a stronger impact on student achievement than individual leadership alone (Leithwood, 2008; Hallinger & Heck, 2010a). Anderson (2012) claims that higher levels of collective influence are positively associated with motivation, teachers' working conditions, and student achievement. Hallinger and Heck (2010a), in an analysis of 192 elementary schools found significant direct effects of a measure they called collaborative leadership on the change in the school's academic capacity and indirect effects on rates of

growth in student achievement in mathematics. Interestingly, in a reciprocal model of the effects of collective leadership on school capacity and student achievement, Hallinger and Heck (2010b) found that changes in collaborative leadership compounded over time through an indirect feedback loop consisting of changes in school improvement capacity and growth in student mathematics achievement (p. 105). Leithwood (2008), using a national survey of teachers, found that distributed forms of leadership significantly impacted teachers' perceived working conditions and capacity, thereby indirectly impacting motivation and commitment as well as student achievement. In a more recent analysis of patterns of distributed leadership, Anderson (2012) found that even with increased distributed leadership, principals still enact the greatest influence and that their influence is not diminished by greater influence from others. The effect of leadership is greater when distributed more widely throughout the organization, leading to improved student outcomes as well as enhanced capacity for organizational change.

Dexter, Seashore Louis and Anderson (2009) argue that it is critical to take a distributed perspective for technology leadership, as such team leadership is essential to yield the extensive technical and instructional knowledge needed to engender substantive change to the core of teaching and learning. In addition, Hiltz and Dexter (2012) found that in schools with technology leadership distributed over a larger social network there were higher levels of technology integration than in schools with less widely distributed leadership networks. Inan and Lowther (2010) found that a measure of shared leadership described as overall support of teachers by administrators, teachers, parents, specialists, and students was strongly and significantly related to teacher beliefs about laptop

integration and teacher readiness for laptop integration, both of which significantly impacted technology use in the classroom. Distributed leadership involves many individuals including technology specialists, teacher leaders, and administrators in providing support for technology integration, and has been associated with high levels of technology integration (Dexter, 2009; Shapley et al., 2010). A distributed leadership perspective and the concept of sharing or distributing leadership throughout an organization provide the theoretical foundation for effective leadership in organizations implementing one-to-one technology programs to enhance teaching and learning.

Teacher Learning to Integrate Technology and Personalize Learning for Students

Personalizing learning by implementing one-to-one technology into classroom instruction requires meaningful teacher learning, not just about the technical components of integrating new devices and digital learning tools, but also about how technology can help students meet learning targets of a particular content area (Mishra & Koehler, 2006). This requires teachers to renegotiate their models of understanding of what constitutes effective instruction (Spillane, 2001). The environments for teacher learning, often established by leaders, provide teachers with a variety of formal and informal learning opportunities (Jones & Dexter, 2014), which enable teachers to construct new pedagogical strategies that harness students' powerful computing tools. This section of the literature review will discuss empirical and theoretical literature focusing on ways teachers learn to integrate technology, characteristics of effective professional development, models defining teacher knowledge and understanding of technology integration, and teacher beliefs about technology integration. Finally, this section will

touch on the very limited information about how teachers learn how to personalize their students' learning with one-to-one technology. This relies on quality teacher learning, as well as beliefs and dispositions likely to turn new knowledge and understandings into effective instruction that harnesses one-to-one technology.

Effective learning for technology integration. While the characteristics of effective professional development certainly apply to teacher learning for technology integration, there exists literature targeted specifically at teacher learning for technology integration. Curwood (2011) argues that features of effective technology-focused professional development include a sustained dialogue around teachers' curricular goals and students' learning outcomes, hands-on learning with digital tools, ongoing analysis of student work, and a view of knowledge as social construction (p. 74). Jones and Dexter (2014) extoll the importance of looking beyond formal professional development opportunities and professional learning communities (PLCs) to include informal learning with colleagues and independent learning in a holistic approach to learning for technology integration. Through a qualitative investigation of math and science teachers at two effective technology-integrating middle schools, Jones and Dexter (2014) found informal learning such as brief face-to-face or email conversations to be valuable in supporting teachers' technology integration and formal professional development goals. They also noted that independent learning is essential to learning new tools and finding resources for technology integration (Jones & Dexter, 2014). Teachers indicated a need for independent time to bring their creative ideas into the classroom and learn how to integrate new tools into instruction, noting that such time was often not organizationally

provided (Jones & Dexter, 2014). While offering many benefits, informal and independent learning opportunities suffer from drawbacks including limited coherence with organizational goals and possible information overload (Jones & Dexter, 2014). Jones and Dexter (2014) recommend that leaders support a holistic approach that includes a range of formal, informal, and independent teacher learning opportunities. Teacher learning for technology integration remains a complex endeavor that relies not only on independent and informal learning opportunities, but also requires significant opportunities to learn new tools and skills, and develop more sophisticated mental models of instruction in one-to-one computing environments.

Characteristics of effective professional development. The quality of the outcomes of a one-to-one laptop program relies on how effectively teachers integrate the new technology in the classroom (Penuel 2006). While leadership can serve as the driver of such changes, teachers often implement instructional changes based on a variety of factors including how they make sense of the new reform in the context of existing knowledge, experiences, and beliefs (Spillane, 2004; Inan & Lowther, 2010). For one-to-one technology programs to enhance instruction by integrating technology into the classroom, significant teacher learning must occur (Fleischer, 2012; Inan & Lowther, 2010). Often, teachers learn new tools, techniques, or strategy through professional development opportunities provided by their school or school division, and these learning opportunities are often considered essential to the success of nascent one-to-one programs. (Penuel, 2006; Shapley et al., 2011).

Research has illuminated core elements of effective professional development that

are likely to lead to changes in teacher practice. Using a nationally representative survey of 1,027 teachers, Garet, Porter, Desimone, Birman, and Yoon (2001) investigated the influence of structural features, such as traditional or reform type (i.e. traditional workshops versus study group or network), time span and contact hours, and collective participation, as well as core features such as content focus, active learning, and coherence with other goals and learning activities, on teachers' knowledge and skills and change in teaching practice. Using linear regressions and path analysis, they found that reform type activities were more likely to feature collective participation and were typically longer lasting than traditional professional development (Garet et al., 2001). They also found that time span and duration have positive relationships to active learning and coherence, as well as a smaller positive correlation with content focus (Garet et al., 2001). They noted that all three of the core features were associated with enhanced knowledge and skills, which were significantly related to changes in teacher practice. Desimone, Porter, Garet, Yun, and Birman (2002) further found in a 30-school, three-year longitudinal investigation of the aforementioned features of professional development that those learning opportunities characterized by active learning, collaborative structures, content focus, and coherence were more likely to change teaching practice. Their analysis provides evidence of benefits from technology-related PD when there is a focus on specific strategies for technology use and collective participation from teachers of the same school, department, or grade level (Desimone et al., 2002). Despite Desimone et al. (2002) not finding empirical support for duration in their analysis, the indirect positive relationship of time span on opportunities for active

learning and coherence found by Garet et al. (2001) support the importance of longer-duration professional learning opportunities. It is essential for leaders to design high-quality professional development opportunities to help teachers to learn new knowledge and skills and develop dispositions and beliefs to integrate one-to-one technology effectively in their classrooms.

Technological pedagogical content knowledge. Teachers can better conceptualize the knowledge needed for teaching and learning in one-to-one teaching environments by utilizing theoretical frameworks such as technological pedagogical content knowledge (TPACK) (Mishra & Koehler, 2006). TPACK builds off of Shulman's (1986) characterization of content and pedagogical knowledge as fundamental knowledge for teachers, and their intersection as pedagogical content knowledge. According to Shulman (1986)

> Pedagogical content knowledge goes beyond subject matter knowledge to the dimension of subject knowledge for teaching, including the most useful forms of representation of those ideas, the most powerful analogies, examples, illustrations, demonstrations, and explanations – in a word the ways of representing and formulating the subject that make it comprehensible to others (p. 9).

Mishra and Koehler (2006) later incorporated technological knowledge and the corresponding categorical intersections, technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPCK or TPACK). This latter type of knowledge encompasses the complex interplay between the three forms of knowledge and is the basis of good teaching with

technology (Mishra & Koehler, 2006). TPACK is characterized by how technologies can enable effective content representations, pedagogical techniques, and knowledge of pedagogy for specific content goals (Mishra & Koehler, 2006).

Developing TPACK requires sustained, hands-on, learning through design and problem-solving in a fluid and flexible way that focuses on specific needs of teachers in specific content areas, using certain pedagogical strategies, and enhanced by specific technological tools (Harris, Mishra & Koehler, 2009). Harris et al. (2009) emphasize focusing instruction on "content-based pedagogy, which is facilitated by judiciously selected and implemented technology" (p. 403). While it is helpful to couch knowledge for technology integration into existing knowledge frameworks of content and pedagogy, it may limit teachers' development by implying that technology is integrated into current traditional and mostly teacher-directed forms of instructing.

None of the white papers and recent literature on personalized learning that informed this literature review mentioned the TPACK model, despite frequently being cited in regards to teachers' integration of technology into instruction. Despite this, one could consider the intersection of content, technology, and pedagogy similar to what Patrick et al., 2013 discuss when calling to merge competency-based instruction (pedagogy), blended learning (technology), and academic standards (content). The application of this model to personalization of content implies that a teacher must be knowledgeable about these three important domains as well as the various intersections of those domains to effectively implement personalized learning.

Teacher beliefs related to one-to-one technology integration. Research

indicates that teacher beliefs about the value of laptops for learning and influence of technology on student achievement are associated with teacher use of laptop technology in instruction (Inan & Lowther, 2010; Lei & Zhao, 2008; Penuel, 2006). Teachers who believe that laptops are essential to student learning and effective instruction utilize one-to-one technology more frequently in the classroom (Inan & Lowther, 2010). Such beliefs are related to what Bandura (1997) describes as perceived self-efficacy, which is concerned not with the number of skills one has, but with what one believes one can do with those skills under different circumstances. In a variety of studies, perceived self-efficacy has been shown to be a critical contributor to performance accomplishments, whatever the underlying skills might be (Bandura, 1997). These self-efficacy beliefs apply to technology integration, as teachers who believe they can integrate one-to-one technology in effective and engaging ways are more likely to do so, regardless of skill levels and technological knowledge.

Bandura (1997) states that self-efficacy beliefs are constructed from four principal sources of information: enactive mastery experiences that serve as indicators of capability, vicarious experiences that enable learning and comparison with the successes of others, verbal persuasion and encouraging social interactions, and psychological and affective states from which people partly judge their capabilities (p. 79). In schools that integrate technology well, teachers often share effective instructional strategies for integrating one-to-one technology into instruction, and administrators and peers often apply supportive persuasion to integrate innovative technology-enhanced instructional strategies (Shapley, et al. 2010). Teachers who experience numerous opportunities to

learn about new uses of one-to-one technology, to practice using new technological tools, to receive support from many individuals for integrating those tools, and to observe new tools being used successfully are likely to have stronger beliefs about the importance of one-to-one technology for teaching and learning (Inan & Lowther, 2010). Attending through various avenues to the beliefs of teachers and their self-efficacy regarding integrating one-to-one technology is an essential leadership practice to foster enhanced teaching and personalized learning using one-to-one devices.

How teachers learn to personalize learning for their students. The review of literature uncovered no research studies that identified how teachers best learn to personalize learning for their students. Patrick et al., 2016 report on ways in which states are providing teachers with opportunities to learn how to implement competency-based education. For example, a task force in Iowa recommended hiring professionals to provide professional development and curricular resources, New Hampshire plans to implement professional development programs including workshops facilitated by experts, consultants, and coaches, Vermont featured professional development seminars and training for teachers, and Colorado offered micro-credentials for teachers who develop skills to succeed in innovative learning models (Patrick et al., 2016). Davis and Rose (2007) recommend that professional development for teachers of online and blended classes utilize those models for their own learning. Patrick et al., (2016b) suggest personalizing professional development by modeling competency-based learning with demonstrated performance and outcomes. These recommendations are incredibly vague and often recommend modeling professional learning after the very strategies teachers

would be implementing.

Influence of One-to-One Programs on Teachers and Students

The proliferation of one-to-one programs across the United States and even the world has yielded numerous opportunities to evaluate and research the impacts of such programs. The purposes of such programs span broad range, from equity of providing each student with equal access to technology and associated resources, to economic competitiveness in a technological future, to improved student engagement, to higher student achievement on standardized tests, and to improved 21st century skills (Bebell & Kay, 2010; Lemke, Coughlin, & Reifsneider 2009; Penuel, 2006). With expanding one-to-one laptop programs, researchers have been investigating the impacts of what is also referred to as ubiquitous computing, or technology as always present in a way that weaves itself into the fabric of everyday life until it is indistinguishable (Weiser, 1991, p. 94). Such research has gleaned many findings of how teachers and students have reacted to one-to-one technology programs, yet there are still many unanswered questions due to the short timeframe of many of these initiatives and the dearth of large-scale experimental studies of the impact of one-to-one laptop programs (Fleischer, 2012).

The literature illuminates various impacts of one-to-one computing programs on teachers and students, but does not provide convincing evidence of consistent positive effects on teaching and learning in most core subject areas (Fleischer, 2012; Penuel, 2006; Cuban, 2013). Fleischer (2012) organized his literature by examining teacher-related results and pupil-related results. This literature review follows a similar structure as a way to identify impacts to teaching, as well as the effects on student outcomes in

ubiquitous computing environments. The review will also illustrate deficits in current research as well as opportunities for future investigation in the area of ubiquitous computing for educational purposes.

Defining one-to-one computing programs. This research study will borrow from the literature reviews conducted by Penuel (2006) and Fleischer (2012), who defined one-to-one computing by the following criteria: students have access to laptop computers with modern productivity software at all times, the devices must be connected to the internet, and students use the laptops to complete academic tasks such as homework assignments, tests, and presentations. This type of access is different from shared models of computer access. In some schools, despite a one-to-one student-to-computer ratio, students may access shared computers in a computer lab or computer carts in teachers' classrooms. In these types of arrangements, computers are not personalized to individual students, but rather are a shared resource accessible by many students but controlled by teachers and the school. In this literature review, the researcher will interpret one-to-one computing as synonymous with the notion of ubiquitous computing as defined by Weiser (1991), where computers are always seamlessly available to students and teachers for any academic purpose. Papert (1980), a prescient advocate for ubiquitous computing, argued that to fundamentally change our schools and allow students to create deeper understandings, it is necessary for all pupils to have or be assigned a computer for their sole use.

Teacher-related findings in one-to-one programs. Educators have often heralded that new technologies would revolutionize teaching and learning (Cuban, 2001).

One-to-one computing is no different; its proponents emphasize the plethora of new opportunities it affords to teachers and students. Ostensibly, constant access to powerful information search, productivity, creativity, and communication tools offer many possibilities for educators and students to explore the world and learn in different ways. There is substantial evidence that in one-to-one environments, teachers utilize technology exponentially more frequently as the barriers caused by sharing technology resources are removed (Bebell & Kay, 2010). Using observations and surveys, Bebell and Kay (2010) found that teachers quickly adopted and incorporated technology into a wide variety of new practices beyond the use with their students in the classroom. However, skeptics such as Larry Cuban (2013) argue that teachers have integrated technology into existing traditional teaching methods without making significant changes to the way they teach and students learn.

Teacher integration of one-to-one technology. In one-to-one programs, teachers incorporate laptops more frequently for a variety of purposes than those in traditional environments (Bebell & Kay, 2010). However, researchers have noted high levels of school and subject-level variability, as mathematics teachers report less technology use than social studies, ELA, and science teachers (Bebell & Kay, 2011; Howard et al., 2015). In a study by Lowther et al. (2012), a team of researchers observed 599 randomly selected one-to-one classrooms and found that the Internet was the most commonly used tool, as it was observed in 65% of the visits. Teachers integrated word processing, research tools, presentation software and drill and practice educational software. In addition, in those random 599 visits to classrooms, over 70% were rated as being

"meaningful" or "somewhat meaningful" use of laptops such as problem-based, critical thinking, or processing and manipulating information. Finally, in their questionnaire, Lowther et al. (2012) found that teachers in one-to-one environments showed significantly greater confidence that they knew how to meaningfully integrate laptop use into lessons and align the use of laptops with curriculum standards.

In observations of teachers in two middle schools, Dunleavy, Dexter, and Heinecke (2007) found that the most frequent use of laptops by teachers and students was online research in conjunction with productivity tools, followed by drill and practice, and electronic communications. Dunleavy et al. (2007) concluded that one-to-one programs add value to the teaching and learning process by increasing formative assessment, individualizing instruction, self-guided pacing, accessing online resources, and electronic communication and exchanging materials (p. 449). In addition to using new tools at greater levels, one-to-one programs enable teachers to incorporate more variety of instructional strategies. Shapley et al. (2011) found that students in one-to-one programs reported more growth in participation in class activities involving technology and opportunities to work in groups than students in comparison schools. In one-to-one environments, there is evidence of changed teacher practices to include more student-centered, constructive, student-paced lessons (Lowther et al., 2012).

There remain skeptics that view teachers' integration of technology, even in one-to-one settings, as virtually unchanged within traditional teaching strategies (Cuban, 2013). Lowther et al. (2012), while observing frequent uses of laptops during observations, also found that direct instruction was seen occasionally to extensively

during 82 percent of visits, and independent seatwork was seen during 73 percent of the visits. They witnessed student-centered practices such as independent research occasionally or extensively in 43 percent of visits, project-based learning in 35 percent of visits, and cooperative learning in 33 percent of visits (Lowther et al. 2012). Shapley et al. (2010) found that while teachers on average used technology increasingly to support their teaching, there was little change in the frequency of students' technology use in classes (p. 45). Of 21 schools in their fourth year of a one-to-one program, Shapley et al. (2010) reported that only four had achieved substantial levels of classroom technology immersion, and concluded that students' access to and use of laptops fell short of the expectations established in the theoretical framework of the program. While teacher-related changes may be occurring in one-to-one environments, teachers may also maintain traditional teaching practices, despite access to technological tools that can foster potential transformation of teaching practices. Leadership may play a role in the level to which teachers are integrating one-to-one technology in ways that are transforming or maintaining traditional teaching practices.

Factors related to levels of integration of technology. There are many teacher factors that are associated with levels of technology integration. Inan and Lowther (2010) developed and validated a conceptual framework and path model for technology integration based on existing research. They posited that teacher readiness and teacher beliefs impacted laptop integration, and that they were related to the level of overall support, technical support, and professional development. Using a teacher survey with a sample of nearly 400 teachers, Inan and Lowther (2010) conducted a path analysis, which

revealed that teacher beliefs had the most impact on laptop integration, with overall support having the strongest association with teacher beliefs. Also, teacher readiness was also a critical factor and was most strongly related to professional development

Howard, Chan, and Caputi (2015) sought to build upon the Inan and Lowther (2010) framework using data from questionnaires to several thousand teachers in a large-scale Australian one-to-one program. They attempted to identify differences in the impact of readiness and beliefs on integration for teachers in math, English, and science, as well as based on years in the program (Howard et al., 2015). Overall, they found that science teachers reported a higher frequency of integration than English teachers, that both recounted more frequency of use than mathematics teachers, and that mathematics teachers described less confidence and belief in the importance of technology than English and science teachers (Howard et al., 2015). Their findings illustrate that subject area is a key factor in technology integration and that each content area may have unique trajectories over time (Howard et al., 2015). These conclusions align with other studies, which have found that mathematics teachers integrate technology less frequently than other subject area teachers (Bebell & Burraston, 2014; Grimes & Warschauer, 2008). Technology integration and time required for integrating technology vary based on curricular area, partially due to beliefs about technology and readiness to integrate technology for curricular aims (Howard et al., 2015).

Student-related findings in one-to-one programs. Students in one-to-one computing environments have access to laptop computers, productivity software, high-speed wireless Internet, and instruction that may or may not integrate technology, leading

to some positive influences on important student outcomes, but falling short of significant impacts on core academic achievement (Fleischer, 2012). The result is that one-to-one computing proffers students a broad swath of information, analytical tools, software, creative technologies, and communication channels that are both immediately and universally accessible by all students while at school or at home. Also, teachers can integrate laptops in ways that open up countless ways for students to interact with information, generate knowledge using new tools, demonstrate understanding in novel ways, communicate with teachers and peers electronically, and receive timely feedback. Given the vast innovations made possible by one-to-one computer access, it is not a surprise that so many schools are leaping enthusiastically to connect each student to computers. However, while the literature has uncovered some positive impacts of one-to-one computing for students, there is little evidence that such programs will significantly impact student learning in most core academic areas (Bebell & Kay, 2010; Fleischer, 2012; Shapley et al. 2011).

Students' uses of technology. Studies of one-to-one programs have identified many ways in which students utilize computers in one-to-one computing environments. In a mixed-method study of laptop programs in approximately 90 schools in Michigan, Lowther, Inan, Ross, and Strahl (2012) conducted nearly 600 observations, surveyed 380 teachers and 5,770 students in so-called Freedom to Learn (FTL) schools. The most frequently observed activity was the use of laptops as a learning tool, which occurred significantly more in FTL schools than comparison schools (Lowther et al., 2012). They found that the internet was the most commonly used tool, followed by word processing,

presentation software, and drill and practice educational software, in order of most common to least common, and over 70% of computer activities were considered by observers to be meaningful. In addition, 80% of students reported that they worked most frequently alone, and used laptops most often in language arts, social studies, and science, while using them least in mathematics classes (Lowther et al., 2012). Bebell and Kay (2010) reported that students in one-to-one middle schools use the internet to find information, check teachers' websites, take notes, play educational games, edit papers, complete assessments, solve problems, create and deliver presentations, and communicate with peers and teachers more than students in comparison schools. Lei and Zhao (2008) found that students most commonly use laptops to do homework, search for information for schoolwork, communicate electronically, surf online for fun, work with specific software, and play computer games, noting that students also used laptops to stay organized.

In observations in two middle schools, Dunleavy, Dexter, and Heinecke (2007) observed students most commonly using online research in conjunction with productivity tools, and next most often drill and practice tools, and third most common communicating electronically with teacher via websites and email. Dunleavy et al. (2007) noted that these uses of technology aligned with the design criteria established by Bransford, Brown, and Cocking (2000) calling for the learning environment to be learner-centered, knowledge-centered, assessment-centered, and community-centered. Shapley, Sheehan, Maloney, and Caranikas-Walker (2011), analyzed data from 21 one-to-one middle schools compared to 21 traditional programs, and found that in one-to-one

classrooms activities involving technology increased at a faster rate than in comparison schools. In a longitudinal mixed-methods case study, Grimes and Warschauer (2008) found that students used laptops more often in language arts, science, and social studies than in mathematics classes, and can research, explore, and access "just-in-time" instruction using computers. They concluded that the one-to-one program helped facilitate writing-intensive, information-rich, multimodal, and student-centered instruction (Grimes & Warschauer, 2008). Bebell and Burraston (2014) found that in a high school one-to-one setting, students used computers much more often to look up grades, find information, write papers, play games, present information, take assessments, take notes, and stay organized using a calendar than in traditional settings. Current research provides evidence that in one-to-one computing environments, students are more likely to use computers for a variety of instructional tasks, communication, and organization.

The impact of one-to-one programs on students' technology proficiency. In ubiquitous computing environments, students have access to computers throughout the school day and at home, leading to significant use of technology for a variety of academic and personal reasons. Shapley et al. (2011) measured students' technology proficiency in 21 one-to-one schools and 21 comparison schools using a technology survey, which asked students to rate their skills in using applications. Baseline data and data collected three years later for one cohort and two years later for another cohort demonstrated consistently higher rates of growth of technology proficiency at one-to-one groups than in control groups, who showed no increase in technology proficiency over the same time

periods (Shapley et al., 2011). Interestingly, a statistically significant interaction variable between students' economic status and one-to-one participation showed that economically disadvantaged students at treatment schools grew in technology proficiency at a significantly faster rate than more affluent immersion peers, while closing the gap with affluent control peers (Shapley et al., 2011). This suggests a potentially stronger influence of one-to-one access on disadvantaged students' technology proficiency. Lei and Zhao (2008), in a study of 231 students in an upper-class middle school, conducted surveys at two times in the year to measure students' technology proficiency, among other things. They found that students made significant gains in technology proficiency between the beginning and end of the school year, and attribute those gains to increased opportunities in one-to-one environments for students to work on technology and solve technology-related problems, thereby learning new technology skills and acquiring knowledge about the use of technology (Lei & Zhao, 2008). Empirical evidence is convincing that students in one-to-one computing environments will develop stronger technology proficiency than students who are not in a one-to-one environment.

The impact of one-to-one programs on students' writing abilities. One of the most robust findings in the literature is that the writing ability of students in one-to-one programs improves at a faster rate than students in traditional environments (Bebell & Kay, 2010; Fleischer, 2012; Shapley et al. 2011). Silvernail and Gritter (2007) conducted an evaluation study of Maine's statewide one-to-one laptop program, and compared eighth-grade standardized writing assessment scores in 2000 to those in 2005, five years after the implementation of a one-to-one laptop program. They reported that eighth

graders who had experienced one-to-one computing in seventh and eight grade scored a statistically significant 3.44 points higher on the writing assessment than students who had not experienced one-to-one computing, a moderate effect size of .32. Students who used laptops effectively in the writing process outscored students who did not use laptops in writing by a large and statistically significant margin, with a large effect size of .64 (Silvernail & Gritter, 2007). Students in this one-to-one program scored similarly when tested on computers or using paper and pencil, showing that students' writing improved regardless of the testing medium (Silvernail & Gritter, 2007).

In a more recent study of a one-to-one laptop program in five middle schools in Massachusetts, Bebell and Kay (2010) noted that seventh graders who had been in the program for two years and who used laptops to complete a state writing test wrote more and scored higher on assessments than those using paper and pencil (p. 45). Students use laptops to draft, revise, edit, and receive feedback from teachers, a process that leads to students becoming better writers (Silvernail & Gritter, 2007). In both studies, there may be other causes for the improved writing scores, but the scale of the studies implies that the computing environment may have played a role in students' improved writing ability.

Student engagement in one-to-one environments. Many studies have reported that students in one-to-one laptop environments are more engaged in learning. Bebell and Kay (2010) conducted classroom observations in laptop schools and non-laptop schools and found that students were more engaged and motivated when provided opportunities to use technology in their classes. Penuel (2006) notes that many studies show positive effects of laptop programs on student motivation or engagement, but few studies measure

it in other ways than a self-reported survey item (p. 342). Fleischer (2012) concludes that students in one-to-one programs are more engaged and motivated, noting that autonomy to choose learning materials or modes of presenting materials allows students more freedom and control over their learning.

While student and teacher self-reported measures support the notion that students are more engaged in one-to-one environments (Penuel, 2006), there is evidence that students may be more engaged, but in off-task behaviors that do not support educational aims. In an observational study of middle school classes in the first year of a one-to-one program, Donovan, Green, and Hartley (2010) developed three configuration maps of laptop usage in classrooms. In one low-use configuration, laptops were rarely used, in the second configuration laptops were used often to support traditional instruction and sometimes for non-academic purposes, and in one high-fidelity configuration, laptops were the primary tool used for academic purposes throughout the lesson (Donovan et al., 2010). While laptops heightened engagement in both higher-usage configurations, in the configuration where teachers integrated laptops into traditional teaching methods such as paper and pencil tasks, students displayed more off-task behaviors, for example completing other assignments, playing games, or completing personal tasks (Donovan et al., 2010). In the high-fidelity laptop integration configuration, where students used laptops seamlessly to complete student-centered, long-term academic tasks, the authors reported that there was less off-task behavior than in the other two structures and that off-task behavior did not impact student achievement as students were more engaged and motivated to complete tasks (Donovan et al., 2010). Thus student engagement and the

level of off-task behaviors may differ based on the degree of fidelity of implementation of one-to-one technology in teachers' classes. While one-to-one technology integration may increase student engagement in many ways, there also remain more opportunities for students to engage in off-task behaviors.

Students' perceptions of one-to-one computing. Students consistently rate laptop computers in one-to-one environments positively (Lei & Zhao, 2008; Lowther et al., 2012). For example, 87.5% of students surveyed by Lei and Zhao (2008) reported that laptops were important to them, 89% said laptops had significantly helped them with homework, and 83.6% reported that the laptops had significantly helped them increase computer knowledge and skills (p. 115). Lowther et al. (2012) surveyed 5,770 middle school students, and 90% of these students wanted to use the laptops the next year, 69% believed they had improved their internet research skills, 62% shared that laptops made their schoolwork easier, and 59% claimed that laptops made them more interested in learning. Zucker and Hug (2008) described that 90% of students surveyed reported that laptops had a positive impact on how much they learn from school, and nearly the same fraction state that laptops make classes more interesting (p. 589). Overwhelmingly, students report positive perceptions of laptop use for a variety of academic, communication and learning purposes, and state that laptops tend to make them feel more interested in school.

The impact of one-to-one computing on core student achievement. The research has been clear on the limited impact that laptop programs exerted on student achievement in core academic subjects. Outside of evidence of positive effects on students' writing

ability (Bebell & Kay, 2010; Fleischer, 2012; Shapley et al. 2011), there has been no evidence that students in one-to-one computing environments achieve at higher rates than students in traditional environments (Penuel 2006; Shapley et al., 2011). In one of the most comprehensive experimental designs to analyze the impact of one-to-one laptop computing on student achievement, Shapley et al. (2011) found no significant difference in achievement between laptop students and non-laptop students on mathematics or reading standardized assessments after controlling for student and school levels of poverty. Silvernail and Gritter (2007) reported that overall performance on the 8th grade Maine Education Assessments had not changed appreciably since the inception of the laptop program (p. 4). One study by Dunleavy and Heinecke (2007) of a one-to-one program for 100 seventh grade students used a pretest-posttest control-group design and found that there was a significant effect of the laptop treatment on science posttest scores controlling for pre-existing science achievements, and a significant interaction effect for boys in the laptop environment. However, the fact that the study did not control for teacher effects, and the small sample size severely limits the value of these findings. In this study, students showed no significant effects on math achievement (Dunleavey & Heinecke, 2007). Taken as a whole, there is little evidence that students in one-to-one environments will achieve at higher levels in core academic subjects, excluding writing. The findings also illustrate the need to consider differences in teacher practice with regards to integrating one-to-one technology as well as subject area when analyzing student achievement data.

Limitations in current literature on one-to-one programs. While the enthusiasm

for one-to-one programs paves the way for efforts to evaluate the effectiveness of these programs, there remains limited empirical evidence of the impacts of one-to-one computing on student achievement in core academic subjects. The current literature features plentiful research on one-to-one programs in middle schools with little research conducted in high schools. Also, many of the schools in empirical studies were provided access to technology resources based on reform efforts to improve low-performing, high-poverty schools (Shapley et al., 2011). Furthermore, the exploration of variations of integration between schools and within schools by subject area, as well as impacts on students of different backgrounds all require further investigation. The current literature fails to sufficiently explore teachers' integration of technology in instruction and the specific practices that lead to positive student outcomes. Many evaluation studies conducted by technology companies may suffer from an optimistic bias towards one-to-one technology.

Finally, the vast majority of the research on one-to-one programs does not approach the initiatives from the personalized learning perspective; rather seek to investigate the integration of technology within technological, educational contexts. Despite this, the research on one-to-one initiatives is important to consider when the implementation of personalized learning occurs concurrently with one-to-one device deployment. Further, educational technology systems that are often used to implement personalization for students require significant understanding of the technology and what potential challenges and benefits arise from providing students one-to-one access to devices.

Summary

As school districts and schools seek to improve student outcomes by adopting personalized learning strategies that are bolstered by one-to-one device access, it is tantamount that school and district leaders are familiar with the research on personalized learning, technology leadership, teacher learning and one-to-one programs. Leaders set the stage for teachers to learn about and implement strategies that personalize learning for students. The literature identifies key leadership practices that are associated with student achievement (Leithwood & Seashore-Louis, 2012), as well as with effective technology integration (Anderson & Dexter, 2005). Leadership is essential to establishing the conditions for teachers to learn how to personalize learning for students (Digital Promise Global, 2016).

While personalized learning is touted as a promising alternative to traditional teaching methods (Pane et al., 2015), there is still little empirical evidence that these strategies will lead to improved student outcomes (Penuel & Johnson, 2016). The lack of consensus on how to define personalized learning makes it even more challenging to implement with fidelity (Patrick et al., 2013). Similarly, evidence from studies on one-to-one initiatives illustrates some benefits of student access to one-to-one devices, but limited effects on core academic achievement (Fleischer, 2012). Integrating one-to-one devices to personalize learning for students will require significant teacher learning and effective leadership. While it is reasonable to expect some of the student outcomes uncovered by research on one-to-one initiatives, the research is not clear how personalization strategies facilitated by such educational technology can impact student

outcomes. Enthusiasm for the promise of technology to transform learning from the time-bound standardized traditional model of delivering instruction to a personalized, mastery-based, and tailored educational model (Horn, 2016; Patrick et al., 2016) has yet to be validated by empirical evidence.

Chapter 3: Methodology

This study inquired about leadership practices to establish the conditions in which teachers learned about integrating one-to-one technology to personalize learning. The literature on personalized learning, school leadership, teacher learning, and one-to-one technology integration supports a conceptual framework that links leadership actions to support technology integration as well as opportunities for teachers to learn about how to integrate technology to personalize learning for their students.

Conceptual Framework

The conceptual framework for this study is undergirded by Inan and Lowther's (2010) school-based factors of total support (support from administrators, peers, students, parents, and community for laptop integration); technical support (adequacy of technical support, availability of resources, and assistance with laptops); and professional development (adequacy and amount of professional development and training opportunities provided by the school regarding laptop integration into classroom instruction). They found that these factors were statistically significantly related to mediating variables of teacher readiness (capability and skills required to integrate laptops into classroom instruction) and teacher beliefs (about laptops' influence on student learning and achievement and impact on classroom instruction and learning activities) (Inan & Lowther, 2010). Using a path analysis, they determined that teacher readiness and beliefs were significantly and directly associated with teachers' integration

of laptops in instruction, and all three school-based factors were related to the two teacher factors (see *Figure 1*) (Inan & Lowther, 2010). Howard et al. (2015), building on this framework, found differences in readiness and beliefs in teachers of different curricular areas, an important factor when considering technology integration in a secondary school organized substantially by content area. Their school-based factors framework, while helpful in connecting school-level factors with teacher-level factors, lacks an explicit foundation in leadership practices. In addition, the simple quantity-based measure of teacher use of technology does not address whether teachers are using one-to-one technology to personalize instruction for their students.

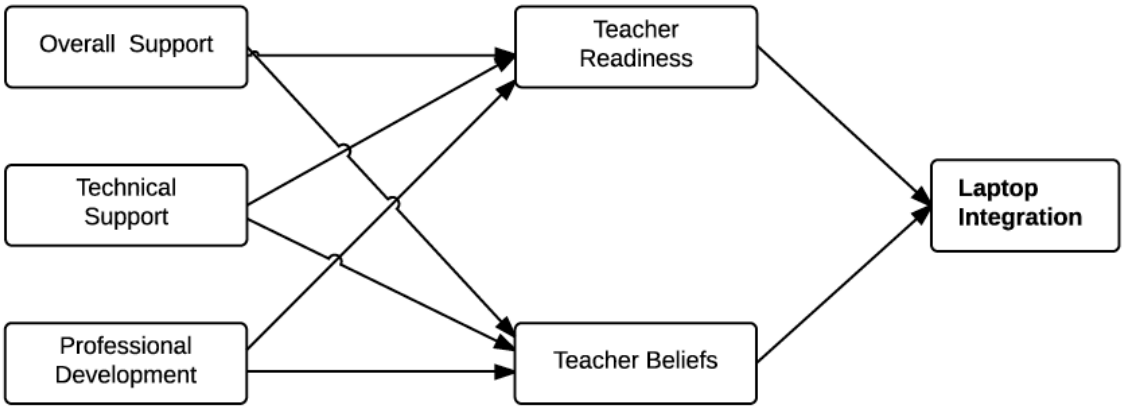

Figure 1. Path model of school-based factors' influence on teachers' laptop integration. (Inan & Lowther, 2010, p. 939).

Building a Leadership Framework for Personalized Learning in a One-to-One Computing Environment

This study associated the "school-based factors" of Inan and Lowther's (2010) model with Leithwood's (2012a) core domains of leadership practices of setting directions, developing people, and redesigning the organization. The overall support

factor is congruent with the notion of distributed leadership for technology integration, as well as dimensions of fostering collaboration within the domain of redesigning the organization (Leithwood, 2012a). The technical support factor captures how leaders provide teachers technology and individual support for one-to-one technology use and connects to the domain of redesigning the organization (Leithwood, 2012a). Finally, the professional development factor connects with Leithwood's (2012a) developing people domain by enabling formal and informal learning opportunities, individualized support, and intellectual stimulation. There are also aspects of the professional development factor that correspond to redesigning the organization to foster collaborative cultures in which teachers can share and develop knowledge and skills for technology integration. Lacking in the school-based factors is explicit mention of the school's vision or goals for one-to-one or personalized learning programs, a fundamental element of the leadership framework established by Leithwood et al. (2004) as well as of effective leadership for technology integration (Anderson & Dexter, 2005a; Dexter, 2011).

Distinct from Inan and Lowther's (2010) theoretical path model, in this conceptual framework, school-based factors are framed by Leithwood's (2012a) three domains of core leadership practices, thus making more clear leaders' function in influencing school-based factors linked to teacher factors related to increased technology integration. The school's direction for the one-to-one program was included as an essential factor potentially affecting teacher readiness for and beliefs about technology. Also, this study sought to identify specific leadership tools, routines, and practices directed toward effective integration of one-to-one technology to personalize learning.

Focusing on leadership actions to support teacher readiness for and beliefs about integrating one-to-one technology and personalizing learning allows the analysis of which leadership practices are most helpful in supporting teachers' technology beliefs and teacher readiness to integrate one-to-one technology for personalized learning.

Teacher factors. Inan and Lowther found that the three school-based factors were related to higher levels of the mediating variables of teacher readiness and beliefs, which exerted strong direct effects on teachers' integration of laptops (2010). The factor of teacher readiness includes teacher knowledge about teaching in one-to-one environments as well as skills for integrating laptops into classroom instruction (Inan & Lowther, 2010). Teacher beliefs about technology integration and the impact laptops have on teaching and learning as well as teacher readiness were associated with teachers' integration of laptops in the classroom (Inan & Lowther, 2010).

This study incorporated teacher readiness and beliefs as mediating variables between leadership practices described above and teachers' integration of one-to-one technology in instruction as well as their perceived ability to foster personalize learning. In *Figure 2*, the school-based factors are reframed in terms of this study's leadership framework, adding a measure of setting directions for the one-to-one and personalized learning initiatives. The outcome measure includes the original laptop use variable as well as a measure of teachers' integration of one-to-one technology for personalized learning. This conceptual framework creates a similar yet theoretically distinct model with leadership explicitly augmenting the school-based factors. I hypothesized that a theoretical framework with a foundation in leadership theory would explain more of the

variation in the mediating factors and thus indirectly in the integration of one-to-one technology for personalized learning. It also enabled the investigation of the leadership practices associated with teacher learning and support for personalized learning in one-to-one computing environments. By analyzing associations between broad categories for leadership, as well specific tools and routines for teacher support and teacher learning, this model enabled an in-depth exploration into the conditions related to the effective integration of laptops for personalized learning.

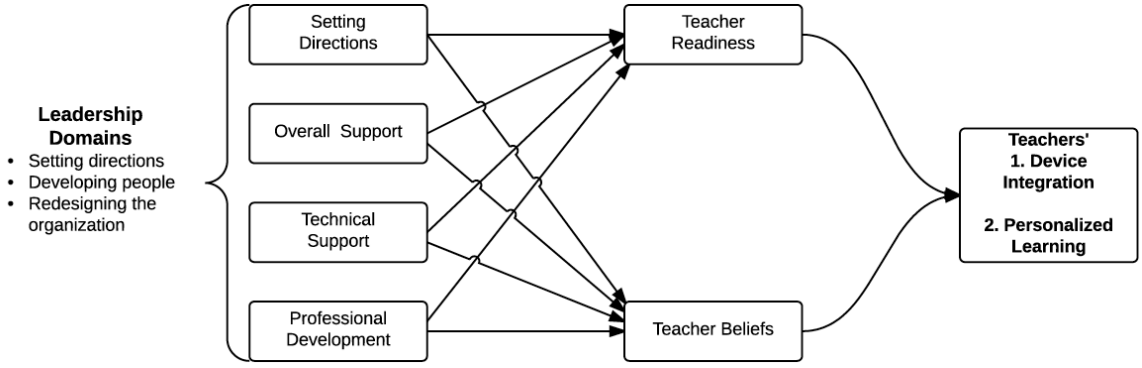

Figure 2. Leadership framework for one-to-one technology integration and personalized learning.

Summary

In this study, I established a leadership-oriented conceptual framework for personalized learning in a one-to-one computing environment, which enabled me to investigate the relationships between leadership practices, teacher readiness for and beliefs about integrating one-to-one technology, and teacher integration of one-to-one technology for personalized learning. Explicitly incorporating leadership practices as variables in a path analysis and validating leadership practices, tools, and routines through qualitative focus-group data enabled contribution to the limited scholarship on

technology leadership and leadership for personalized learning. Further, such research helped identify actionable leadership practices that are associated with stronger levels of support and subsequent one-to-one technology integration and personalization strategies. This conceptual framework can also leaders evaluating such programs by identifying logic model elements such as resources, inputs, activities, outputs, outcomes, and impacts (Kellogg, 2004), as well as indicators that can be monitored for continuous improvement. This will allow educational leaders and teachers to continue improving learning environments that will contribute to personalized learning through effective one-to-one technology integration.

Research Design

This research project utilized a mixed-methods approach to analyze a one-to-one laptop program and personalized learning initiative in three comprehensive high schools located in a suburban public school district. Creswell and Plano Clark (2007) argued that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone. The study explored leadership practices, teacher preparation, and support for integration of laptops in instruction, and the implementation of personalized learning strategies enabled by the one-to-one computing environment. The researcher also analyzed teacher perceptions of leadership factors, teacher factors and their integration of laptops into instruction for personalized learning. Informed by the conceptual framework described above, the current study attempted to elaborate the linkages between leadership practices, school-based factors, teacher readiness for and beliefs about technology integration, and

personalized learning in one-to-one technology environments.

The methodology most closely aligns with the multilevel triangulation design model described by Creswell and Plano Clark (2007) where quantitative and qualitative methods are used to address different levels within a system, in this case, leaders and teachers. I collected data by conducting focus groups with district and school leadership teams as well as by administering a teacher survey. Then, I merged the findings from qualitative and quantitative methods into one overall interpretation (Creswell & Plano Clark, 2007). The methods of data collection, respondents, and instruments used in this study can be found in Table 1.

Table 1
Research Questions, Respondents, and Data Collection Methods

Research Question	Respondents and Methods		
	District Leaders	School Leaders	Teachers
1. How have district and school leaders defined personalized learning?	Focus Group	Focus Group	
2. What leadership practices have district and school leaders employed to help teachers prepare for and implement personalized learning in a one-to-one computing environment?	Focus Group	Focus Group	LTTQ-PL Survey
3. What leadership factors do teachers report as key for helping them to integrate one-to-one laptops for personalized learning?			LTTQ-PL Survey

Investigating leadership practices. The first two research questions addressed

leadership practices, and so key informants were district and school leaders. The second and third research questions seek to identify key leadership practices to help teachers prepare for and implement personalized learning in a new one-to-one technology environment. To address these questions, the researcher conducted focus groups with leaders at the district and school levels using semi-structured focus group questions (see Appendix A) aligned to the Leithwood et al. (2004) leadership domains and the school-based factors in the Inan and Lowther (2010) model (see Appendix G). Two district-level leaders directly involved in implementing the personalized learning participated in the district focus group. At the school level, focus groups at each high school included the principal, assistant principal(s), a lead teacher, other school leaders, and in only one school the instructional technology coordinator (ITC). Focus groups consisted of a set of open-ended questions, sometimes accompanied by probes, that helped guide or structure the discussion, ensuring that each focus group covered substantially the same topics (Remler & Van Ryzin, 2011). This format allowed the researcher to capture detailed and in-depth perspectives related to the leadership domains and school-based factors outlined in the conceptual framework. I audio recorded and transcribed the focus groups, and then coded the focus groups based on the conceptual framework.

I employed a coding scheme established deductively based on leadership practices framed by Leithwood et al. (2004), namely the domains of setting directions, develop people and redesign the organization, with the school-based factors outlined by Inan and Lowther (2010) as secondary codes (see Appendix C). I then analyzed the qualitative interview data using Dedoose, a web-based secure coding and data-analysis software.

The coded leadership focus groups illustrated relationships between leadership practices, routines, and tools and school-based factors that were related to influential teacher-level factors (Inan & Lowther, 2010). Leaders' actions that explicitly related to school-based and teacher-level factors enabled inferences about leadership practices related to increased use of technology by teachers and teachers' ability to personalize learning. This established a logical linkage between leadership practices described in the focus groups and the teacher-level quantitative data associating school and teacher factors to levels of technology integration.

An overall interpretation of the quantitative and qualitative of data allowed inferences about the role leaders play in supporting effective one-to-one technology integration and personalized learning. This linkage may also enable the development of future instruments or measures with which researchers can investigate leadership for technology integration. Building on the model created by Inan and Lowther (2010) by adding a leadership dimension fostered a deeper understanding of the leader's role in supporting one-to-one technology integration for personalized learning.

Investigating teacher perceptions. To answer research question three, I invited all teachers in the three high schools to participate in an online survey about their perceptions of opportunities for learning, leadership support for integrating laptops, and the extent to which they integrated one-to-one technology into instruction and personalized learning. This enabled the analysis of teachers' perceptions of leadership and teacher-level factors related to integrating one-to-one technology and personalizing learning. I first analyzed survey data using descriptive statistics including means and

standard deviations reported on each of the overall scales as well as on individual question responses (see Appendix I). Next, I conducted a path analysis using the models in the conceptual framework on the one-to-one technology integration variable, as well as the variable representing teachers' perception of their ability to personalize learning using one-to-one technology. The path analysis investigated relationships between independent variables, mediating variables and the outcome variables within each of the path models in this study.

Data sample. The survey sample included all teachers who are primarily responsible for delivering instruction in three comprehensive high schools in the school district, as well as all special education and teachers of English for speakers of other languages (ESOL) who co-teach in general education classrooms. The final sample consisted of the 168 teachers out of the 460 invited teachers. I excluded counselors, administrators and support staff from this sample, as they did not deliver instruction in the one-to-one environment. The response rates yielded sufficient responses to make up the recommended minimum sample size of 160 for the path analysis with eight measures (i.e. 20 per measure) (Klein, 1998 as cited in Stage, Carter, & Nora, 2004).

Survey instrument. The survey included all 20 items from the validated Freedom to Learn Teacher Technology Questionnaire (FTL-TTQ) survey developed originally by Lowther and Ross (2000), adapted by Lowther, Strahl, Inan and Bates (2007) for their evaluation of the Freedom to Learn one-to-one initiative in Michigan, and then later used by Inan and Lowther (2010) in their analysis of factors related to use of laptops. The reliability of the FTL-TTQ was determined to be high for each of the five subscales of the

instrument, ranging from .75 to .89 (Inan & Lowther, 2010). Similarly to how Inan and Lowther (2010) modified questions to replace the terms "computer" and "technology" with "FTL laptop computers," this survey used the term "device" to fit the context of the current study. Using a five-point Likert-type scale ranging from strongly disagree (1) to strongly agree (5), teachers rated their agreement with statements regarding six main areas: teacher beliefs, teacher readiness, overall support for school technology use, technical support, professional development, and laptop use.

Also, I included a measure of the school's direction or vision for the one-to-one technology program as setting directions is key in the Leithwood et al. (2004) framework but was not present in the FTL-TTQ. This measure consisted of four Likert-type items drawn directly from the Leithwood et al. (2004) leadership domain of setting directions. Finally, the survey included one item regarding teachers' perceptions about their ability to foster personalized learning. This permitted the interpretations in terms of teachers' personalization of learning as opposed to simple quantity of laptop use. The survey in this study was henceforth referred to as the Leadership TTQ for personalized learning, or LTTQ-PL (see Appendix F).

Path analysis. Path analysis is a statistical technique for analyzing the relationships among a set of variables to reveal the relative effects of each variable on the other variables (Allen, 1997; Schumaker & Lomax, 2004, as cited in Inan & Lowther, 2010). This path analysis attempted to uncover associations between school-based and leadership factors (exogenous variables) and teachers' ability to personalize learning, mediated by teacher-level factors (endogenous variables) of beliefs about technology and

readiness to integrate technology, as illustrated in the conceptual framework in *Figure 2*. This framework preserved all measures used by Inan and Lowther in their entirety, and added a measure of the leadership domain of setting directions (Leithwood et al., 2004). The endogenous variables of teacher beliefs and teacher readiness were also the same measures used by Inan and Lowther (2010). To analyze the teacher perception survey data and investigate relationships between leadership practices, teacher factors, and technology integration for personalized learning, I conducted three separate path analyses. First, I replicated the path analysis conducted by Inan and Lowther (2010). Then I conducted path analysis based on the leadership path model that included the setting directions scale and the original device integration variable, and finally I ran the path analysis replacing the device integration variable with the personalized learning variable. This new outcome variable provided a measure of the teachers' perception about their ability to personalize learning in a one-to-one computing environment.

I employed an analytical statistical program to determine the standardized regression coefficients in the multiple regression models that make up each path model. The first model replicated Inan and Lowther's (2010) path model which included three multiple regression equations: (1) teacher readiness as the dependent variable, with overall support, technical support, and professional development as the independent variables; (2) teacher beliefs as the dependent variable, with overall support, technical support, and professional development as the independent variables; and (3) device integration as the dependent variable, with teacher readiness and teacher beliefs as the independent variables. The second model added the exogenous variable based on the

setting directions scale. Finally, the third model maintains the exogenous variables from model two but replaces the device integration outcome variable with a personalized learning variable. The path analyses resulted in the calculation of path coefficients, represented by standardized regression coefficients (Beta), which indicate the magnitude and direction of the relationships that were theorized to exist between the variables (Schumaker & Lomax, 2004 as cited in Inan & Lowther, 2010).

The calculation procedures yielded three types of effects: direct (the effect of one variable on another after controlling for the other variables in the model), indirect (sum of all direct effect coefficient on all the paths of that variable through mediating variables), and total (the sum of the direct and indirect effects) (Inan & Lowther, 2010). In the results section, I report each coefficient, direct effects, indirect effects, and total effects as well as the path models with effects represented along the paths in each model's diagram. This analysis helped illustrate more clearly the relationship between leadership practices and teachers' perceived level of one-to-one device integration and personalized learning.

Data analysis timeframe. I conducted the three school-based focus groups between August and October of 2016, and I conducted the focus group with district leaders of the personalized learning initiative in December of 2016. I transcribed and coded the focus group data immediately after conducting the focus groups. I administered the online teacher survey in October and November of 2016. To do so, I visited each school site to invite teachers to participate in the online survey and asked the principals to send invitation emails and reminder emails to teachers (see Appendix D). I then analyzed the survey data in November and December of 2016 as well as January of 2017. The

qualitative and quantitative analysis enabled the connection of leadership practices to school and teacher-level factors, as well as to a measure of personalized learning and one-to-one laptop integration. This process provided a holistic view of a one-to-one laptop program, leadership practices, teacher support, teacher learning, and levels of one-to-one technology integration.

Conclusion

Personalizing learning and one-to-one initiatives have proliferated widely throughout schools and districts. Evaluations and research about one-to-one programs have yielded notable findings (Fleischer, 2012) yet remain unconvincing of the ability of one-to-one programs or strategies to personalize learning to significantly impact most core academic achievement (Pane et al., 2015; Penuel & Johnson, 2016; Shapley et al., 2011). The literature on current models of personalized learning lacks empirical evidence of any positive influence of such strategies on student outcomes (Horn, 2016; Penuel & Johnson, 2016). Current conceptions of leadership that influence student achievement lack explicit mention of practices related to technology integration, and literature on technology leadership remains scarce and largely unhelpful in suggesting best practice (McCleod & Richardson, 2011; Richardson et al., 2012). This review of the theoretical and empirical literature on personalized learning, leadership practices, teacher learning, and outcomes for teachers and students in one-to-one computing programs established the foundation for further investigation of the key leadership practices that foster necessary supports and teacher learning about integrating one-to-one technology to implement personalized learning. The conceptual framework in this study supported

further inquiry about leadership actions to foster personalized learning in one-to-one computing environments.

This research examined a one-to-one program and personalized learning initiative in three comprehensive high schools. Using mixed-methods multi-case study methodology to collect and analyze qualitative and quantitative data, I answered research questions about leadership, teacher learning and support, and teachers' perceptions about one-to-one technology integration and personalized learning. This research led to action communication products including a recommendations report to school and district leaders and a personalized learning planning guide for use with school and district leadership teams. The recommendation report will provide an executive summary of the study, as well as summarized findings, data, data analysis, and recommendations. To support further implementation of personalized learning using one-to-one devices, the second action communication product, a personalized learning planning guide, will provide district and school leaders guiding questions organized around the conceptual framework and research findings. District and school leaders may use responses to these questions to generate a logic model and driver diagrams that inform action planning and bolster future implementation efforts. Finally, findings and recommendations from this study may inform school and district leaders, teachers, and policymakers seeking to implement personalized learning or one-to-one programs by clarifying essential leadership practices and teacher support structures foster personalized learning.

Chapter 4: Results

To identify leadership practices supporting the personalized learning and one-to-one initiatives as well as to determine how district and school leaders defined personalized learning, the results reported will first consider teachers' perceptions as measured by the Leadership Teacher Technology Questionnaire for Personalized Learning (LTTQ-PL) (see Appendix F). I then explicate the results from three path analyses conducted with the teacher perception survey data. Next, I describe the results from the focus groups with school leaders from three comprehensive high schools and the district office. The school focus groups prompted leaders to share what they have done to foster the integration of one-to-one devices and personalized learning, organized around three leadership practices of setting directions, developing people, and redesigning the organization (Leithwood & Seashore-Louis, 2012). The district focus group follows and provides insight into the district context in which school leaders work.

Teacher Perception Survey Results

Through the LTTQ-PL, teachers at all three schools in the study were asked to share their perceptions about school-based factors, leadership practices, teacher factors and their integration of technology and ability to personalize learning for their students. First, I describe the participation rates of this online survey; then I report themes from the survey responses on overall scales as well as on individual survey items. The overall

response rate for the online survey was 43.7%, however, adjusted to reflect only fully completed surveys, the adjusted response rate was 36.5% (*n* = 168). The response rate varied between schools, as shown below in Table 2. As a caution, the inclusion of only three schools in the study and the low response rate, in particular at Mayorsville and Rocky Heights, are limitations of the study. As a result, average results may be slightly skewed towards the Coral High School (*n* = 81), which had the highest response rate and nearly half of the total responses in the overall sample. To preserve the anonymity of the schools in this study, all school names and the district name in this report are pseudonyms.

Table 2
Response Rate For Teacher Online Survey at Each Participating School and Overall (Number of Respondents in Parentheses)

School Names	Response Rate
Mayorsville	27% (39)
Coral	47% (81)
Rocky Heights	34% (48)
Overall	36.5% (168)

Note. Response rates reflect completed surveys only.

Teachers in three high schools in Park Gables Public School District shared their perceptions about leadership in their schools, as well as their perceptions of readiness and beliefs about technology integration. The leadership and teacher scales are composed of average responses on four to six Likert-type questions ranging from “strongly disagree,” with a numerical value of zero, to “strongly agree,” represented by a numerical value of four, with a value of two indicating the neutral rating, “neither agree nor disagree.” Table 3 shows the average teacher perception ratings in the three schools and overall district

ratings of setting directions, total support, technical support, and professional development (Inan & Lowther, 2010). Also shown in Table 3 are the results for teacher readiness and teacher beliefs, as well as the results for teacher perceptions of integrating student devices into instruction, and personalizing learning.

Leadership factors. Overall teachers' perceptions of the four overarching leadership factors for the personalized learning initiative varied from below the "neither agree or disagree" response to just below the "agree" mark, indicating that teachers do not see leaders taking significant action in support of the personalized learning initiative. Of the four leadership constructs, the lowest rated by teachers was setting directions, where at no school did teachers' average responses for that leadership construct reach the score corresponding to "neither agree or disagree." As it pertained to personalized learning in a one-to-one environment, on average teachers did not agree that leaders had set a shared vision, established goals, set high performance expectations or communicated the vision and goals effectively. Teachers rated leaders' communication of the vision and goals lowest across all three schools. In addition, teachers across the district, and in particular at Rocky Heights did not perceive there to be a well-developed technology plan that guides integration efforts. Despite teachers perceiving that leaders had not established or communicated a shared vision, goals, or performance expectations for personalizing learning, they did report slightly higher ratings on other leadership factors.

Table 3
Average Teacher Perceptions of Leadership and Teacher Scales, Device Integration and Personalizing learning

	High Schools	District

	Mayorsville	Coral	Rocky Heights	
Leadership Scales				
Setting directions	1.6	1.9	1.6	1.8
Overall support	2.4	2.4	2.1	2.3
Technical support	3.0	2.8	2.5	2.8
Professional development	2.3	2.6	1.9	2.4
Teacher Scales				
Teacher readiness	3.1	2.9	2.8	2.9
Teacher beliefs	2.6	2.4	1.9	2.3
Integration and Personalization Outcome Variables				
Teacher integration of laptops	2.9	2.6	2.7	2.7
Personalize learning	2.7	2.4	2.0	2.3
n	39	81	48	168

Note. Each rating reflects average responses to Likert-type questions making up that scale or variables with ratings as follows, 0=Strongly disagree, 1=Disagree, 2=Neither agree nor disagree, 3=Agree, 4=Strongly agree.

On average teachers perceived overall support to be slightly above the "neither agree or disagree" rating, reflecting that teachers are just barely in agreement that they receive support from administrators, parents and the community, and other teachers. This overall scale reflects teachers' marginally higher ratings about whether parents and other teachers are supportive of device integration efforts, and slightly lower ratings about the administrative support and the support of a well-developed technology plan to guide integration efforts. Teachers rated overall support second lowest after setting directions and just below professional development.

Teachers were more likely to agree with statements relating to the technical support the school and ITCs were providing, especially at Mayorsville (3.0) and Coral (2.8), and to a lesser degree at Rocky Heights (2.5). Across all three sites teachers on

average agreed that students had adequate access to up-to-date technology resources, yet rated access to materials such as software, printers, and supplies much lower, especially at Rocky Heights (1.8). Teachers at Mayorsville and Coral demonstrated higher levels of agreement that laptops were kept in working order and that they could obtain answers to technology-related questions than teachers at Rocky Heights. While teachers rated technical support comparatively higher than the other leadership factors, the results varied, with Rocky Heights teachers less likely to agree that they received sufficient technical assistance.

Finally, on the professional development scale, teachers on average indicated that they just barely edged beyond the "neither agree or disagree" rating as to whether they had received professional development for technology integration, and the results varied more between schools on this scale. On the item related specifically to whether teachers had received adequate training to integrate devices into instruction, teachers hovered around the "neither agree or disagree" rating. Coral teachers were more likely to agree that they "frequently participated in professional development delivered by the ITC" (2.6) than Mayorsville (2.0) or Rocky Heights (2.0). Teachers at Rocky Heights and Mayorsville were just above the "neither agree nor disagree" rating as to whether professional development influenced the frequency or quality of their integration of technology. Throughout these three schools, to a lesser degree at Coral, teachers do not perceive that they have received adequate training opportunities, and also see professional development opportunities as infrequent and not likely to influence the frequency or quality of technology integration.

Teacher-factors, laptop use, and personalized learning. On average, teachers in Park Gables perceive that they are ready to integrate technology into instruction but are more neutral about whether or not they believe it is valuable to do so. All three schools clustered tightly around the "agree" rating (3.0) for the four-question scale for teacher readiness, indicating that teachers felt that they have knowledge and skills needed to integrate technology meaningfully into the classroom. For example, teachers agreed that they had adequate computer skills to foster device integration and to a slightly lower degree that they knew how to integrate technology meaningfully into lessons. Overall and consistently across schools, teachers see themselves as ready to integrate technology into instruction.

Alternatively, teachers' lower ratings on the teacher beliefs scale indicate that they may not perceive value or benefit to integrating technology. This was particularly true at Rocky Heights High School, where the overall rating on this scale fell just above the "neither agree or disagree" mark (1.9), while Mayorsville (2.6) and Coral (2.4) teachers rated this scale slightly more positively. Digging into the items that make up this scale, the lowest rated items overall related to whether device integration had changed classroom learning activities in a positive way or had improved the quality of student work. Rocky Heights teachers rated those two items, as well as items related to whether device integration makes their teaching more student-centered or interactive below the "neither agree or disagree" mark. Teacher belief ratings are relatively lower than ratings of teacher readiness, especially at Rocky Heights.

Teachers' perceptions of the frequency of teachers' integration of student devices

in the classroom and the personalization of learning on average fell between the neither agree or disagree rating (2.0) and the "agree" (3.0) with a slightly more positive perception of device use. There was more variability in teachers' perceptions about whether the use of laptops enabled them to personalize learning for their students, with Mayorsville teachers reporting more closely to the "agree" rating, and Rocky Heights teachers falling right below the neutral rating. Overall, teachers' perceptions of their integration of devices and personalizing learning for students fell predominantly between "neither agree or disagree" and "agree."

Path Analyses of Survey Results. I conducted path analyses to determine the relative impact of the leadership factors on the teacher factors and on the technology integration and personalized learning variables (See Table 3). A total of three models were created to investigate these relationships. The first path model replicated Inan and Lowther's (2010) work and included just the three school-based factors, teacher factors and device integration outcome variable (see *Figure 3*). The second and third path models include an independent variable on leadership, the setting directions scale. The outcome variable in the second path model (see *Figure 4*) is the frequency of teacher integration of laptops variable, which refers to how much teachers agree with a statement indicating that they regularly integrate laptops into instruction. The outcome variable in the third path model (see *Figure 5*) is personalized learning, which refers to teachers' agreement with a statement about their ability to use one-to-one devices to personalize learning for their students.

Thus, as in the Inan and Lowther (2010) model, the first model incorporates the

independent variables of overall support, technical support and professional development. The second and third path models include an additional leadership independent variable of setting directions. Teacher readiness and teacher beliefs are both dependent and independent variables in all three models. This section will report the standardized regression coefficients (Beta) and the coefficients of determination (R^2) for each regression equation in each model, and will also report the direct, indirect, and total effects for each explanatory variable in the models.

Path model one results. In this section, I share the results (see Table 4) from the model replicating the path analysis conducted by Inan and Lowther (2010). Similar to what Inan and Lowther (2010) found, teacher readiness and teacher beliefs were strong and significant predictors of teachers' integration of student devices. In this model, the independent variables explained 49% of the variance in teacher readiness and 41% of the variance in teacher beliefs. Altogether, the five variables explained 45% of the variance in teachers' integration of devices.

In this model, the overall support measure had the strongest effect on teacher readiness and also on teacher beliefs, both of which were statistically significant effects. Technical support had the next strongest influence on teacher readiness and teacher beliefs. Professional development had a weak association with teacher beliefs and readiness and was only statistically significant at the 10% level ($p<0.1$) in its effect on teacher beliefs. Other than teacher readiness and beliefs, professional development was the only school-based factor that had a statistically significant ($p<0.1$) and positive direct effect on device integration. Contrary to findings by Inan & Lowther (2010), professional

development did not exert a significant effect on teacher readiness, but did exert effects on teacher beliefs and device integration. The other two school-based factors did not have statistically significant direct effects.

Table 4
Direct Effects of Factors Influencing Device Integration Inan and Lowther 2010 Model

Variables	Endogenous (dependent) variables		
	Teacher beliefs	Teacher readiness	Device integration
Overall Support	0.437***	0.387***	0.179
Technical Support	0.210**	0.211*	0.188
Professional Development	0.146*	0.132	0.230*
Teacher Readiness			0.319***
Teacher Beliefs			0.386***
R^2	0.492	0.413	0.4351

*Note. *p<0.1, **p<0.01, ***p<0.001*

Table 5 below shows the direct, indirect, and total effects of each independent variable in the model. The total effects for all three factors are stronger than what was found by Inan & Lowther (2010). Overall support ($p<0.001$) and to a lesser degree, technical support ($p<0.1$) and professional development ($p<0.1$) demonstrated a statistically significant total effect on teacher device integration. This replicates the findings of Inan and Lowther (2010) that overall support for school technology had the strongest indirect effect, and teacher beliefs, because of its significant direct effect, had the highest total effect on laptop integration.

Table 5
Direct, Indirect and Total Effects of Factors Influencing Device Integration Inan & Lowther (2010) Model

Variables	Direct	Indirect	Total
Overall support	0.179	0.292***	0.383***
Technical support	0.188	0.148*	0.307*
Professional development	0.230*	0.099	0.329*

Teacher readiness	0.319***	0.319***
Teacher beliefs	0.386***	0.386***

*Note. *p<0.1, **p<0.01, ***p<0.001*

Path model one is shown in *Figure 3* with all standardized regression coefficients, or direct effects displayed in this path diagram below.

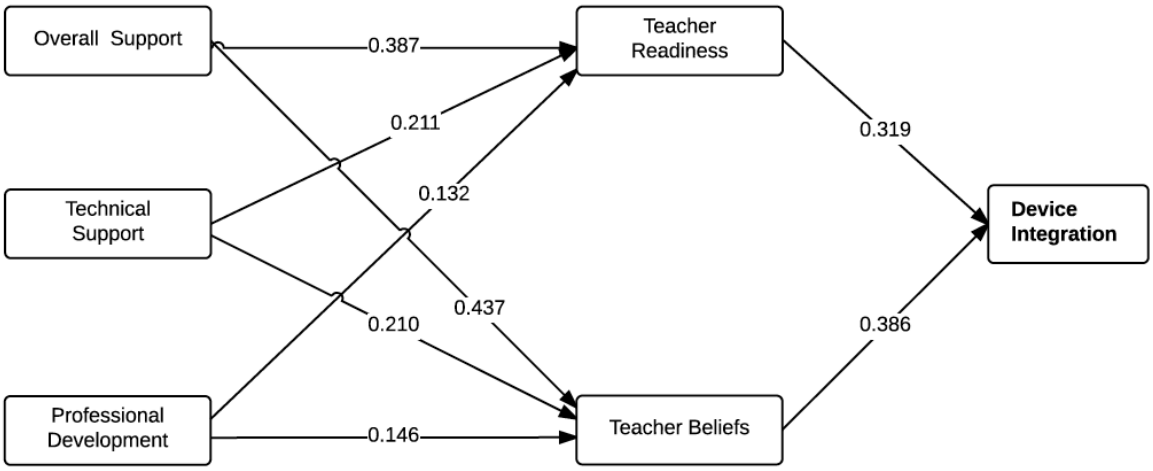

Figure 3. Path analysis for the replication of the Inan and Lowther (2010) model.

Path model two, incorporating leadership. The second path model featured the same outcome variable and teacher variables as model one, but included the leadership scale of setting directions (see Table 3). I report all standard regression coefficients and coefficients of determination in Table 6. In model two, the additional leadership variable of setting directions did not have a significant direct effect on either of the teacher variables or the outcome variable. The direct effects of teacher readiness and teacher beliefs on teachers' device integration are the same as in the previous model as this regression equation is identical. However, in model two, the overall support effects on teacher beliefs and teacher readiness are stronger and statistically significant. Additionally, technical support and professional development exert smaller yet

statistically significant effects on teacher beliefs and teacher readiness, and professional development exerted a statistically significant ($p<0.1$) direct effect on teachers' device integration.

Table 6
Direct Effects of Factors Influencing Device Integration Modified Model

Variables	Endogenous (dependent) variables		
	Teacher beliefs	Teacher readiness	Device integration
Setting directions	-0.004	-0.107	-0.024
Overall support	0.439***	0.445***	0.197
Technical support	0.210**	0.209*	0.188
Professional development	0.147*	0.153*	0.237*
Teacher readiness			0.319***
Teacher beliefs			0.386***
R^2	0.4920	0.4195	0.4077

*Note. *p<0.1, **p<0.01, ***p<0.001*

Table 7 details the direct, indirect, and total effects of the variables in this model. These results demonstrate that the setting directions variable is not a significant predictor of the integration of devices into instruction. However, in this model, the overall support has the strongest and most important total effect on device integration, while teacher beliefs, technical support, and teacher readiness all have relatively strong and statistically significant effects.

Table 7
Direct, Indirect and Total Effects of Factors Influencing Device Integration Modified Model

Variables	Direct	Indirect	Total
Setting directions	-0.0241	-0.036	-0.060
Overall support	0.1968	0.311***	0.508***
Technical support	0.1880	0.148**	0.336**
Professional development	0.2369*	0.106	0.343*
Teacher readiness	0.319***		0.319***
Teacher beliefs	0.386***		0.386***

*Note. *p<0.1, **p<0.01, ***p<0.001*

Figure 4 illustrates the path model and standardized regression coefficients in model two. While the setting directions variable does not influence the exogenous variables in model two, the overall support measure exerts strong effects on teacher readiness and teacher beliefs, which in turn are positively associated with device integration.

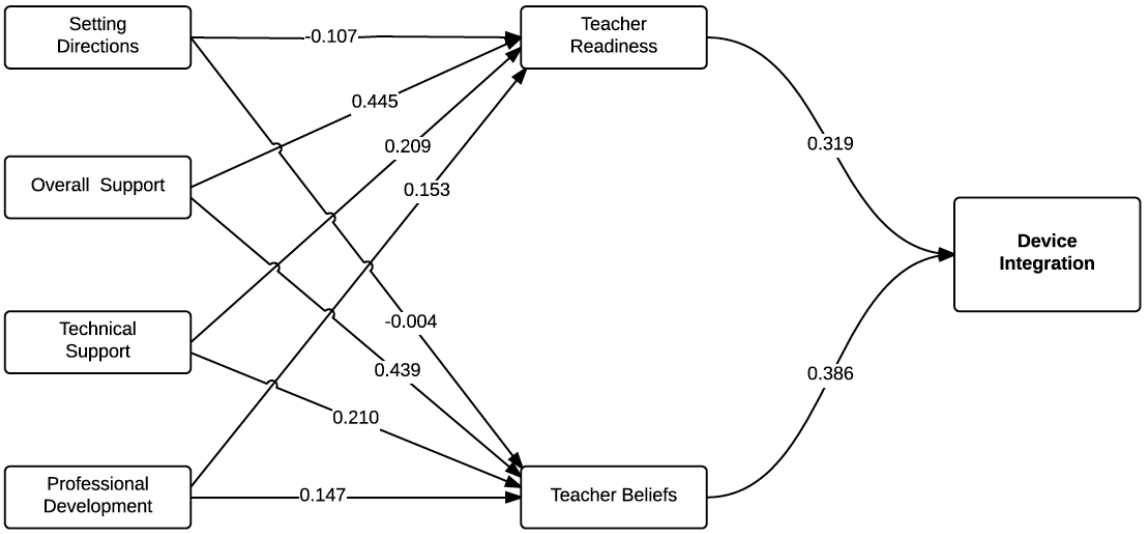

Figure 4. Path model two, with setting directions scale and device integration.

Path model three, incorporating leadership and personalized learning. In this model, I replaced the teacher device integration variable in the previous two models with a personalized learning variable (see Table 3), which reflects teachers' perceptions of being able to implement personalized learning in a one-to-one computing environment. See Table 8 for all standardized regression coefficients and coefficients of determination for model three. The results in model three differed from those in previous models in that the teacher readiness measure was no longer a statistically significant predictor of

whether teachers personalize learning for their students, but the teacher beliefs measure had a much stronger and statistically significant direct effect on personalizing learning. Additionally, while the overall support variable exerted strong and statistically significant direct effects on teacher beliefs and teacher readiness, the overall support, technical support, and professional development variables all exerted statistically significant direct effects on the personalized learning variable. While these direct effects were not nearly the magnitude of the effects exerted by teacher beliefs, these effects are notably different from the previous two models in this study, and Inan and Lowther's (2010) original study.

Table 8
Direct Effects of Factors Influencing Personalized Learning Model

Variables	Endogenous (dependent) variables		
	Teacher beliefs	Teacher readiness	Personalized learning
Setting directions	-0.004	-0.107	0.054
Overall support	0.439***	0.445***	0.276*
Technical support	0.210**	0.209*	0.339**
Professional development	0.147*	0.153*	0.243*
Teacher readiness			0.081
Teacher beliefs			0.737***
R^2	0.4920	0.4195	0.6263

*Note. *p<0.1, **p<0.01, ***p<0.001*

In model three, the indirect effects of the four leadership factors pass almost entirely through the mediating variable of teacher beliefs. In this model, the direct effect of teacher beliefs on personalized learning is the strongest of all three models, with overall support, technical support, and to a lesser degree professional development yielding substantial total effects as well (see Table 9). In addition, professional

development is more strongly related to teachers' personalized learning for their students than it was for simple device integration in the previous model.

Table 9
Direct, Indirect and Total Effects in Factors Influencing Personalized Learning Model

Variables	Direct	Indirect	Total
Setting directions	0.054	-0.011	0.042
Overall support	0.276*	0.360***	0.636***
Technical support	0.339**	0.172*	0.511**
Professional development	0.243*	0.121*	0.364*
Teacher readiness	0.081		0.081
Teacher beliefs	0.737***		0.737***

*Note. *p<0.1, **p<0.01, ***p<0.001*

In model three, the personalized learning path model (see *Figure 5*), notice the standardized regression coefficients relating the independent variables with the teacher variables are the same as in model two (see *Figure 4*). Here the difference is that the outcome variable has changed, and thus the direct effects of teacher beliefs and readiness reflect the stronger effect of teacher beliefs on personalized learning, and the negligible effect of teacher readiness on personalized learning.

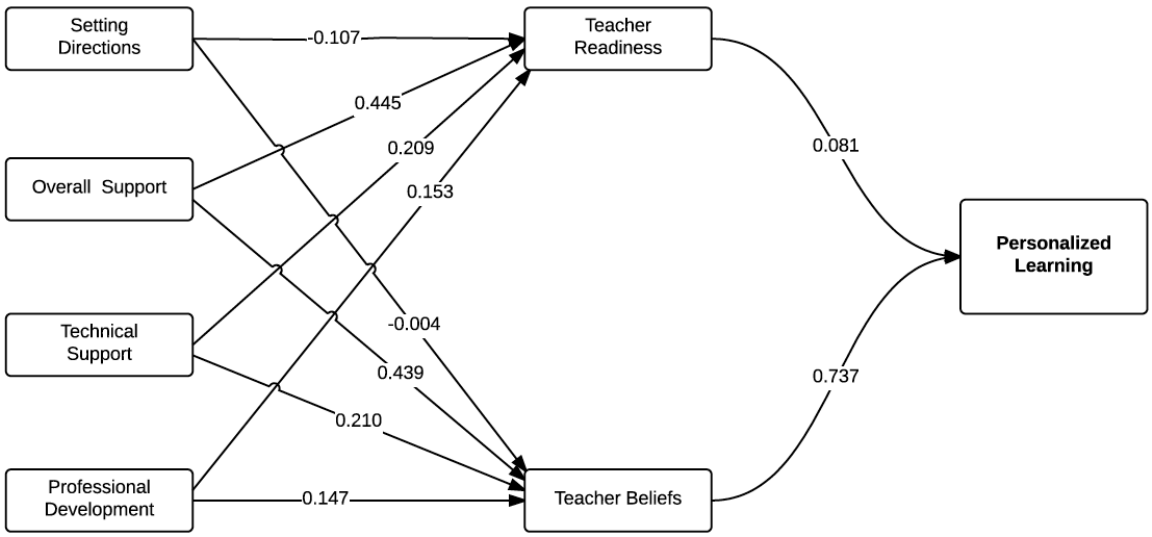

Figure 5. Path model three, leadership path model with personalized learning outcome.

Summary. The path analyses and teacher perception survey results provide empirical evidence of the importance of several factors when implementing one-to-one laptops for personalized learning. Despite the limitation of low response rates and only including three schools in the analysis, the results did yield statistically significant results. As explored in the three path models in this study, the overall support provided to teachers by administrators, other teachers, and the community is essential in fostering teachers' ability to integrate devices into instruction and personalize learning.

In addition, teacher beliefs are confirmed to be the most important teacher factor for integrating devices and are especially important for personalizing learning for students. The teacher beliefs construct directly addresses components related to personalized learning. For example, questions making up the teacher beliefs scale include student interaction and collaboration, student-centered learning, and teacher perceptions of the effect of device integration on achievement, learning activities, and the

interactivity of instruction (see Appendix H). While teacher beliefs play a major role in teachers' integration of devices into instruction, it plays a critical role in teachers' perceptions of their ability to personalize learning.

Notable in the third model was the strength and significance of technical support in helping teachers personalize learning for their students. This variable had a strong total effect and demonstrated the strongest and most significant direct effect on teachers' ability to personalize learning. Finally, professional development was a more powerful and more significant predictor of teachers' ability to personalize learning in this model, working primarily through the teacher beliefs variable.

Surprisingly, in path models two and three, the setting directions scale had a negligible effect on teacher beliefs and teacher readiness, even though it is identified in the literature as critical for school improvement and educational technology initiatives (Dexter, 2011; Shapley et al, 2010). On average, responding teachers across the three school sites did not perceive that school and district leaders had set a shared vision or goals, established performance expectations, or communicated the vision and goals. Teachers' consistently low ratings of the setting directions scale may have resulted in limited variability on the setting directions scale across teachers and schools, which may be why the setting directions scale did not exert any explanatory relationship on teacher readiness and beliefs, and thus on the device integration or personalized learning outcome variables.

To further investigate these expected and unexpected results, next I report on the focus groups with leaders at the three schools included in the study. During these focus

groups, I asked leaders to describe the practices they have used to set directions, develop people, and make the organization work for the one-to-one laptop initiative and to personalize learning.

Focus Groups at the Three Schools Integrating One-to-One Devices to Personalize Learning

At each of the three high schools in this study, members of the schools' leadership team shared their perceptions of what leadership practices had been enacted to support the one-to-one initiative and begin implementing personalized learning in the school. The focus group questions addressed research questions one and two:

1) How have district and school leaders defined personalized learning?
2) What leadership practices have district and school leaders employed to help teachers prepare for and implement personalized learning in a one-to-one computing environment?

Mayorsville High School. Leaders from Mayorsville High School, including the principal, one assistant principal, a teacher who served as department chair and instructional lead teacher, and the Instructional Technology Coordinator (ITC) met in a conference room at the school for about one hour to participate in the focus group.

Leaders' definition of personalized learning. The Mayorsville principal defined personalized learning as centered around traditional educational goals of developing students who can think critically, communicate, understand, read, write, and reason, noting that the devices are mechanisms by which this can happen. He also described that one-to-one access to devices broadens the context and scope of access students have to

communicate, engage, and understand. The ITC indicated that personalized learning means new avenues for students to express themselves, and a 24/7 student-paced learning environment opening learning beyond the school day and saw these possibilities as being facilitated by the one-to-one computer access. An administrator added that in his mind inquiry-based learning, project-based learning, and student-centered constructivist learning with teacher as facilitator together created the conditions for personalized learning. In addition, this administrator noted that personalized learning means providing opportunities for students to engage in material that he or she finds of personal interest, at a level that they can understand and able to respond in a way that is good for them. The ITC then added that student ownership of the learning process is central to his definition of personalized learning:

> With personalized learning, the learner takes ownership of their own learning where there's guidance certainly, but they're the head of their own learning. When that ideal is realized, that's the way you look. These kids are being given the tools that they need to facilitate, they own the information, [and] they own the knowledge.

The principal added that student choice and inquiry were essential to personalized learning: “Students are choosing in the driver's seat, as the ITC suggested, in constructing knowledge and building knowledge and creating work products, and the teacher is guiding and reciprocating that process, but it's all based on student choice and inquiry.” At Mayorsville, leaders defined personalized learning as student-centered, student-directed, inquiry-based learning, where students are constructing knowledge and teachers

guide and reciprocate learning.

Throughout the discussion of what personalized learning means to the Mayorsville administrative team, equity was a recurring theme. All members of the team made reference to equity as a cornerstone of the purpose of the personalized learning initiative. The Principal noted "first, it's an equity issue that we've made the technology available to students that did not have access to it." A teacher leader noted, "personalized learning, when it's truly happening, is equity; every student is getting what they need at whatever level." In contrast, the ITC, while touting equity, noted that the current situation more closely resembles equality, "I use the term 'equality' instead of 'equity' because they're putting the exact same device in every student's hand no matter what kind of access they have once they get home. I still don't think it's totally equitable, but they all have the equal device." Central to Mayorsville leaders' definition of personalized learning, equity was a critical justification for providing one-to-one access to devices to students to level the playing field within the school and throughout the district and was noted several times as essential to the rationale for providing one-to-one access and personalizing learning at Mayorsville High School.

Leadership practices enacted at Mayorsville High School. The leadership team at Mayorsville high school described very few leadership practices associated with implementing personalized learning or integrating one-to-one devices into instruction. However, they did relay that the one-to-one program was imposed upon the school from the district leadership as part of the district's strategic plan goal to provide optimal, technology-rich learning environments. Furthermore, Mayorsville leaders indicated

district leaders had yet to communicate or develop directions for personalized learning with input from them or the school's teachers. Overall, they conveyed a sense that they were in a response mode to the quick and ongoing set of demands required by the implementation, and that this influenced the leadership system of practice they'd been able to create so far.

Describing the rapid rate of district rollout, the ITC recalled, "It did kind of spring up. I know this is something the school board's been talking about. This is one of their ways of the strategic plan, but it kind of just sprung up like a mushroom. I'm not aware of there being a lot of outreach prior to the implementation". A teacher leader stated, from "the teacher perspective, I can't really recall being involved in any of the process or ever being really told what the vision was. It was just kind of, 'We're thinking about starting this one-to-one device initiative,' and then the next year, we come in and the 9th graders are given the devices. I don't know how much work was done involving teachers. I was not involved in it; I know that." The Principal shared that "the district was moving with speed and that it came without much warning to the staff." District leaders and the ITC notified the principal in the spring that the devices were coming as well as the timeline for the rollout of the devices, but the principal said he did not have input in the process. The decision to implement a one-to-one computing initiative happened quickly and with little time to develop a shared vision for the initiative at the district or school-level.

While the ITC provided limited professional development opportunities and addressed many of the technical support needs of the school, the Mayorsville leaders for technology have yet to develop many of the practices recommended for leading

technology such as crafting a vision for personalized learning, or harnessing collaboration structures to help teachers integrate one-to-one technology or personalize learning for students.

Setting directions. Facing a hasty initiation of the one-to-one program, leaders at Mayorsville were forced to quickly adapt to devices that were being deployed over four years, one grade at a time. At the point of the focus group, beginning the third year of the initiative, the leadership team was preparing to deploy devices to the third of four grades, resulting in about three-quarters of students and staff with access to new devices during the 2016-17 school year. During the first two years of implementation, leaders acknowledged not providing directions for personalized learning or integrating one-to-one into instruction. However, one administrator described participating in a 2015 district-level Digital Learning Steering Committee meeting, which worked included teachers, administrators who worked to generate meaning, vision and shared goals for personalized learning. However, they reported that the loss of key district leaders had temporarily halted this process.

School leaders had yet to create a school plan for one-to-one device integration or personalized learning, but identified this as a productive future leadership activity. One administrator's suggestion that, "teachers should be given an opportunity to write a three or five year plan, site-based, technology integration plan for our school" conveyed a needed leadership practice he could see as beneficial to the school. He added that such a leadership practice would "make it our own and develop a cohesive plan and figure out ways to engage folks and develop a coordinated plan, a vision for the school and as

administrators, what we can do to help facilitate implementation of that plan and supporting our teacher leaders who hopefully are at the forefront of helping us". Teachers at Mayorsville also on average "neither agreed nor disagreed" (2.0) whether the school had a well-developed technology plan that guided integration efforts. In all, while administrators see the value of creating a school-based plan for personalized learning, they had not yet done so at Mayorsville High School.

The Mayorsville administrative team discussion indicated that before the focus group, little to no practices around establishing a shared vision occurred at the school level, and school staff was minimally involved in the district-level efforts to develop a common vision for the initiative. Teachers reported in their survey responses that they did not perceive that leaders had established a common vision for the personalized learning initiative and that there had been little communication regarding the directions of the one-to-one initiative and personalized learning. Although the leadership team had not yet crafted or conveyed to the teacher any vision for personalized learning, the degree of consensus in the leadership team implied they had invested time to discuss and agree that the purpose of the one-to-one initiative was equity and providing equal access to devices and digital tools to all students. The Mayorsville administrative team admitted to being in the initial stages of establishing goals, creating performance expectations, and communicating the vision and goals of personalized learning, and teachers' survey responses (see Table 3), echoed the lack of goals and performance expectations for personalizing learning and integrating one-to-one into instruction.

The leadership team at Mayorsville identified constraints to their work to set

directions for personalized learning. Those constraints included competing school-improvement activities such as tiered systems of supports, a school-wide literacy initiative, and cultural competence training, which challenged the ability of the administrative team to focus on personalized learning as a whole school. Administrators also noted that only three of four grades of students and not all staff members would have access to new devices during this coming school year; along with turnover in key district leadership positions made it difficult to progress towards a vision of personalized learning.

Developing people. Mayorsville administrators described their limited efforts achieved so far to provide professional development for teachers on how to personalize learning for students using one-to-one devices. Initially, when the devices were rolled out, professional development centered on how to use the devices, with an emphasis on allowing teachers to play and learn how to use them on their own. One administrator shared that initial communication focused on allowing teachers and students to get familiar with new devices:

> It seemed like the ITC's were given the party line that the first year was about teachers getting familiar with the device. 'Play with it on your own, learn about it.' We're all asking, 'What do you want us to do with them?' The first year, we all had to participate in a 45-minute training that basically showed you how to turn it on, open the folders, kind of basic stuff.

The support and consideration, as well as opportunities for professional growth have been provided primarily by the school-based ITC, who felt constrained in offering more due to

competing school improvement efforts.

The ITC noted the challenge of providing support and professional development opportunities to staff while also mitigating copious technical issues. Also, the ITC and a teacher leader observed that teachers' varied levels of computer skills and comfort with computers, made it difficult to provide appropriate opportunities for adults to learn how to personalize learning and integrate technology meaningfully into instruction. This teacher recalled:

> I've gone to things before thinking, "Oh, I can learn more about Google or something," but then the next 30 minutes of the session is the ITC having to explain to three of the teachers in the room the difference between Google Drive and Google Docs. I stopped going to them. I can learn a lot from the ITC, but not when there's a teacher there that is like, "Ah! Computers!" It's hard.

Providing support and professional development for teachers on personalized learning is also in its infancy as students and teachers do not yet all have the same devices. In reference to teachers' ability to meaningfully integrate devices, the teacher-leader quipped, "we're like embryo stages right now."

Administrators report that school or district-level administrators have provided teachers minimal individualized instructional support to teachers. The ITC has almost single-handedly provided Mayorsville teachers' support to date. He described using a variety of ways to provide technical assistance and varied professional learning opportunities such as through drop-in sessions and support during planning periods or lunch:

> I've tried various ways to maximize the ability to provide support that is coming from the needs of the teacher, not just 'I found this cool thing, go do this.' To do that, I have tried doing just general sessions where I don't actually have a topic. I call that "Teach me anything." It's an opportunity to get a group of teachers together in an open-ended environment where we just start talking about the issues and problems and ways to do it.

These sessions sought to provide support to teachers, but teachers and the ITC noted the difficulty in addressing individual teachers' needs in such group sessions. While limited and challenging, at Mayorsville, the ITC made efforts to offer support to teachers in as individualized fashion as possible. One administrator indicated that they could frame the goal setting and evaluation process for teachers' goal setting to align with several initiatives including personalized learning, but the leadership team had not yet implemented that practice.

In addition to the efforts of the administrative team and the ITC, Mayorsville administrators saw teachers reaching out and assisting one-another as a primary source of support for integrating laptops. A teacher leader noted, "Beyond sessions provided by the ITC, in order to learn more or see what other people are doing, we have to reach out to each other." An administrator observed, "I think the teachers that have really taken the lead in using it in new ways have done it on their own time and they've done it through finding their own support network within the building of colleagues." The support and individual consideration at Mayorsville relied significantly on teachers seeking out aid from the ITC during drop-in sessions or planning periods, or from other teachers.

At Mayorsville, leadership practices to help teachers learn how to personalize learning and integrate one-to-one technology were highly limited and focused primarily on training teachers to use and the new devices. The ITC offered some professional development on how to use the devices when they were initially deployed. Currently, the ITC has provided monthly professional development opportunities focused on technology tools or sharing out what people are doing to build momentum through early adopters and sharing throughout the teacher community. These optional sessions, which took place during planning time, after school or at lunch, focused on tools and strategies but sometimes were open-ended for teachers to discuss problems they were facing. The ITC stated:

> I'll say, 'Here's a cool new thing, here's a little app, here's a technique that you might want to use.' What I'm trying to do is, I'm not necessarily going to be able to, in a reasonable or realistic way, change dramatically, but I'm going to set some plants and seeds and hope that little cores will grow around those seeds and they'll send tendrils out to other little cores, and people will start building a little community around that, so it'll spread a little bit… For me, if I can get a tipping point, identify the people who are going to be the early adopters, get them excited, get them sharing it with the others, and then eventually you get to the point where it becomes so many people are at that tipping point where you're the outlier if you're not. That's where it needs to be.

However, the Principal admitted that they "hadn't done much with technology in terms of professional development," a conclusion that teachers at Mayorsville shared, rating the

adequacy of the training they had received as below the "neither agree nor disagree" rating (see Table 3). While teachers perceived the ITC to be a valuable asset to the school, their responses about frequently participating in professional development that influenced the quality and quantity of device integration on average were just above the "neither agree nor disagree" mark. The administrative team acknowledged the limited efforts primarily by the ITC to develop teachers' professional capacity to integrate one-to-one devices and personalize learning.

While the ITC provided nearly all school-wide efforts around professional development, the leadership team at Mayorsville shared that teachers in certain curricular departments would be leading upcoming professional development sessions within their content area about how to integrate certain tools into the classroom. A teacher leader noted that an upcoming social studies meeting would be a full day of breakout sessions from teachers showing each other how to use various technology tools. However, the teacher-leader reported that the sessions were not coherent as an overall plan of learning, with no collaborative structure for teachers to discover and share strategies for technology integration and personalized learning. She also shared that while many teachers participated, afterward they may not exhibit any change in their teaching. The teacher leader remarked, "Most teachers who don't want to be interested in it can say, 'That's nice,' and just go back to how they were doing it before." Despite the session offerings shared leadership opportunities with teachers, the limited and incoherent nature of these professional learning opportunities indicates Mayorsville's nascent stages of engaging teacher leaders to foster professional growth in personalizing learning with one-

to-one devices.

Leadership practices that redesign the organization. The Mayorsville administrative team described that they had created a variety of experiences over the years to establish a professional learning community within the school to distribute leadership through teaming and build a collaborative culture. For example, he explained that this coming year he would be providing teachers time to meet in their collaborative teams by removing after-school faculty meetings. However, they had yet to formally harness this structure to help teachers personalize learning or integrate one-to-one devices into instruction. While the ITC and some teacher-leaders had completed some leadership tasks, few organizational structures have been put in place to foster personalized learning. Other than providing devices and basic infrastructure such as the technical assistance provided by the ITC, few other technical support resources have been allocated to the one-to-one initiative. The Mayorsville administrative team presented limited leadership practices to redesign the organization to implement personalized learning.

Other members of the leadership team indicated that teacher collaboration and sharing of information had been key to fostering technology integration. An administrator shared, “I think the teachers that have really taken the lead in using it in new ways have done it on their own time and they've done it through finding their own support network within the building of colleagues.” A teacher leader indicated that for teachers to “learn more or see what other people are doing, we have to reach out to each other.” While the teacher noted that there hasn’t been “built in space for that to happen,” the administrative team is actively considering ways to build in time for teachers to collaborate and work in

teams on integrating technology and personalizing learning for their students.

At Mayorsville, the principal and the administrative team are planning to structure opportunities for teachers to work together during the upcoming school year. In this focus group, the Principal shared that he is planning to dedicate specific time for teachers to collaborate in their teams, and will offer them the opportunity to work with the ITC on technology integration if they choose to do so. The structure for collaboration mentioned by the Principal will include release time from traditional faculty meetings to work in their collaborative teams. He shared:

> We are allocating time next week, two hours next week, for the PLCs to meet. We are allocating one of our other release days for PLC meetings and four, five faculty meetings, we're not meeting as faculty, it's go and work in your PLC and I'm going to advise the PLCs to bring in some of the resources. If technology is something that they want to do, invite the ITC to come into their meetings. Sit and help them. "How do we integrate this?" I would always encourage them: don't go about it as, "How do we integrate technology into this?" It's "Here's what we want to do." Ultimately it's "What are the learning outcomes that we want? What do we want to know and be able to do at the end? What are things that we can do to help accomplish that and is technology a resource for that?"

An administrator also would like to "structure time for folks to talk with one another, make it their own, have the time and initial idea to pilot use of [student] blogs in their classroom, and a peer coaching component, where the teachers who have done it can support their colleagues, giving them building stuff and others who can coach their

peers." Thus the administrative team has plans to structure time for collaboration with the possibility to address technology integration. However, even with collaborative structures in place, past collaborative expectations have not required work to personalize learning or integrate one-to-one technology into instruction, and plans indicate that this will be optional.

As it relates to organizational resources of teachers' time, and as described above, the administrative team described competing commitments that jockeyed for teachers' attention during the time structured for their collaboration. The principal again acknowledged how the school's other initiatives produced constraints on teachers' time and made it difficult to dedicate structured time to one-to-one integration or personalized learning strategies. One assistant principal said of the personalized learning initiative, "If this is a priority, then we need to say this is the priority, this is what we're going to do, this is what we're taking off the teacher's plate." The need to remove an organizational imperative from teachers to make time for personalized learning illustrates the structures and leadership practices necessary to begin implementing personalized learning and integrating one-to-one technology meaningfully.

The principal also remarked that the current organizational structure of their comprehensive high school is at odds with the notion of personalized learning, saying, "We've got an old model of organizing school an old model of measuring learning that does not align with the personalized aspect that the device allows." This leadership team admits being at the nascent stages of how to structure the organization to promote collaboration as well as to facilitate Personalized Learning with new one-to-one

technological tools.

Allocating Resources. Organizationally, at the district-level, the priority for resource allocation had been to provide schools one-to-one devices as well as the technical infrastructure to support those devices. At the school level, leaders had not added sufficient resources to maintain student and teacher devices. Implementing a one-to-one program in the district dramatically increased the number of devices in each school and district-wide over the last three years. The ITC described that while some technical support positions had been added at the elementary level, no technician support staff had been added at Mayorsville. While the principal lauded the ITC for working incredibly hard to manage all of the student and staff devices, the ITC stated:

> Here's the thing. We have a technician, but he's shared among other schools, and we have set an expectation amongst our teachers that we're going to be one-to-one. We're not quite a one-to-one if this kid's machine is broken, this kid's machine is stolen, this student's machine is ... So I can say 'All I'm going to do is write the ticket and the tech is going to come over a week later.' Or I can grab the machine and try to fix it myself so the student is not without a machine for a week. I'm a slow learner so what I do is grab the machine and do what I can do, as much as I can. Is that the best use of my time? Absolutely not.

With an additional 1500 devices to maintain and support, it is clear that sufficient resources have not been allocated to provide additional technical support to support the initiative. Despite this, teachers rated the technical support scale at Mayorsville relatively higher than the other high schools, indicating that they agreed that devices were kept in

good working condition, that they could get answers to technology-related questions, and that students had adequate access to up-to-date technology resources. This indicates that the ITC and the part-time technicians were able to provide a level of basic support to teachers.

In addition to fielding many technical assistance requests from students and educators, the ITC described the conflict between the technical support requests and his responsibilities to provide individual instructional support and professional development to teachers:

> Basically the intervention period in the late morning, and through the lunch periods, there were kids at my door almost constantly, dropping off machines, wanting to pick up machines, passwords need to be reset. That's a block of time. I try whenever possible to fit opportunities into times when teachers have some flexibility, their planning periods, their lunch hours, that kind of thing. If you're willing to bring your lunch and come down to my lab, we'll do a work session or we'll do anything, so they can get an opportunity to do that. If I'm going to take care of the needs of the students and teachers, because teachers have problems with the machines too, there's a tension there between what do I give up? My primary responsibility to the school is to provide training, to provide support, to provide to teachers, not necessarily to be the Technical Support Team.

This phenomenon appears in the teacher survey results as teachers rated technical support high yet rated the adequacy of training and professional development much lower. The sheer quantity of technical assistance needs of a one-to-one program coupled with no

added staffing results in this trade-off between technical support and professional development, as the ITC at Mayorsville handles most of both responsibilities. The principal and other administrators acknowledged the need for additional staffing in the form of a technician at the school for at least part time or another ITC to address technical issues, in order to also free up the ITC to deliver professional development and support teachers' technology integration.

Coral High School. The focus group at Coral High School included the principal, five assistant principals, a curriculum coordinator, the director of counseling, the director of student activities, and the assistant director of student activities. Meeting during a regularly scheduled administrative team meeting, I spoke with school leaders for approximately 40 minutes.

Definition of personalized learning at Coral. The administrative team at Coral defined personalized learning as students taking control of their learning and differentiating instruction in preparation for success in a global society. Seeking to clarify the distinction between one-to-one integration and personalized learning, the principal noted that one-to-one devices should be "just another resource that can help with personalized learning." The Coral administrators included individualizing instruction, preparing students for college and career in a global society, using assessment data to inform learning, differentiating instruction and enabling students to take control of their learning in their definition of personalized learning. Speaking about how the district defines personalized learning, an administrator shared that personalized learning allows students "to get a little bit away from the traditional model of, one size fits all education

and find a way to meet more individualized needs that students have." Another administrator added how personalized learning could "prepare students with the skills that they're going to need to compete globally and be work ready, and know how to manipulate technology not only for entertainment but also for educational purposes and eventually for work."

Finally, the Coral school leaders shared that their idea of personalized learning also encompasses the notion of self-directed student enterprise and control over the learning process. An administrator remarked, "there's a student choice component, too, that how students are taking control of learning and I think we've also been going through that transition for a while in that students do not need us to tell them facts anymore." The administrative team at Coral emphasized that one-to-one access was only a resource to help personalize learning for individual students by differentiating for their specific needs and choices.

Leadership practices enacted at Coral High School. The leadership team at Coral High School described that they had not yet adopted leadership practices to set directions for the personalized learning initiative. Administrators noted that the ITC had provided limited opportunities for teachers to learn how to integrate one-to-one devices into instruction, but indicated that they had not yet delivered learning opportunities targeted to personalizing learning for students. The team relied heavily on the ITC to deliver much of the professional development and technical assistance to students and staff.

In addition, at the time of the focus group, the nascent district-led process of

establishing a shared vision for and providing professional development on personalizing learning had so far only consisted of a recent meeting between school principals and district leaders. Beyond deploying devices, providing training to teachers on the devices and their LMS, and providing essential technical support to students and staff, over the past several years, school leaders at Coral had been developing a professional learning community to foster a collaborative culture and build structures for collaboration. However, administrators had yet to formally tap those structures to support the implementation of personalized learning with one-to-one devices. The administrative team acknowledged that they are in the early stages of implementing personalized learning but see much of what they have done in the past as congruent to their notions of personalized learning.

Setting directions. The administrative team at Coral explained that they had not yet taken steps to establish a shared vision or common goals for personalized learning. By the time of the focus group, the principal had just recently attended a meeting where district leaders presented a preliminary district vision for personalized learning to school principals. The Coral administrative team had yet to determine any meaningful practices to establish directions for the initiative at the school-level. While Coral teachers rated the setting directions construct on the teacher perceptions survey comparatively higher than did teachers at the other two schools, overall ratings at all schools for setting directions is the lowest of any of the leadership practices. School leaders at Coral had just begun working with district leaders to start learning about personalized learning.

At Coral High School, the principal indicated that the process of building a shared

district-wide vision for the personalized learning initiative had begun just a week before the focus group. At that meeting, district leaders had shared for the very first time their vision for the personalized learning initiative with school principals. The district leaders disseminated information about another school implementing personalized learning characterized by "three or four blocks in a day where kids are self-directed for half the day working on individual projects they develop with some minimal supervision." The principal cautioned that the example school was much smaller than Coral, where such learning would be difficult to facilitate for over 2000 students. This meeting for the principals was described as the first substantive effort to build a district vision for personalized learning, although he also reported it was a one-way communication, with no discussion among the principals.

Not surprisingly, administrators added that they did not feel involved in the process of establishing a shared vision for personalized learning during the first two years of the initiative. They also noted that they were not aware that the district had planned to hire new positions to support personalized learning until they were recently hired over the previous summer. One administrator noted that new positions were created without consulting the schools about their needs:

> I don't feel as school administrators we have any say in what we would envision that position doing for the schools. It seems like it's something that people are thinking about creating the position and then sending out through the schools to see what our needs are instead of being the opposite, which is to me the way it should be.

The school-level administrators in the focus group stated that they did not have a say in what the district's vision for personalized learning would be, or about the role of those supporting the program. Administrators at Coral identified the principals' meeting with district leaders as the only leadership activity so far targeted at building a shared vision for personalized learning in Park Gables Public Schools. The school administrators reported that no school-level practices had yet been established to contribute to this process and garner school-level support for a shared vision.

School leaders at Coral reported that they had attempted using the district's teacher evaluation and goal setting process to establish goals that aligned with one-to-one integration and personalized learning. For example, an administrator commented about working with teachers to establish goals for differentiating instruction, which she considered key to personalizing learning:

> I think with the SMART goals for the last few years; we've talking about differentiation and meeting the needs of students. That is not a new concept. I do think there will need to be some clarification around the role that the one-to-one device will play and how we can get better at differentiating and meeting students where they are. I think we'll need to work on our messaging as to, is this different than what we've been asking teachers to do for a long time now.

While acknowledging that the team is just beginning to move towards personalized learning, another administrator detailed her perspective on how a tiered system of supports and formative assessment can help teachers identify student learning needs and use that information to personalize learning for students:

> The end goal of that is for every student to be successful and to really make use of formative assessment at the moment to figure out what students' weaknesses are and why they need support. In that sense, I think it's moving in the direction of personalized learning, but I don't think that we have gone beyond that piece [formative assessment] yet. We're still actually just introducing that piece of it.

Also, one administrator acknowledged the different level of comfort teachers have with integrating one-to-one technology, and the trepidation many felt about establishing goals focusing on technology integration or personalized learning. The leadership team at Coral regarded the goal-setting process and evaluation system as an opportunity to set shared goals aligned with personalized learning, but have yet to foster goals explicitly focused on personalized learning or integrating technology.

Coral's administrative team reported communicating with teachers and the community primarily about one-to-one implementation, and that they had not yet communicated about the direction for the personalized learning initiative. One administrator mentioned, "I think at our level we haven't really gotten too much information." The principal remarked that the district-level leaders had informed them that the strategic plan was driving decisions related to the one-to-one and personalized learning initiative, stating, "It's something that the system is trying to get everybody on board with as resulting from their strategic plan that the school board developed." Beyond some communication between district leaders and school leaders, the Coral administrators had not communicated with teachers, students, or the community about the vision and goals for the personalized learning initiative. The leaders at Coral viewed

personalized learning as a re-branded initiative about which district leaders were just beginning to communicate with school leaders.

Developing People. Administrators at Coral indicated that during the first two years of the one-to-one initiative the ITC had delivered the vast majority of professional development opportunities related to integrating technology into instruction. The ITC had provided individual instructional support and had differentiated some of professional development offerings based on teachers' ability level and instructional needs. Professional development to date focused on teacher use of the devices and new learning management system (LMS). The ITC offered varied options for professional development such as online videos and a weekly email, but teachers were able to opt-in, or not, to these offerings. Some of these opportunities were contingent on whether the teacher had obtained a new laptop or interactive whiteboard, and not all teachers, administrators, or students had new devices. While teachers at Coral rated the professional development construct on the teacher perceptions survey comparatively higher than did teachers at the other two schools, on average teachers still reported that they were just above the "neither agree nor disagree" rating as to whether they had received adequate training to incorporate laptops into instruction. However, they were closer to agreeing that frequently participating in professional development provided by the ITC and increasing the frequency and quality of technology integration due to the professional development. The administrative team at Coral indicated that they had not yet focused professional development on the personalized learning strategies.

The ITC at Coral provided the majority of individual support teachers during the

first two years of the one-to-one program. Administrators noted that while the ITC gave some support and consideration to teachers, his time was limited due to technical assistance responsibilities for student devices. One administrator noted, "You wonder how much more staff development and one-on-one time he would have with teachers if he didn't have to worry about the students' computers." While administrators mentioned providing individualized attention through teacher goal setting, this practice was not used systematically to support teachers to personalized learning for their students. School leaders at Coral noted that students and educators had provided support to one another, but that this occurred organically and not as a result of specific leadership practices. Other than ITC support, the administrative team did not note other leadership practices to help teachers individually in integrating one-to-one devices to personalize learning.

At Coral, the ITC provided the majority of teacher training on how to use the devices and the LMS during the first two years of the initiative. An administrator commented that when devices were initially rolled out, many teachers were stressed about the new devices and did not have high levels of comfort with the new devices:

> Some 9th grade teachers, they got the training when they first got the devices, but the first year the devices came out, they came out in October. There was a lot of stress that first year of the device that teachers were getting a new device, too. Many did not have very high level of comfort with it. The training was right when they came out or right before they came out. I think a lot of the training has been incumbent upon our ITC here at the school to provide that opportunity that teachers have taken advantage of both over the summer and during the school

year.

An administrator observed that during the fist two years of the initiative, the ITC had provided professional development opportunities focused on teaching tools using one-to-one devices, as well as the new LMS, remarking "When the devices first came out three years ago, the training was more, how to use [the devices]. In that first year, the directive was, just play around with it and get comfortable with [the device]." Despite the ITC providing teachers with professional development opportunities focused on the core operation of new devices and a new LMS, the Coral administrators admitted not yet focus professional development on how to personalize instruction.

In addition to initial training on devices and the LMS, the ITC has been differentiating professional development and offering alternative learning opportunities to teachers by sending out a weekly email and creating instructional videos for teachers to access. The team did not mention the degree to which teachers had accessed these learning opportunities. The administrative team also noted that the ITC had attempted to differentiate professional development opportunities by offering beginner and experienced sessions on the LMS. Despite these efforts, an administrator admitted the need to provide "a lot more training" on personalizing instruction with one-to-one devices. Teacher perceptions also indicated the need for additional training on how to integrate technology to personalize learning for students.

The ITC dedicated significant time to technical support for students, which limited the amount of training and support he was able to provide. One administrator described the ITC's technical assistance role saying, "That piece of it, the administrative,

logistical piece, has become the larger part and has taken away from the amount of time available to provide the training; one ITC does not have time to do all of that." Also, one administrator questioned the ability of the ITC to provide training focused on teaching and learning rather than technological tools, saying:

> I think that some ITC's have more technological background than others. I wonder how that impacts the decisions that they make of the types of training that they offer. If they're just having training on this is a tool, here's how you use it or some are better able to offer more training on here's the learning theory and here's how you might use multiple tools to achieve this learning.

Despite efforts by the ITC to provide teachers with varied professional development opportunities, the need to provide technical support to faculty and students prevented the ITC from providing teachers adequate training and individualized support.

Redesigning the organization. Administrators at Coral described their leadership practices to support the deployment, and technical requirements of one-to-one devices and build community support for the program, but did not share any specific efforts to create collaborative structures for teachers to foster personalized learning for their students using one-to-one devices. The principal at Coral had not yet emphasized personalized learning due to competing commitments such as the creating tiered system of supports for students. The administrative team referenced ways in which the ITC and technicians had provided technical assistance to teachers and students. While leaders at Coral mentioned multiple times how teachers were collaborating on how to integrate devices into instruction, they did not mention specific leadership practices to structure the

organization to foster collaboration, build collaborative cultures, or distribute leadership. The majority of organizational change has revolved around deploying and maintaining devices and developing the one-to-one infrastructure.

The principal at Coral noted the most significant organizational change was the substantial investment made in providing computers for students and building the accompanying infrastructure. This was their third year of the four-year implementation, meaning that students in three of four grades and most staff members had access to new devices. Coral administrators remarked that distributing devices in waves was challenging for those who do not have new devices, as well as for those who get new devices. For example, one administrator illustrated the constraints associated with deploying devices one year at a time by showing her older laptop. She pondered:

> I wonder if I had a new device, then I would know all these awesome things that I could do for personalized learning, but that's not exactly the right attitude. That's just a tool. I wonder if I'm the only one who's waiting for something on a new device before I feel like I understand all the ins and outs of how I could help, too, to be better for the personalized learning.

Coral administrators described how they added infrastructure to support the devices throughout the school, for example installing charging stations throughout the school and in English classes. The focus at Coral has been on distributing devices to students and ensuring that students would be able to access those devices throughout the building.

An ITC and a school-based technician provided technical support to students at Coral, where teachers perceived relatively high levels of technical support. Teachers on

average agreed that devices were kept in good working condition and that they could get answers to technology-related questions, and also viewed the ITC as a valuable asset to the one-to-one program. One example of how the ITC had provided technical support to students was through a library-based system described as follows:

> Our ITC has set up a system for students where there are lockers in the library. They submit an email request to our help desk, and then those requests get sent to our ITC and our technician. They lock their computer in the locker and the request is sent. He's been giving a lot of thought to how can he maintain his sanity and then there be a systematic way to get support, but while those computers are out I think kids just don't have anything. Going back to the link between having the device and personalized learning that could get in the way.

Despite efforts made by the ITC, leaders at Coral indicate that technical needs of students overwhelm the ITC, who then has less time to work individually with teachers or provide professional development.

During the first year of the program, school leaders reported that the ITC had reached out to parents and the community on several occasions to build support for the one-to-one initiative. One administrator described these efforts, as well as some of the concerns of parents who attended those sessions:

> I remember the ITC had to give these parent seminars that first year. I don't think those are still going on. We did some meetings and the parents who attended those were, and I think he still does deal with this, but they were really concerned about how are they going to control that device when they came home? How

> could [the district] give a device and then make parents take on that responsibility of having to police the device?

While noting that support had increased over time, the administrative team acknowledged that there were those in the community who had concerns about student access to their own devices at school and at home. The Director of Counseling reported concerns over technology addiction that they had not seen before. The principal stated that despite these concerns, all students were given laptops, and that there was no choice. Administrators and the ITC had offered parents and community members' opportunities to learn about the devices and communicate with the school about their concerns.

Coral administrators presented the ways the ITC and the technician had provided technical support to students and staff, as well as ways they had built infrastructure to support one-to-one devices in the school. The ITC and the full-time technician had allocated resources to address technical needs, which interfered with the ITC's ability to provide individual support or professional development. They alluded to teacher collaboration and support for one another in implementing one-to-one, but did not specify leadership practices specifically targeted to building collaborative cultures or structures in support of personalizing learning with one-to-one devices. Administrators viewed competing commitments as consuming time and resources that would have been necessary to focus on personalized learning.

Rocky Heights High School. At Rocky Heights High School, the school Principal, three assistant principals, a teacher leader, the director of counseling, and the director and assistant director of student activities met during a regularly scheduled

administrative team meeting to participate in the focus group. At the time of the focus group, the ITC was out for two weeks and unavailable to attend. The focus group lasted approximately 45 minutes.

Rocky Heights leaders' definition of personalized learning. The Rocky Heights administrative team defined personalized learning as differentiating instruction, involving students' interests, and enabling student agency. The principal shared that they had been trying to differentiate instruction for years. He shared his definition for personalized learning as follows:

> Personalized learning is trying to do something that we've tried to do at Rocky Heights for some years, and that is to differentiate instruction and to go beyond it to reach student interests. That's how I see personalized learning. It's differentiation with an additional focus on tapping into student's interests, student's initiatives, student's energy, directed in the area that they're interested in.

In addition, the Rocky Heights principal explained personalized learning as more than one-to-one device access and as a way to foster self-directed learning in many areas, saying:

> We're talking about the one-to-one initiative, but I see personalized learning going beyond it and not just hooked into the fact that our students all have computer access. The challenge, it seems to me, is going to be how do we use the fact that we have one-to-one for all students, but when students are more self-directed, how do we help them pursue areas that may not come naturally to them, they may not have great interest in, a student who may not want to self-direct learning in

> math, using a device or otherwise, how do we do that? How do we increase that while trying to tap into their natural interests as well?

The Principal emphasized self-directed learning as a component of personalized learning at Rocky Heights, and another administrator noted that the one-to-one program broadened the ability of students to pursue their interests. Administrators described what they considered examples of personalizing learning including a student selected senior project and research papers based on student-interest. The definition of personalized learning at Rocky Heights revolved around student-driven, differentiated, and interest-based learning.

Leadership practices enacted at Rocky Heights High School. At Rocky Heights High School, the administrative team had enacted very few leadership practices aimed at implementing the one-to-one initiative or personalized learning. They described leadership practices targeted to establishing a professional learning community and creating a tiered system of supports but admitted that they had yet to begin implementing the new personalized learning initiative beyond distributing devices to students. At the time of the focus group, the principal and the administrative team were starting to work with district leaders toward developing a vision for what personalized learning means and how one-to-one devices can be integrated meaningfully into instruction to support personalized learning. This vision had yet to involve teachers or be communicated broadly to the school community. Teachers at Rocky Heights reported comparatively lower perceptions of leadership practices than the other schools, viewing the set direction (1.6) and professional development (1.9) scales as below the “neither agree nor disagree”

mark and overall support (2.1) and technical support (2.5) just above that mark. Teacher perceptions corroborate leaders' description of their minimal leadership actions taken to foster one-to-one integration to personalize learning over the first two years of integration. Rocky Heights leaders portrayed few efforts to provide professional development for teachers, and while they had built structures to foster collaboration among teachers, they had yet to redesign organizational structures to support personalized learning with one-to-one devices.

Setting directions. At the point of the focus group, the Rocky Heights administrative team had not yet set any directions for personalized learning in their school. The Rocky Heights Principal reported recently attending a principals' meeting focused on personalized learning, and shared that district leaders were currently developing a district vision for the personalized learning initiative. The administrative team primarily discussed their ideas about a future vision for personalized learning, but had not taken any actions to create a shared vision, shared goals, or performance expectations at the school level and had not yet communicated any directions to the broader school community. Teachers perceived this lack of setting directions, and on average were between the "disagree" and "neither agree nor disagree" rating on items related to whether leaders had established a shared vision or goals, created a plan to guide technology integration, set high performance expectations, or communicated the vision and goals. Teachers at Rocky Heights reported lower than average perceptions of leaders' setting directions for the personalized learning initiative, which parallels leaders' descriptions of their limited actions directed at fostering one-to-one integration to

personalize learning.

The principal at Rocky Heights reported recently attending a district-level principals' meeting where district leaders shared their vision for personalized learning. This was the principal's first action related to setting directions for personalized learning at Rocky Heights, and the assistant principals reported that they would be attending a similar meeting shortly. No prior actions were reported by the administrative team to work either with school or district staff on establishing a shared vision for personalized learning with one-to-one devices.

The Rocky Heights leaders acknowledged that during the first two years of implementation they had not been very involved in developing a vision for the personalized learning and the one-to-one initiatives, which they noted began very quickly. The principal emphasized the importance of district-wide direction for the personalized learning and one-to-one initiatives, "[the district] has to be very clear about what good instruction is, what good education is." The administrative team at Rocky Heights described their skepticism about one-to-one integration and personalized learning and maintained support for traditional teaching methods if they had been effective and if they represent teachers' strengths. The principal and other administrators shared that traditional methods of instruction have been successful at Rocky Heights High School for many years and should be preserved. The principal noted:

> I think there are teachers who are very effective at lecturing, and I would rather have that teacher use that great strength and be a student in that class than someone who is fumbling and bumbling with the computer, just to have me use it,

> a math app or something. I think we look down on what we call maybe more traditional forms of instruction that can still be effective, and are still used post-high school… If someone's strengths - not to say they wouldn't use varied modes of instruction - but if their strengths lie in certain areas, like maybe someone shouldn't lecture, you know? Maybe someone else it's a great strength and they should, so I like to see, I think that's something we try to do with the school, to be honest. What your strengths are as an instruction, we're not inclined to say, "Don't do that, do this." I think we recognize that there's large faculty with varied strengths in the way they present material, and I think that should be respected.

In addition, one school leader questioned the potential of personalized learning to improve instruction:

> Well, let's face it. There are teachers in this building that aren't going to have the kids open their computers this year who could conceivably be some of our most effective teachers. The idea of a personal learning device all the sudden making a teacher more effective, that's a false, I think that's a false assumption. In fact, I would argue that it's probably a hindrance on teachers because they've had to figure out how to integrate it because it's there. It's simply there.

Leaders at Rocky Heights indicated a desire to support teachers' preferred teaching modes, even if it conflicts with teachers' integration of technology. Also, Rocky Heights teachers perceived the lowest level of teacher beliefs (1.9), rating items about whether integrating student devices led to more collaborative, interactive, or student-centered teaching, or higher-quality work and student achievement at or below the "neither agree

nor disagree" level. Leaders at Rocky Heights protected teachers from changing their practice to integrate technology as long as teachers demonstrated strengths or preferences in other modes of instruction.

In all, there was evidence that administrators are beginning to participate in meetings to establish a shared vision for Personalized Learning, but have yet to enact leadership practices at the school level to build a common vision for the program. The Rocky Heights administrative team is struggling to reconcile how the vision for personalized learning with one-to-one devices will fit in with what they described as traditional and effective teaching methods.

Developing people. Leaders at Rocky Heights High School indicated that they had provided minimal professional development opportunities for teachers to learn how to integrate one-to-one devices or how to personalize learning for students. Over the last several years, administrators had been focusing professional development for teachers primarily on competing school improvement efforts such as establishing a professional learning community or creating tiered supports for students. The principal described the professional development efforts and the introduction of personalized learning at the recent principals' meeting, "Personalized learning is just being introduced. We've been working with [a tiered system of supports], collaborative learning and PLCs, and that even is our professional development here in the school for the year. Now they're introducing personalized learning. That's the new thing they introduced at the workshop." Rocky Heights leaders described competing commitments for professional development and for teachers' time, as well as the status of the school regarding providing professional

development for personalized learning and integrating one-to-one devices into instruction.

Rocky Heights administrators acknowledged that they had not yet provided teachers with professional development on personalized learning and only basic training on how to use one-to-one devices and technology tools. Rocky Heights teachers rated the professional development scale, as well as individual items such as whether they agreed that they had adequate training, whether they integrate devices into instruction as a result of professional development, and whether the quality of their technology integration had improved as a result of professional development provided by the ITC below the "neither agree nor disagree" level. Teachers at Rocky Heights on average rated item related to whether the ITC had been a valuable asset to the school's one-to-one program, 1.4 scale points lower than the other two schools. The ITC, while tasked with providing individualized support and professional development to teachers, is also faced with the daunting task of managing many technical responsibilities, making it difficult to work individually with many teachers. The principal shared:

> Ideally, the ITC would be this instructional catalyst to work with the teachers and engaging in new lessons and moving onto the next classroom, next classroom, but the fact is that, one, I think they need training in that regard, and two, there are so many logistical and practical pieces, they're running around just trying to make sure everybody's computer is working so they don't really have the time very often to sit down thoughtfully and help teachers decide lessons in varied disciplines, which is a chore in and of itself. But a part of that is, again, like right

> now, ours is out for a few weeks. We have someone here for two days a week that is going to be busy with practical pieces. He's not going to have time to sit down with teachers to talk about, "How can we design a good lesson using one-to-one?"

An administrator noted that the ITC had provided some individual support and training on how to use the new devices as well as the new learning management system (LMS). One administrator described the ITC's actions to provide teachers with professional development and individual support on the LMS, "I think the focus for teachers has been using the LMS. Our past ITC did a lot with training on the LMS, both in groups as well as individually." While the ITC provided opportunities for teachers to learn how to use devices and the LMS, technical support responsibilities impeded the ITC's ability to provide additional professional development to teachers. The administrative team at Rocky Heights acknowledged that the professional development focused on core functions of new devices and a new LMS and that they had not yet begun to develop teachers' capacity to integrate one-to-one devices to personalize learning for their students.

A teacher-leader claimed that receiving devices with little notice contributed to the limited professional development provided by the ITC during the initial period of the implementation of the initiative, and as a result teachers provided each other support in integrating devices and digital tools into instruction. For example, a teacher leader shared, "It's become of a teacher-led initiative, where we get together and I'm like, 'Oh, I just found this great resource,' and sharing with one another, versus it being like you're going to have these in your classroom, because it did happen very quickly." One of the

administrators added, “There's a lot of teachers helping each other with learning how to take it to the next level.” Leaders did not report having established those expectations for teacher collaboration and support. However, they did say they worked to develop collaboration within a professional learning community. The administrative team stated that teachers, facing a scarcity of professional development opportunities, often turned to one another to learn how to integrate devices into instruction.

The principal and administrators noted that teachers are at different levels of comfort integrating technology, but did not mention any leadership practices aimed at providing individualized support for teachers at various levels of ability to integrate technology or personalize learning. One assistant principal suggested uniform professional development opportunities, “It might be helpful when you're talking about professional development to have it for everyone as opposed to having separate groups doing separate things”. The principal shared his trepidation about teachers’ abilities, and their willingness to seek out learning opportunities:

> Some people have complete confidence and will use this in a creative and engaging way. I wouldn't have the confidence everybody would… I think there are people who are self-directed to learn and they seek out opportunities, they seek out resources on the website, they're looking and saying to someone else, ‘Look what I found.’ They do that all the time. But there are others who are less self-directed in this area.

An administrator commented that teachers’ years of experience in the classroom might be related to their willingness or motivation to learn new instructional strategies:

> A piece of that too is that generational divide. You have seasoned teachers who have been teaching for 15, 20 years, and the way that he or she has been teaching and been successful, kids excel, they learn, they go onto do great things, and then you have the new teacher who's really familiar with technology and it comes really easy, but how do you bridge that gap?"

The Rocky Heights administrative team recognized teachers' varied abilities and comfort integrating technology but did not report any specific practices aimed at adapting professional development to teachers based on their needs and abilities. Overall, the administrative team at Rocky Heights acknowledged that to date the learning opportunities for personalized learning had been limited and primarily focused on basic use of devices and the LMS. Further, they noted that there exists a need for more training for teachers.

Redesigning the organization. The Rocky Heights administrative team indicated that over the last several years, they had exerted substantial effort to develop a professional learning community at Rocky Heights High School, but did not mention explicitly utilizing those collaborative structures to support teachers in personalizing learning or integrating one-to-one devices. The administrative team spent much of the focus group discussing how they had interacted with their community to explicate the one-to-one device deployment in the face of some concerned parents. Also, the Rocky Heights leaders described the insufficient allocation of technical support resources that made it difficult to adequately address technical issues and provide adequate professional development for teachers.

Administrators at Rocky Heights commented that past professional development efforts have centered on fostering teacher collaboration through the creation of a professional learning community. While not explicitly facilitated by this collaborative enterprise, teacher-leaders and administrators shared that much learning occurs through teacher-to-teacher interactions, teachers sharing information online, or teachers sharing digital tools and resources with one another informally. One teacher-leader described how she collaborates with teachers to identify instructional strategies that integrate technology:

> What we ended up doing, we have a group folder in the cloud, which we actually started last year just sharing what we're using, what's working well with our students, so even if we're not in that face-to-face once a month meeting, we can send a quick email, 'Hey, check out this website'. But finding those materials online and starting a dialogue with one another, and that's really helped to support that roll out as each year.

An administrator offered, "They've been supporting each other in how to start using the LMS with their students, whether it's just a means to turn in work or whether a means to post work that's more accessible to the students, or to have a more interactive discussion." Administrators and teacher leaders at Rocky Heights acknowledged the importance of collaboration to help teachers integrate one-to-one devices and personalize learning, but reported the collaboration as informal and not associated with specific leadership actions.

Perceiving an active parent community, Rocky Heights administrators described

their reactions to community and family support and criticism of the one-to-one initiative during the first two years of implementation. While they did not mention specific leadership practices to build productive relationships with families to support the personalized learning initiative, they did share that they had fielded many parent inquiries and concerns about providing students their own devices. The principal and administrators portrayed parents as very involved, with high expectations for service and immediate communication. For example, a teacher commented, "I have heard a lot of concerns from parents saying, 'Before they could control the screen time at home, with their computer. Now their student has their own computer and how do we balance that?'" An administrator shared a discussion she had with a parent who was saying, "I don't want my child to have this; Schools should not have issued this without our approval." The administrators exhibited concerns about students' excessive non-academic use of devices and possible adverse side effects of ubiquitous access to devices, but beyond communicating with individual parents, students, and community members, they mentioned no specific leadership practices or tools addressing these issues. Administrators, especially the principal and the ITC, responded to those concerns from parents but did not report practices to build upon those relationships to garner support for the one-to-one initiative.

Throughout the discussion, Rocky Heights administrators noted the ITCs challenge of providing adequate technical support to students and teachers, especially since any time the ITC spends on technical assistance matters is unavailable to provide teachers instructional support for integrating one-to-one to personalize learning.

Correspondingly, teachers reported the lowest perceptions of technical support (2.5) at Rocky Heights High School, especially as it pertained to obtaining answers to technology-related questions (2.4) and whether students had sufficient materials such as software and printer supplies for classroom use of laptops (1.8). This year, the school had a new ITC, who was out on leave for two weeks during the focus group. The prior ITC, supported by district-level technology staff rolled out devices to freshmen students over the 2014-15 and 2015-16 school years. An administrator commented, "[The ITC] actually went around to the individual classrooms as the freshmen received their computers and talked to them about expectations and how to set things up. And I know that our new ITC continued that this year."

While district staff helped school's ITC deploy the devices, much of the daily burden of maintaining devices and solving technical problems fell primarily on the shoulders of the school-based ITC. Administrators noted that the ITC spent the majority of his time solving technical problems for thousands of student devices or teacher devices, which created a conflict between providing technical assistance and providing instructional support. When asked about additional technical assistance staff, the team noted that they had an additional technical support person who they shared with three elementary schools. The administrative team at Rocky Heights indicated that there were insufficient resources to adequately support the technical infrastructure of the one-to-one initiative.

This lack of technical support influenced students' ability to participate in learning, as well as administrators' time for other tasks. A Rocky Heights leader shared a

recent experience illustrating how technical issues can influence students' ability to participate in learning:

> Another downside to this is that when a computer is down - I just met a kid in the hallway - "I need to see the ITC, my computer is not working," I think that happens more than we would like for it to happen, because when a student doesn't have a device and you're teaching, he or she is not there. That impacts the ability to learn, to participate in the lesson.

The principal shared that devices weren't readily available to students who were new to the school or who had to return their device for service. Even an administrator admitted to spending time helping a student troubleshoot a recent technical issue:

> Monday I spent at least an hour with the students, between on the phone with the ITC and another school, trying to just get through a password that had been reset. It took much longer and it still wasn't working. I think he had returned the computer three times before we just finally gave up and re-imaged it. But that was a student without his computer for two days, and I don't know before he came to me how long it hadn't been working. There needs to be at least somebody here that would help.

In addition, administrators at Rocky Heights expressed their and teachers' frustration with the process for obtaining support from district-level technical assistance staff when the school-based ITC is unavailable or unable to solve a technical problem:

> Support services are a very frustrating process. It is call, leave a message or send an email, and then they'll get back to us occasionally on their own schedule.

> When you're working with a kid, I mean, you cannot speak to a human being. Unless you call a specific human being. The general support line, it's very difficult when you're trying to get something done with a kid to get help. If our in-school people can't help us, which a lot of stuff is out of their hands on this, it does become cumbersome.

The school-based ITC, with limited additional on-site technical support staff, has had to mitigate the majority of technical challenges that educators and students faced at Rocky Heights, but administrators and teachers also report dedicating their own time to helping students solve technical issues, which impinges on their own time and ability to complete other tasks.

The arrival of student devices for students has enabled teachers to select from varied and new instructional resources, indicating that district and school leaders are now allocating resources to harness one-to-one devices and make way for personalized learning. A teacher leader described how her department was considering options for instructional resources that would align with one-to-one integration:

> I think it's changing the way we look at our materials because for example, ELA [English language arts] is in the process of a textbook adoption right now and so they surveyed teachers last year. We wanted more online access to sites, so getting licenses for a variety of things versus the typical textbook that you have to drag around.

One administrator reacted by saying that some students may prefer to read out of a textbook. The Rocky Heights administrative team and teacher leaders indicated that they

were beginning to consider instructional resources that would feature one-to-one devices integration, but did not specifically note any resources that would help teachers foster personalized learning.

Summary. Leaders at Rocky Heights, as well as teachers, indicated that they had enacted limited leadership practices to further the integration of one-to-one devices to personalize learning for students. Low teacher perception ratings of setting directions, overall support, professional development, and teacher beliefs support this result and indicate that leaders have not begun implementing practices to build teacher capacity to integrate devices and personalize learning. Administrators emphasized their beliefs in the importance of supporting teacher's instructional strengths even if they are incongruous with the objectives of one-to-one technology integration for personalized learning. Finally, at Rocky Heights, the ITC and the administrative team reported insufficient resources to mitigate technical issues, and limited professional development to help teachers learn to integrate one-to-one devices and personalize learning.

Focus Group with District Personnel About the Context for Personalized Learning

It is important to consider the district context of the leadership teams and teachers at each school to gain a deeper understanding of the leadership practices in place to support the one-to-one and personalized learning initiative. District leaders play a critical role in enabling leadership practices throughout the district and within schools in the district (Hallinger & Heck, 1996; Waters et al., 2003). Thus building a broader perspective of the leadership practices enacted by district leaders informs the interpretation and analysis of what school leaders reported they had done to support

personalized learning in the new one-to-one environment.

Just after the three school focus groups, I conducted a focus group with two newly hired district-level leaders of the personalized learning initiative. One participant was a newly hired individual in a position created in 2016, and the other was another newly hired secondary-level district leader in an existing position in the department of instruction. They detailed recent efforts to re-launch a district-level committee tasked to set directions for the initiative, as well as potential plans to develop teachers' capacity to implement personalized learning and possible ways to redesign the organization to foster personalized learning at the high school level. One district leader shared that the personalized learning initiative in Park Gables had evolved over the three years of implementation, by increasingly focusing in on the impact of the devices on the students' learning experience:

> Originally the vision of personalized learning was actually about the personalized devices, putting a device in every student's hand. Now, we're pulling that vision apart so we're now looking at those devices as a way to support the actual personalized learning in classrooms of giving students voice, choice, having students move at their own pace.

Teachers' low rating of leaders setting directions for the personalized learning initiative confirms this report by district leaders of what has been done at the district level to set directions. Both district leaders made clear their intention to articulate a vision that goes beyond the simpler earlier association of one-to-one devices being equivalent to personalized learning, and moving to a more nuanced definition of personalization where

devices are one of the learning tools available.

The district leaders described that along with an assistant superintendent they were beginning to reconvene and expand a group of stakeholders to define and articulate a shared vision for personalized learning. She explained the process that is starting to take place to set the directions for the initiative in Park Gables:

> I would say, at this point, we don't have that full vision. We're actually just beginning that vision process next week, as a matter of fact. We're pulling together a large stakeholder group of about 60 folks, [and] we're actually going to start going through those steps and really say what is that vision for Park Gables Public Schools. What does it look like here? We have the definition but what does it look like in our own environment?

While the one-to-one program that was initiated over two years ago was titled "Personalized Learning," the district leadership is just beginning to mobilize resources, tools, and processes to implement a more comprehensive version of personalized learning. Initiated before the 2014-15 school year, the original iteration of the personalized learning initiative focused primarily on deploying personal learning devices to all students one grade at a time at the high school level. At the time of this study, schools had just disseminated devices to the third of the four high school grades, as well as about three-fourths of staff.

During the late spring of 2016, the district created a new director-level position and hired a new assistant superintendent and a new secondary level district leader, who all had responsibilities for leading the personalized learning initiative. These new leaders

described that as they came on board, their work to set directions included practices such as visiting a nearby school district that had been implementing personalized learning for three years. One district leader described practices she had observed such as creating a cohort of personalized learning design teacher-fellows who would be part of the cohort and a community of practice, would experiment with resources, and would provide support for other teachers in their schools. She explained her view of how these practices would enable schools to implement personalized learning and what she saw as the time frame for implementing such strategies:

> That's how we're seeing things progressing and I would think that this cohort would be some of those folks that would be doing the piloting of some of these [personalized learning strategies]. I think the goal is at that 2020 mark to have, in some form, in every school that they're personalizing learning. Again, I think that could be different for every school. We're not prescribing a particular model. I think it's going to be what works.

The district-level leaders indicated that they had not determined exactly who or how the directions for the initiative would be set but suggested that the process would be collaborative and would include various stakeholders. The other district-leader described his work with principals and said, “I like to define what is reasonable and then ask them a little bit more.” They did not describe specific practices they would enact to help school leaders and teachers implement personalized learning strategies.

These district leaders described setting directions for personalized learning by re-casting a Digital Learning Steering Committee consisting of school and district

stakeholders, who would meet to develop the directions for personalized learning and act as a conduit of information between district leadership and the schools. One leader listed the people who would participate in this process, as well as their responsibilities:

> Where we're pulling together a large stakeholder group of about 60 folks where we're actually going to start going through those steps and really say what is that vision for Park Gables Public Schools. What does it look like for here? We have the definition but what does it look like in our own environment? The purpose not only to create this vision but we want this group to be the group that goes back with that essential message. We want someone in every building to be able to articulate what it is that we're trying to do as a department. That's really the purpose of this group… We will start with that vision and once we have that vision these are the people that will be able to disseminate that vision.

District-level leaders explained current and upcoming district-level leadership practices, which will help them set directions for the personalized learning initiative and begin the process of supporting school leaders and teachers in implementing more comprehensive personalization strategies at the high school level.

To enable personalized learning, these district leaders also elaborated ways in which they anticipated potentially modifying existing organizational structures and practices. They described possible adaptations to current approaches such as standards-based grading, mastery learning, flexible scheduling, flexible learning environments, and new ways of delivering content. Acknowledging that these changes may represent substantial departures from traditional high-school models, they described the importance

of garnering family support and communicating the benefits of such changes to parents, students, teachers, and the broader community. The two recently hired district-level leaders supervising the personalized learning initiative made clear that they were just beginning the major district-wide efforts to implement personalized learning beyond providing students one-to-one access to devices. They were mostly focused on the process of developing the directions for this ongoing initiative and to a lessor extent, they are determining how they need to develop teachers' abilities and redesign the organization to foster personalized learning.

Summary of focus group findings. The three school-level leadership teams and district leaders indicated that leadership practices for the personalized learning initiative were in their infancy. While district leaders demonstrated a strong understanding of what personalized learning meant, school leaders had recently begun learning the meaning of personalized learning beyond providing each student a personal device. Limited leadership practices had yet been enacted to bolster the integration of one-to-one technology in classrooms or to implement personalized learning strategies with students. District and school leaders recently started participating in some activities related to establishing a shared vision for personalized learning due to new district leaders taking on that charge. Beyond recent district action, school-level administrative teams had mostly focused leadership on supporting the one-to-one program that is not yet fully deployed, not yet enacting professional development or organizational change to foster personalized learning.

Chapter 5: Discussion and Recommendations

In this chapter, I first discuss the findings of the study by triangulating the results from the teacher perception survey, the path analyses, and the school and district leader focus groups. The discussion section addresses the research questions of the study and relates the findings to the research in the literature review. Then, I offer recommendations about leadership practices to address the problem of practice: leadership to support teachers in implementing personalized learning in a one-to-one environment. The recommendations draw on the research presented in the literature review, as well as the conclusions from this study. Then, I present the implications of those recommendations for practitioners and further research, as well as possible impediments to implementing the recommendations. The final components of this chapter are the action communication products, which provide district and school leaders a recommendation report from this study as well as a personalized learning planning guide to help school and district leaders plan for continued implementation of personalized learning in the district and at each of the high schools.

Discussion of the Findings

Overall, a major theme about the leadership practices across all three schools as they relate to personalized learning in a one-to-one computing environment is their absence. There was a dearth of leadership practices enacted by school-based leaders to

support the implementation of personalized learning. All three principals referenced prioritizing competing commitments over personalized learning during the past two years. Additionally, district leaders had just begun to engage school leaders in disseminating the district vision for the personalized learning initiative. As such, leadership practices described in the focus groups had been enacted primarily by the ITCs to support the deployment of one-to-one devices throughout the schools but had not yet been put into place to support the implementation of personalized learning. Finally, teacher data from the perception survey helped identify key support practices for integrating one-to-one devices and personalizing learning.

This section triangulates the results of the qualitative focus groups and the results of the quantitative analysis of the teacher survey data to identify findings that answer the research questions posed in this study. In the general order of the research questions, it relates the findings to the literature review and draws broader conclusions supported by the survey and focus group data. The findings may address multiple research questions as there is some overlap between leadership practices identified by school and district leaders and elements identified by teachers as essential to supporting their implementation of personalized learning in the one-to-one environment.

Finding 1: Leaders articulated limited definitions of personalized learning (RQ1). This section answers research question one by summarizing how district and school leaders defined personalized learning, as informed by the focus group data from the district and school-level focus groups. Overall, district leaders shared a more comprehensive definition personalized learning as compared with current frameworks for

personalization (LEAP, 2016; Pane et al., 2015), whereas the school leaders identified some of the main components of personalized learning as defined in the literature review.

The district leaders shared the most sophisticated definition of personalized learning (see Table 9), including mastery learning, student choice, student learning plans including goals and choice for materials, and teacher as facilitator. Here is what one district leader shared as the definition of personalized learning:

> It is that students can influence how they learn and are able to decide how they would demonstrate that knowledge that they are working towards mastery of a particular goal not just working towards a letter grade. They are able to choose how to demonstrate that mastery. I envision it as students that are working in different places so you may have that flexible learning environment. Depending on the teacher I look at it in different ways. It might look like a flipped classroom; it might look like a blended learning classroom. For the future, I envision students having their own learning plans where they've set their goals, and they are then choosing those materials to accomplish those goals. That the teacher really becomes more of that facilitator who's orchestrating all of this but it's really taking the lead from the students.

The definition espoused by these district leaders covers many aspects of modern definitions of personalized learning and incorporates one-to-one technology as a tool to achieve personalization. As a caveat, this notion represents future aspirations for personalized learning in Park Gables Public Schools and not what is currently occurring.

School-based leadership teams referenced many components of current

definitions of personalized learning but emphasized different aspects. For example, all three leadership teams included in their definition of personalized learning student choice, self-directed learning, differentiating based on student characteristics, and one-to-one technology as a tool for learning. See Table 10 below for how leadership teams identified key elements of personalized learning each school's leadership team in the focus groups as compared to one personalized learning model developed by the Bill and Melinda Gates Foundation (2014) and investigated by Pane et al. (2015).

Table 10
Components of Personalized Learning Identified by School and District Leaders

	Learner profiles	Personal learning paths	Competency-based progression	Flexible learning environments	College and career readiness
Mayorsville	X	X			
Coral	X	X			X
Rocky Heights	X	X			
District	X	X	X	X	

Note. Components from Pane et al. (2015)

It must be noted that the Pane et al. (2015) components represent only one model of personalized learning. The statements by school leaders provided evidence of a basic connection of learner profiles and interests driving personalized learning, but did not clearly define how learners profiles or personal learning paths would be determined or implemented. None of the school-based principals mentioned competency-based progression or mastery learning, and although two teams discussed students learning outside of school, no team mentioned how the learning environment within the school might be adapted to foster personalized learning. Finally, Coral administrators indicated that personalized learning should prepare students to be "compete globally and be work

ready," but none of the other administrative teams mentioned college and career readiness as part of the definition of personalized learning. In the four focus groups, district leaders shared a more comprehensive definition of personalized learning than did school-based leadership teams.

Some schools included additional components, not in the Pane et al. (2015) model. For example, Mayorsville High School leaders saw equity as an essential part of personalized learning, whereas Coral administrators mentioned connecting students with the global society, and Rocky Heights leaders noted student interests as key to personalized learning. Coral was the only group to suggest using formative assessment data to identify student needs, as well as student self-evaluation. Mayorsville leaders explicitly mentioned student-centered instruction and project-based learning as part of personalized learning, as well as teachers acting as facilitators. Mayorsville and Rocky Heights administrators viewed learning beyond the school day as a component of personalized learning but didn't specify whether the learning environment would be adjusted in school. However, Coral's principal shared an example from a recent principals' meeting of how another school had modified the learning environment to make extended blocks of time to accommodate personalized learning.

While district-level leaders described a comprehensive definition of personalized learning, school-level teams only described minimal elements found in current models of personalized learning (LEAP, 2016; Pane et al., 2015). While there is no consensus definition of personalized learning (Herold, 2016; Horn, 2016; Patrick et al., 2013), it is clear that Park Gables leaders have not yet established a consistent definition for

personalized learning. As such, school leaders are still in the process of learning what it means to personalize learning and determine what personalization will look like in their buildings.

Finding 2: District leadership is not fulfilling the typical role as initiator of implementation (RQ2). During all three school-based focus groups, school leaders described the district leadership as driving decisions around major school improvement initiatives, which over the past years included developing professional learning communities (PLCs), building a multi-tiered system of supports (MTSS), and cultural competence training. In the case of implementing personalized learning, leadership throughout the district lagged a couple of years behind implementation. Whereas for the initiatives mentioned above the district provided professional development, support to principals, and resources such as early-release time for teachers to work on new initiatives, with the result that principals and administrative teams reported devoting significant time and additional school resources to those efforts. At the outset of the third year of the rollout of one-to-one devices in the personalized learning initiative, district leaders were just beginning to consider the district supports for schools to implement personalized learning.

District leaders in charge of the personalized learning initiative acknowledged the initial association of personalized learning with just providing one-to-one devices, but described pivoting to rebrand and implement personalized learning throughout the district. They were planning to reconvene the Digital Learning Steering Committee made up of school and district stakeholder representatives who would work to establish and

disseminate a shared vision for the personalized learning initiative in Park Gables's High Schools. Evidence from the three school-level focus groups and the district-level focus group indicates that the district had yet to provide schools adequate guidance on what personalized learning means and how school-level educators should implemented it in conjunction with integrating one-to-one technology.

The school administrators, acknowledging this departure from the typically strong direction for most district initiatives stating that they have not felt involved in establishing a vision for the initiative. Teacher survey results suggest universally low perceptions of leadership practices to set directions, goals, and expectations for personalized learning, as well as to communicate the vision and goals. While the path analysis does not indicate any significant relationship between setting directions and improved teacher integration of devices or personalization of learning, the survey and focus group data illustrate limited efforts district leaders made to elucidate the directions for the initiative. District and school leaders established insufficient practices to set directions, something research about school leadership and technology leadership indicates is essential to obtaining positive student achievement and technology integration outcomes (Andersen & Dexter, 2005b; Kouzes & Posner, 1987; Leithwood & Seashore-Louis, 2012; Shapley et al., 2010).

School leaders acknowledged the important role that district leadership plays in establishing directions, priorities, and goals for the schools, as well as directing resources and school improvement efforts. School-level administrators mentioned that other initiatives had been taking priority for resources, professional development, and teachers'

time. As a Mayorsville leader remarked about personalized learning, “If this is a priority, then we need to say this is the priority, this is what we're going to do; this is what we're taking off the teacher's plate.” The district leaders acknowledged this and believed personalized learning would subsume at least one of the concurrent district initiatives, and would rely heavily on the collaborative structures of PLCs for its implementation.

School leaders indicated that during the first two years of the initiative they had mostly adapted existing leadership practices to accommodate the flood of new devices, and had not yet begun working with teachers to go beyond the basic integration of technology and into personalization strategies. They indicated that at the time of the focus groups, the district leaders were just beginning to communicate with them about personalized learning. School leaders saw district leaders as initiators of setting directions and identifying what personalized learning would mean in their schools. Correspondingly, school leaders were waiting for more clarification and guidance from district leaders, to understand better what they would be implementing in their schools. The recent district-level principals’ meeting seemed to provide some guidance to principals, but they were still not ready to perform any leadership action to foster personalization strategies with teachers and students. The school leaders expressed a need for guidance from district leaders, as well as organizational supports and resources from the district-level leadership to facilitate the process of implementing personalized learning and integrating one-to-one devices.

Finding 3: Absent guidance, school administrators integrated one-to-one to foster existing goals (RQ 2). With the one-to-one personalized learning initiative

deployed initially to provide each student access to a personalized learning device with negligible vision beyond said access, school administrators used this new tool to bolster existing school vision and goals. This aligns closely with what McLaughlin (1976) considers cooptation of the implementation where strategies are modified to conform to current classroom and school purposes, and not a more successful implementation where mutual adaptation from implementers and the innovation lead to significant changes in teachers' attitudes, skills, and behaviors. For example, at Mayorsville High School, which is home to a relatively high number of impoverished and minority students, administrators viewed the one-to-one program as primarily addressing equity of access to learning tools both in the school and across the district. As such providing each student a personal device suited the school vision and goals around equitable access to learning tools. Administrators at Coral incorporated preparing students for participation and work in a global society as key to their vision for personalized learning with one-to-one access, which relates to their school programs and vision of international education. Finally, administrators at Rocky Heights high school, where nearly all students attend post-secondary institutions, homed in on academic tasks such as writing papers and more traditional measures of academic success and viewed personalized learning as tailoring those tasks to individual student interests. Without a compelling shared vision shared throughout the district for integrating one-to-one devices to personalize learning, school leaders adapted the program to meet the vision, goals, and needs of their school and their students.

This lack of district-wide directions for personalized learning led school leaders to

rely primarily on the vision and goals for their school to guide the implementation of the one-to-one devices and personalized learning initiatives. Research indicates that the quality of the school's technology vision influenced the tools and routines put in place, and how leaders and followers interact around integrating technology (Dexter, 2011). Furthermore, theories such as transformational leadership (Kouzes & Posner, 1987; Leithwood & Janzi 2006; Wong & Li, 2011) detail the importance of a strong, widely-shared vision that motivates individuals to exert efforts towards that vision. Integrating one-one devices in the absence of a widely shared vision and goals may have resulted in teachers integrating technology to meet their instructional demands and maintain traditional teacher-centered instructional methods (Cuban, 2013; Lowther et al., 2012; Shapley, 2010).

Since leaders have not elaborated concrete and shared directions for what forms of personalization they would implemented in the high schools, it is likely that teachers have used the one-to-one devices primarily in ways that do not deviate significantly from previous practice (Lowther et al., 2012). This may also parallel the finding by Pane et al., (2015) who found that schools implementing versions of personalized learning implemented strategies that were extensions of traditional practices, and rarely implemented more challenging strategies such as competency-based progression. The one-to-one personalized learning program in Park Gables arrived rather unexpectedly, and school leaders did not have the time or district direction to explicitly establish shared vision or goals for how to integrate one-to-one devices to foster personalized learning. As a result, school leaders merged the initiative into existing leadership practices and

organizational structures, in which teachers likely have not integrated one-to-one devices to diverge from traditional practices into forms of personalized learning.

Finding 4: Limited professional development was focused on tools (RQ 2 & RQ3). Over the first two years of the one-to-one initiative, school-based ITCs delivered professional development primarily focused on teachers learning about the new devices and instructional tools such as the new LMS. This theme emerged throughout the three school-based focus groups and is congruent with district leaders' description of the initial implementation of the Personalized Learning initiative as providing personal devices to each student over four years. In preparation for teachers integrating one-to-one technology, school-based ITCs offered professional development on how to use new computers and incorporate a new LMS and other technological tools. Some training opportunities were only available to teachers who had received new devices, some were optional, and some were delivered to the entire instructional staff. At all three school sites, teachers rated the professional development for integrating one-to-one technology low, noting that they had not received sufficient training and that the training offered did not necessarily help them increase the frequency with which they integrated devices or the quality of their integration of devices. With other initiatives requiring professional development and ITCs who were swamped with technical support duties, the professional development provided during initial years was perfunctory, insufficient, and focused on basic tools as opposed to effective technology integration to support personalized learning strategies. School administrators noted this lack of professional development for teachers and acknowledged the need for additional training for teachers, especially as it

related to personalizing learning.

While teachers and administrators agreed that training was insufficient and did not help teachers meaningfully integrate technology, the path analysis indicated that professional development exerted a medium direct and total effect at the 10% statistically significance level ($p<0.1$) on device integration, and slightly weaker but still statistically significant direct and total effects on teachers' perceptions of personalizing learning with one-to-one devices. The total effects of professional development on personalizing learning worked mostly through teachers' beliefs about devices and how devices can make instruction more student-centered, interactive, collaborative, and productive for learning. While overall levels of professional development were weak and focused on tools, professional development activities provided by the ITC and by the school district may eventually positively influence teachers' ability to integrate devices to personalize learning meaningfully.

At the district and school levels, leaders recognized the need for professional development opportunities that were differentiated based on teacher needs and level of technology knowledge. So far, district leaders had offered an optional online course on personalized learning to interested educators, and described the possibility of mirroring another district and creating a personalized learning cohort of teachers who would pilot strategies and provide professional development to their peers. District leaders had yet to provide more widespread professional development opportunities but were currently focusing on teachers who had an interest in learning more about personalized learning through the online course.

School leaders recognized how teachers' technical capabilities and level of comfort with technology varied widely. For example, Rocky Heights leaders described a gap in skills and comfort levels with technology between new teachers and veteran teachers, "Some people are really savvy about doing it and figuring it out, and there are others who aren't. So there needs to be that system of support for those who aren't as comfortable." Each administrative team observed the need to provide differentiated learning opportunities to technology beginners as well as more experienced teachers, whether it comes to their facility with a new device or implementing a new LMS. An ITC invoked Rogers' (1995) phrase, early adopter, to describe his approach:

> For me, if I can get a tipping point, identify the people who are going to be the early adopters, get them excited, get them sharing it with the others, and then eventually you get to the point where it becomes so many people are at that tipping point where you're the outlier if you're not. That's where it needs to be.

This theme across school leadership teams indicates a cognizance and attempts by the ITCs to provide differentiated professional development opportunities for teachers, especially at Mayorsville and Coral, where teachers rated professional development slightly higher than at Rocky Heights.

This finding aligns with research that states professional development should connect with teachers' content area, be collaborative, align with other district initiatives, extend over time, and enable active learning (Desimone et al., 2002; Garet et al., 2001). Many of these characteristics suggest that professional development should be differentiated, and Rogers (1995) recommends organizing professional learning along a

continuum of how individuals implement a new initiative, where early adopters eagerly take on an innovation while late majority and laggards take much more time to adopt an innovation. Leaders acknowledged that teachers need differentiated learning opportunities because of their differing background and comfort with technology, aligning with the literature on adult learning (Garet et al., 2001; Rogers, 1995).

Providing individualized support and consideration to teachers to teachers is key to developing people, especially as it relates to integrating technology purposefully to support student learning (Dexter 2011; Leithwood 2012a). School leaders indicated that ITCs were unable to provide sufficient individualized instructional support due to excessive technical assistance responsibilities. School and district leaders had yet to implement a robust offering of professional learning opportunities to address the needs of teachers at varying levels of ability and comfort with technology, and were just dabbling with different mostly optional practices for providing teachers professional learning on how to integrate one-to-one devices into instruction.

Finding 5: Key organizational structures support one-to-one integration and personalized learning (RQ 2 & RQ 3). School and district administrators alike agreed there was a need to structure the organization to foster collaboration, and over the last three years had worked to establish professional learning communities to accomplish that. They also noted the potential usefulness of these collaborative structures to enable teachers to collaborate on how to implement personalized learning strategies in the new one-to-one computing environment. One of the district leaders exclaimed, “PLC, that is where all of the magic is happening. This is where you're examining all of that data,

really seeing where your students are, making those instructional decisions and creating all of those formative assessments." At the district level, the push over the last several years to establish PLCs at each school may provide the structure for collaboration and collaborative cultures that will support the implementation of personalized learning. However, the district leaders had not yet explicitly made personalized learning strategies the focus of collaborative work within PLCs.

Two of three school leadership teams described plans to focus the PLC collaboration on technology integration, but they did not describe specific practices other than making time for meetings and encouraging them to focus on technology or work with the ITC during those times. The Mayorsville principal described his plan for the upcoming year to make time available for teacher teams to collaborate, as well as to encourage teams to invite the ITC to their collaborative meetings if they want to focus on technology integration. Despite not having made technology a specific focus of collaboration in the past two years, Mayorsville leaders had plans to make at least optional inviting the ITC to collaborative meetings to share technology integration strategies. Notable in this practice was the emphasis on integrating technology rather than personalizing learning. The principal at Rocky Heights also mentioned the PLC structure as a possible vessel for teachers to collaborate on technology integration, "I think what we can do is foster the collaboration, provide time, and suggest time and agendas for that collaboration." Again here the emphasis is on basic elements of integrating one-to-one devices more so than facilitating personalized learning for their students. Finally, similar to district leader comments, school leaders see the potential for the PLC collaborative

structure to facilitate collaboration on this new initiative but had not yet established personalized learning as an area of emphasis for their PLC.

Redesigning and structuring the organization to foster collaboration and build collaborative cultures (Leithwood 2012a) is an essential leadership practice that aligns directly to the school-based factor of overall support, which includes support from fellow teachers, administrators, and the community (Inan & Lowther 2010). Research shows that schools with higher levels of a professional community tend to have higher levels of technology integration (Anderson & Dexter 2005b) because collaboration helps teachers communicate and plan for technology integration in structured teams (Jones & Dexter, 2014). The teacher survey and path analysis emphatically supports the importance of overall support provided by administrators, teachers, students, and families, a variable which was shown to exert significant and strong effects on teacher beliefs about technology and consequently on teacher integration of devices and personalizing learning for students. Specifically, regarding the personalized learning path model shown in *Figure 5*, the overall support variable exerted powerful and statistically significant effects on personalized learning, especially working indirectly through teacher beliefs. These effects of overall support were more robust in the personalized learning path model than the device integration model (*Figure 4*) or the replicated Inan & Lowther (2010) model (*Figure 3*), indicating that overall support becomes even more influential for integrating technology to personalize learning. These efforts to build collaborative cultures may relate to the finding that overall support exerted powerful effects on teacher beliefs and readiness, and correspondingly on device integration and personalized learning.

Prior research confirms the importance teachers sharing technology integration strategies (Dexter 2011) and administrators applying supportive pressure for teachers to integrate technology (Shapley et al., 2010). Also, Inan and Lowther (2010) affirm the substantial effects of overall support on teacher readiness, teacher beliefs, and teachers' integration of devices into instruction. Collaborative structures and teaming create more opportunities for teachers, teacher leaders, and administrators to interact with the purpose of implementing new instructional practices like one-to-one integration or personalizing learning. This is particularly important given research indicating that teachers often learn about technology integration through informal channels such as sharing with administrators, instructional technology specialists, teacher leaders, colleagues, and professional learning networks (PLNs), as well as by independently experimenting with strategies or tools presented in formal professional learning opportunities (Dexter et al., 2009; Jones & Dexter, 2014). The research mentioned above combined with findings from the focus groups and path analyses suggest that the work described by school and district leaders to build professional learning communities in their schools may have exerted positive impacts on teachers perceived abilities to integrate one-to-one devices into instruction and teachers perceptions of their capacity to personalize learning.

The collaborative structures created in a PLC also engender more widely distributed leadership by facilitating teacher leadership in collaborative teams. In the distributed leadership perspective, leadership is distributed across leaders, followers, and the situation where individuals use tools and routines to activate leadership throughout the organization (Spillane et al., 2004). In these schools, the leadership for technology

integration seemed concentrated within the ITC at each school site with limited district guidance or support for technical or instructional needs. Schools with widely distributed networks for technology leadership have been shown to exhibit higher levels of technology integration (Hiltz & Dexter, 2012). This research supports school and district leaders' plans to harness the structures of collaborative teams found in PLCs to bolster the implementation of personalized learning, as well as district leaders' plans to build teachers' capacity through teacher cohorts who would pilot strategies and share with other teachers. The literature, the school and district leaders statements, and the path analysis indicate that leadership practices to foster collaboration, expand overall support, and distribute leadership are productive avenues for facilitating teachers' implementation of personalized learning.

Finding 6: There was insufficient technical support for teachers and students (RQ 2 & 3). One common theme throughout the three focus groups was the sheer volume of technical assistance needs stemming from the one-to-one devices. This challenge left technical assistance for teachers and students vastly understaffed while also undermining the instructional support and professional development available for teachers. One of the school administrators shared that good intentions do not suffice for fulfilling actual support needs:

> We are not anywhere close to providing teachers with the support that they need or even students with the support that they need. It's sort of like a tidal wave of devices that just arrived with not a whole lot of change to the way we do things. I think for something as big as this, which has the potential to be revolutionary in

> the way that instruction is delivered, we didn't really carve out any space to provide support for it. Everybody is doing the best they can, teachers are doing what they can, the ITC is doing the best that they can, administrators, everybody is doing what they can, but I don't think that with dumping this thing on top of the existing infrastructure there is a possibility to really do the support the way it needs to be done.

While some district-level technical support exists, each high school of about 2000 students and 150 teachers each is supported primarily by one ITC, and one part-time technician, as well as limited district-level technical assistance.

As a result of insufficient technical resources, by all accounts, much of the technical assistance duties fell on the ITC because they are in the building and felt obligated to provide support when possible. One ITC described how thousands of devices were distributed without any additional school-based technical support staff and called the technical assistance needs "a huge gaping challenge." School leadership teams reported that school-based technical support staff was often shared with other schools. Two of the three schools said their technicians were part time, only spending two or three days per week at their school. While teachers rated the adequacy of technical assistance the highest of the school-based factors, the administrative teams all shared that the ITC was not able to adequately meet technical support demands. Further, trying to do so impinged on the ITCs' ability to provide instructional support and professional development to teachers, which is more so the expectation of their roles.

District leaders echoed these concerns voiced by school administrators and ITCs

and cited budget constraints as preventing additional staffing. However, they also perhaps underestimate the level of the problem. One stated, “Ideally, we want the [ITC’s] job to be 80% with teachers, students on that integration, [and] 20% tech. I would say, right now, it's probably 60%-40%. We just don't have the money to hire more technicians to alleviate that.” This district perception of the level of technical support being delivered by the ITCs illustrates a disconnect with what is occurring in the schools. The allocation of resources on devices and technological infrastructure far outpaced the allocation of staffing to mitigate technical issues that arise from the new devices. This lack of sufficient technical support has been one of the biggest roadblocks to teachers and students utilizing one-to-one devices to foster personalized learning.

Administrators and educators in the focus group described the time that they also had dedicated to helping students and educators solve technical issues. They also discussed the impact on students, who were unable to utilize the devices in the classroom while getting service when experiencing technical difficulties. This is because no loaner devices were available to students, and also because of the length of time it took to address technical issues. Administrators also shared their frustration about requesting support from the centralized district technical assistance center either by phone or by email, especially for issues that could not be resolved by the school-based technical support team. They noted that it was time-consuming and difficult to reach someone in person and hat there were delays in addressing issues, as technicians were not necessarily staffed full-time at each school. In addition, administrators at all three schools mentioned that students often demanded immediate attention for technical issues, even reaching out

directly to the principal when a problem was not getting resolved. In all three focus groups, administrators referenced the need for additional technical support at the school both to provide better service, but also to free up the ITC to provide instructional support and professional development to teachers.

Technical support is essential to supporting teachers' readiness and beliefs about technology integration, which then influence teachers' integration of technology (Inan & Lowther, 2010). When redesigning the organization to facilitate personalized learning with one-to-one devices, allocating sufficient resources for technical support to ensure the reliability of technology is a fundamental element of successful one-to-one programs (Anderson & Dexter, 2005b; Dexter et al., 2009; Leithwood, 2012a). The personalized learning path model conducted on the teacher survey data indicated substantial and statistically significant ($p<0.5$) direct and total effects of technical support on teachers' ability to personalize learning using one-to-one devices. In this model, indirect effects of technical support on personalizing learning are mediated almost entirely by teachers' beliefs about integrating technology, indicating that technical support is particularly important for teachers who are integrating technology to personalize learning for students. Even the path model for device integration identifies substantial total effects of technical support on teachers' integration of devices into instruction. The more powerful effect of technical support on personalized learning demonstrates the increased importance of efficient technical assistance when teachers are trying to go beyond just integrating technology into instruction. This finding replicates the results of Inan and Lowther (2010), but adds nuance by illuminating the enhanced importance of technical

support in influencing teacher beliefs and teachers' ability to personalize learning.

Summary. This study provides a multifaceted approach to answering the research questions posed about a current one-to-one and personalized learning initiative. The findings illustrate that school leaders lacked a clear understanding of personalized learning in a one-to-one environment, and by the time of the study had enacted minimal leadership practices to foster the integration of one-to-one devices to personalize learning. Triangulating what leaders presented as the current state of practices aimed at supporting teachers to personalize learning with teachers' perceptions of leadership for personalized learning in a one-to-one environment, allowed me to corroborate and support leaders' statements as well as identify which leadership practices have been key in supporting teachers in implementing this new initiative. Findings indicate that despite a lack of clear directions and professional development for personalized learning, organizational structures providing overall support have exerted strong effects on teachers' beliefs about the value of instructional technology and their perceptions of their ability to integrate one-to-one devices and personalize learning. Also, the lack of sufficient technical support and allocation of support resources also impacted the ability of ITCs to provide training and individualized support, a finding that is supported by leaders' statements and teacher perceptions. These conclusions indicate how district and school leaders might best enact leadership practices to facilitate the implementation of personalized learning in a one-to-one environment.

Recommendations

1) Set Directions for Personalized Learning. District leaders have taken initial

steps to begin setting directions for personalized learning in Park Gables and should follow through on building a vision and plan for personalized learning in collaboration with school leaders, district leaders, and other key stakeholders such as teacher-leaders and community members. Establishing district-wide directions for personalized learning should include constructing a widely shared vision and goals for personalized learning, building school leaders' capacity to facilitate and adapt the vision and goals to their school's context, and communicating the vision and goals widely to all stakeholders to cultivate support for personalized learning. This should all be captured in a long-term district-wide personalized learning plan.

Establish district-wide vision and goals for personalized learning. Creating a widely-shared vision for how to improve student outcomes or integrate technology influences how individuals are motivated to meet established goals, arrange activities and tools, and allocate time and resources (Dexter, 2011; Leithwood, 2012a). This study found that school leaders did not feel involved in creating a shared vision for personalized learning and that teachers did not perceive that leaders had established a vision and goals for the initiative. District leaders should continue the leadership practice of working closely with school principals and administrators as well as key stakeholders to set a clear vision for personalized learning, establish a framework personalized learning, and create short and long-term goals for personalized learning. Here, we saw that school leaders relied on district leaders to initiate the development of vision and goals for this new initiative, so it is essential that district leaders facilitate this process in collaboration with school-based teams and other key stakeholders.

This enterprise of establishing the vision and goals for personalized learning in Park Gables, while involving a wide array of stakeholders, may also require the establishment of a smaller team to create a long-term plan for the implementation of this initiative. The plan should be inclusive enough to ensure that teachers and administrators can contribute, and flexible enough to accommodate the needs and unique context of each school. The plan should include an explicit logic model that includes goals, resources needed, activities, outputs, outcomes, and a flexible timeline for implementation (Kellogg, 2004), and may also benefit from incorporating driver diagrams to identify primary and secondary drivers of desired changes (NHS Education Scotland, 2017). Developing a vision, goals, and a guiding plan for the implementation of personalized learning in the one-to-one environment is a key leadership practice that is best initiated by district leaders who have the ability to bring stakeholders together, allocate resources, and monitor the progress across the district.

Help school leaders establish shared goals based on their context. Concurrently to the process of setting directions for district-wide implementation of personalized learning, district leaders should help school leaders' develop an understanding of and the capacity to develop goals for personalized learning in their building. This study indicated that school leaders did not possess thorough knowledge of major elements of personalized learning and were just beginning to learn about what personalized learning means. Current literature on personalized learning illustrates the murky definitions of personalized learning but also reveals some commonalities within models of personalization that can help district and school leaders weigh options for

personalization. District leaders, in collaboration with school leaders and other stakeholders, should determine a model for personalization in Park Gables, and provide learning opportunities for leaders to begin determining how to adapt the model and develop shared goals for their school's context. To build the capacity of school leaders, district leaders must provide ongoing learning opportunities such as working with experts, visiting other schools implementing personalized learning, and studying models of personalization with district leaders and other school leaders to determine what will be adopted in Park Gables. School leaders are critical in supporting teachers in implementing one-to-one technology for personalizing learning (Anderson & Dexter, 2005; Shapley et al., 2010), thus they must have a deep understanding of personalized learning strategies to set effective goals for implementing those strategies.

Since schools differ in their context, it is imperative that the district plan for implementing personalized learning allows for adaptation of strategies to the particular context of each school. This may include what components to implement and in what order, by which teachers, and in what time frame. The overall goal may be to have certain personalization strategies applied in all schools in a particular amount of time, but given the differences in teachers' perceptions demonstrated in the teacher survey in this study it is important to allow school leaders and educators the ability to adapt the innovation to their context mutually. The teacher perception survey data in this study illustrates differences between schools in teachers' beliefs about device integration, and their current ability to personalize learning, indicating that school leaders should differentiate their approach depending on teachers' current level of technology integration, and

beliefs. District and school leaders must exhibit flexibility in expectations and strategies for implementing personalized learning at each school based on student needs as well as teacher capacity and beliefs. Approaches that might be appropriate for one school, faculty, or student body might not be ideal for another.

Communicate widely to educators, families, students to build support for vision and goals. Components of personalized learning often represent a significant departure from traditional instructional methods and sometimes from schools' established organizational structures. Implementing personalization strategies such as competency-based learning, personalized learning pathways, or flexible learning environments represent drastic changes to current educational paradigms. For these initiatives to be successful, district and school leaders must communicate the purpose of those changes, the vision for the initiative, how it will impact students, teachers, and families, as well as the desired outcomes of the initiative. Leaders should use a variety of formal and informal opportunities to explain the overall vision and goals and convey the reasons why and how they will adapt conventional methods to personalize learning (Leithwood, 2012a). Widely communicating the vision and goals of the initiative helps build support from a variety of stakeholders. This study, as well as prior research by Inan and Lowther (2010), illustrates that overall support for teachers is key in influencing teacher beliefs and device integration to personalize learning. Communicating the vision, goals, and details of the personalized learning initiative is essential to building overall support.

2) Build Teacher Capacity to Implement Personalized Learning. Teachers will ultimately be responsible for implementing personalized learning strategies using

one-to-one devices with their students, and thus it is paramount that district and school leaders provide teachers with ongoing, high-quality learning opportunities tailored to teachers' subject matter, beliefs about technology, and knowledge about technology and personalization. Developing people involves providing support and individual consideration as well as stimulating growth in professional capacities of the staff (Leithwood, 2012a). This study and existing literature illustrate the importance of individualized support and professional development in influencing teachers beliefs and abilities to integrate one-to-one devices into instruction and personalize learning (Dexter et al., 2009; Inan & Lowther, 2010; Leithwood, 2012a).

Provide individual support and consideration. Individualizing support means to take into account teachers' unique needs and expertise (Leithwood 2012a) as well as where they fall on the continuum of implementing an innovation (Rogers, 1995) and their concerns regarding the adoption of the new practices asked of them (Fuller, 1969; Hall, 1974). Leaders in this study acknowledged this need to differentiate approaches to professional learning and provide individualized support to educators, but felt that the ITCs were too bogged down with technical responsibilities to do so. School and district leaders must ensure that they provide teachers adequate individualized support for personalization strategies that go beyond simply using basic tools and integrating one-to-one devices into the classroom. This will likely require increasing the technical assistance provided by others to ensure instructional personnel can stay focused on the type of help they are uniquely suited to provide.

Establish high-quality professional growth opportunities. To begin

personalizing learning, teachers will need to learn how to implement strategies such as competency-based learning or personalized learning pathways (Pane et al., 2015). Thus district and school leaders must develop a comprehensive professional development plan that features elements of effective formal professional development (Garet et al., 2001), but also fosters informal and independent learning through collaboration and time for independent experimentation and application of strategies to teachers' context (Jones & Dexter, 2014). District-leaders described a possible pilot program, which would allow early-adopters to come together in a community of practice to implement personalized learning strategies and share those strategies with others. Such a program is an example of an ongoing, collaborative, targeted, and coherent (Garet et al., 2001) growth opportunity that is differentiated for early-adopters to provide mastery experiences to this group, while sharing those experiences with others (Bandura, 1997; Rogers, 1995).

This study found that many professional development opportunities were optional and focused on tools like the new devices or the new LMS. While this type of training may be necessary, it is essential that all teachers experience growth opportunities and individualized support to implement elements of personalized learning. These opportunities should address teachers' needs and context, and address specific personalized learning strategies and desired student outcomes. District and school leaders beyond the ITC should develop a multi-year professional learning plan grounded in improvement science tools such as a driver diagram or a logic model that identifies the relationships between student learning objectives and results, and the means to achieve them (i.e. teacher outcomes, other outputs, inputs, resources, and activities), all of which

should be monitored for continuous improvement (Kellogg, 2004; NHS Education Scotland, 2017). It is imperative for school and district leaders to build teachers' capacity to learn how to personalize learning for their students using one-to-one devices.

3) Redesign the organization to foster overall support for teachers. This study and extant literature on school improvement and leadership for technology points to the importance of cultivating collaborative cultures, allocating sufficient resources to support school and district goals, and redesigning the organization to build the conditions necessary for teachers to implement new instructional models (Anderson & Dexter, 2005b; Garet et al., 2001; Inan & Lowther, 2010; Jones & Dexter, 2014; Leithwood, 2012a). Findings from this study suggest that collaborative cultures are essential to the construct of overall support, which was shown to exert strong impacts on teacher beliefs about technology integration, which then affects teachers' perceptions about their ability to implement personalized learning and integrate one-to-one devices into instruction. Existing professional learning communities in all three schools have produced cooperative arrangements of teaming and distributed leadership. However, school leaders acknowledged that these collaborative structures have yet to be exploited to foster personalized learning using one-to-one devices.

Harness teacher collaboration for personalized learning. This recommendation is to explicitly include personalizing learning as part of the goals and routines of collaborative structures within schools' PLCs. For example, district or school leaders could provide team leaders or a member of each team training to exert leadership towards implementing components of personalized learning. Also, this may also enable district

leaders such as the director and specialists for personalized learning and school leaders such as ITCs or other personalized learning leaders in the building to participate in collaborative team meetings and provide job-embedded professional development and guidance for how to personalize learning. District and school leaders should enact leadership practices such as establishing meeting time and structures and distributing leadership to facilitate collaborative work around personalizing learning. Teachers must have dedicated time during their school day to collaborate, as well as guidance and support for the desired components of personalized learning. School leaders in this study noted that district leaders must make personalized learning a priority. Together they should provide teachers adequate time for collaboration, sufficient instructional support, and adequate resources to implement key personalization strategies.

Allocate sufficient technical and instructional support. This recommendation relates to this study's finding that district and school leaders allocated insufficient resources to meet technical assistance needs and instructional support needs. It is important that sufficient staffing resources be allocated to address technical and instructional needs for the one-to-one and personalized learning initiatives at each school. School leaders shared that while ITCs are supposed to be addressing individual teachers' instructional technology needs and providing professional learning opportunities, the sheer quantity of technical assistance requirements of students and teachers severely limited this role. The quality and amount of technical assistance varied by school, and survey data reflected that teachers in schools where administrative teams described better ITC and technician assistance rated technical support higher than in schools where

leaders described fewer staffing resources. The path analyses also indicated that supporting personalized learning and to a lesser degree integrating one-to-one devices, technical support exerted strong effects on teacher readiness and beliefs, which then influenced teachers' perceptions of their ability to personalize learning in the one-to-one environment.

The district needs to allocate sufficient staffing to provide technical support to students and teachers, while freeing up the ITC or allocating new personalized learning support positions to provide adequate instructional assistance to teachers. In some cases, ITCs may not be knowledgeable enough to provide support and professional development for personalized learning. In such cases it may behoove district and school leaders to consider staffing a personalized learning coach to meet teachers' instructional needs for personalizing learning while maintaining or expanding the technical support role of the ITC. District leaders must analyze current staffing allocation and determine whether the current staffing structures of ITCs and shared technical support staff can go beyond providing technical assistance for one-to-one devices and adequately deliver support for personalized learning.

Allow for evolving organizational context necessary for personalization. Leaders at several school sites as well as at the district level commented that the current educational context and organization of high schools present challenges to implementing personalized learning strategies. Hyslop and Mead (2015) describe how fixed learning standards, standardized tests, and rigid school calendars conflict with personalized learning strategies such as competency-based progression, where students may differ in

how long it takes to demonstrate mastery. One example district leaders shared is that implementing standards-based grading and mastery learning would require flexibility with the timing of learning, saying, "If it took one person three weeks and another person six weeks it's okay because it's about the standard. Someone should not be penalized because it took them longer to learn content than another student." Implementing these kinds of personalized learning strategies where students exert control over their learning, co-construct their learning path with a teacher, progress through content at their pace (Jenkins & Keefe, 2007), may require an alternative to traditional scheduling and school calendars. The district leadership, in coordination with school leaders, will need to address the incongruities between elements of personalization and current educational realities.

Supporters of personalized learning suggest creating flexibility for the timing of state assessments, seat-time requirements, and ways in which students can show mastery (Hyslop & Mead, 2015; Patrick et al., 2016). This may require staggering standardized testing schedules, adjusting school calendars and schedules, as well as what standards teachers have an obligation to teach. District leaders touched on some of these possible changes, but many are beyond the scope of influence of district and school leaders. When possible, leaders should advocate for such flexibility with state policy makers. However, in the state where the study took place, schools do have the flexibility to establish school calendars, testing schedules, and how and when to cover state standards. Thus district and school leaders should consider what organizational changes would enable the implementation of components of personalized learning in their schools within currently

imposed state and federal requirements. Such changes may be daunting, and could differ between schools, but rely heavily on district leaders to enable and facilitate some of these changes.

Impediments to implementing the recommendations. Personalized learning represents a significant departure from traditional school organization and instructional methods, which suggests that leaders may face substantial pushback from teachers, students, and families. Any change that stakeholders perceive may negatively impact student learning or students' competitiveness with the college admission process might face fierce resistance from parents and students. For example, students and families, worried about students' competitiveness for acceptance to post-secondary institutions, may challenge any innovations that shift away from traditional instructional and grading methods. Many teachers may push back against these instructional strategies because they perceive them to require more work or because they would rather maintain traditional instructional strategies as several studies have shown (Lowther et al., 2012; Shapley et al., 2010). Furthermore, changes that require teachers to deviate significantly from traditional practices also may face resistance from laggards, the teachers who dig in their heels and avoid implementing the desired innovation at all (McLaughlin, 1976; Rodgers, 1995). Teachers may also avoid implementing personalized learning due to assumptions that it is just another fad that will fade away to make room for another reform effort.

State standards and standardized assessments, as well as school calendars and seat-time requirements also present impediments to implementing personalized learning.

States have started to implement policies to enable components of personalized learning (Patrick et al., 2016), but additional concessions to state policies may be necessary to facilitate strategies such as customized learning plans based on student needs and interests, which might differ from state standards, often rigid lists of facts and skills. District and school leaders may need to advocate for changes or flexibility within state and federal accountability policies to implement personalized learning strategies in ways that don't cause schools to be at odds with state and federal accountability measures (Hyslop & Mead, 2015).

Implications

Implications for practice. New initiatives such as one-to-one programs incur significant budgetary costs, not just to purchase new equipment, but also to build the technical infrastructure and adequate staffing to support the new equipment. Significant investments in devices without appropriate technical assistance staff can quickly overwhelm technical support staff and lead to failed one-to-one initiatives (Barshay, 2014; Dexter & Anderson, 2005b; Dexter, 2011; Penuel, 2006). This study illustrated how the lack of technical support staff for the addition of thousands of new devices impacted the ability of ITCs to provide teachers individualized support and professional development, and also usurped students', teachers', and administrators' time. District leaders must consider ways to reorganize existing staffing and bolster technical staffing, while carefully considering the instructional needs of teachers learning to personalize learning with one-to-one devices and how to best meet those instructional needs. Addressing this staffing issue may require hiring new technical support staff, adjusting

the role of ITC, or creating new positions focused on personalized learning. Regardless of how the district decides to address this recommendation, the implication on the budget extends beyond purchasing devices and requires the funding of additional staffing to support personalized learning at the school level.

School leaders in Park Gables Public Schools have been focused simultaneously on several initiatives including one-to-one integration, but have not yet begun dedicating time and resources to helping teachers personalize learning. School leaders must first develop an understanding of personalized learning and how they would like to implement personalized learning in their school building. Additionally, district leaders should help school leaders see how personalized learning strategies may supplant or supplement existing improvement efforts, or work in synergy with current initiatives. For example, district staff noted how personalization might eliminate the need for tiered systems of supports, because teachers could tailor learning based on each student's needs. School leaders also will need to collaborate with district leaders to build teachers' capacity to implement personalized learning with one-to-one devices. This will likely require significant time investment both for professional development that is differentiated based on teacher needs and context and ongoing to provide sufficient training for how to implement personalized learning strategies. As leaders noted, they need to know that this is a priority and begin the work of operationalizing personalization in their school contexts. School leaders must take responsibility for adapting district plans for their school setting, providing adequate professional development and support and holding teachers accountable for implementing personalized learning.

Implications for further research. This study exposes the need for further research on leadership practices to implement personalized learning, different components of personalized learning, and the corresponding outcomes of components of personalized learning initiatives. For example, because the schools in this study have not yet begun implementing personalized learning other than providing students with personalized learning devices, we have mostly learned about the challenge to starting personalization initiatives. Even in schools that report implementing personalized learning, the research indicates that implementation varies and often does not include the implementation of more challenging forms of personalization (Pane et al., 2015). Thus additional research in sites with success stories is needed to learn about the details of what components of personalized learning teachers can implement, and how leadership practices can help foster elements of personalization. In such sites, researchers should investigate what components schools implement, and to what degree schools implement elements of personalization with fidelity, as well as key student outcomes associated with specific personalization strategies.

While this study and previous research highlight leadership practices that are essential in creating the conditions for teachers to improve student learning or integrate technology into instruction, there is a need for rigorous research that goes beyond self-reported measures about the influence of leadership practices on teachers' implementation of technology-supported personalized learning strategies. Such investigation may require classroom and student observations within an ongoing personalized learning initiative to see whether personalization is occurring. In addition,

research is needed to identify how leadership practices have supported teachers in personalizing learning, and to what extent students are experiencing learning that is personalized based upon distinct modes of personalization.

Finally, the ultimate need for further research is for the rigorous empirical study of whether these personalization strategies lead to improved educational outcomes for students. The purpose of personalized learning includes increasing student achievement, fostering student intrinsic motivation, and providing students with educational experiences based on their specific needs (Patrick et al., 2013). There is limited evidence that personalized learning strategies produce positive student outcomes and minimal research on personalized learning strategies implemented in public high schools (Pane et al., 2015; Penuel, 2016). More research is needed to determine whether the implementation of personalized learning in one-to-one computing environments within public high schools is yielding the desired effects on student achievement, student engagement, and students' college and career readiness. Personalized learning is a widely proclaimed strategy (Horn, 2016) with slim empirical evidence supporting its effectiveness (Pane et al., 2015; Penuel & Johnson, 2016). While studies have documented positive student outcomes in one-to-one environments (Bebell & Kay, 2010; Fleischer, 2012; Lei & Zhao, 2008; Shapley et al. 2011; Silvernail & Gritter, 2007), it is unclear whether additional benefits stem from using one-to-one devices within personalized learning environments, and whether the benefits of integrating technology into traditional environments extend to personalized environments. Due to the complex and murky definitions of personalized learning, future research should carefully

categorize the types of personalized learning strategies that are being investigated, and note the impacts of those approaches on student outcomes.

Action Communication Products

This section will present the action communication products that address the recommendations presented in this study. The action communication products include:

1) District & school leader transmittal letter/email
2) Recommendation report
3) Personalized learning planning guide

Action Communication Product 1: Transmittal letter and email to district and school leaders

Intended audience. This letter and email will accompany the recommendation report and personalized learning planning guide that I will send to district leaders, including the Director of Personalized Learning, the Assistant Superintendent of Instruction, and the Director of Secondary Education, as well as the school principals who participated in this study.

Purpose. The transmittal letter thanks district or school leaders for their participation, describes the study, summarizes the findings and recommendations, and describes the attached recommendation report and personalized learning planning guide.

Format. The transmittal letter will be sent both in paper form and via email, with two attachments, the recommendation report and the personalized learning planning guide.

Kevin Spencer Clark, Ed. D.
Department of Administration and Supervision
Curry School of Education, University of Virginia

[District address or school address]

Dear [district leader or school principal]

I recently completed a study of leadership practices supporting teachers in integrating one-to-one devices to personalize learning for students. The study, conducted for my dissertation research through the University of Virginia, consisted of a mixed-methods multi-case study approach in three high schools in your district.

To complete the study, I conducted focus groups with each of the high school leadership teams, and a focus group with district leaders responsible for the Personalized Learning Initiative. I delivered an online survey to teachers to gauge their perceptions of leadership practices in support of the one-to-one and personalized learning initiatives.

The analysis of these quantitative and qualitative data enabled findings based on leaders' and teachers' perceptions about leadership practices at the district and school levels. From these conclusions, I generated recommendations and implications of those recommendations for practitioners seeking to implement personalized learning in one-to-one computing environments.

These recommendations informed the items attached to this letter. In the first attachment, I provide a recommendation report, which includes summaries of the findings, data, and recommendations of this study. The second attachment is a planning guide for district and school leaders in collaboration with the principal stakeholders working in teams to determine leadership practices and action steps in implementing personalized learning. It is not a prescription of what to do or how to do it but is simply a planning resource organized around the literature, findings, and recommendations presented in this study.

If you have any questions about this recommendation report and personalized learning planning guide or would like to discuss anything further, please don't hesitate to contact me.

Sincerely,

Kevin Clark

Attachments (2)
cc: [Director of Personalized learning & Director of Secondary Education]

Action Communication Products 2 and 3: Recommendation Report and Personalized Learning Planning Guide

Intended audience. The first intended audience for the recommendation report and personalized learning planning guide are the district leaders responsible for implementing the personalized learning initiative. This includes the Director of Personalized Learning, the Assistant Superintendent of Instruction, and the Director of Secondary Education.

Next, the recommendation report and planning guide are intended for principals and administrative teams at each school. These teams include school administrators, ITCs, teacher-leaders, and other school-based leaders who are responsible for implementing personalized learning at the school level. I will provide these action communication products to the school principals who can then share them with their teams.

Purpose of the recommendation report. The purpose of this action communication product is to provide district and school leaders a summary of the findings in a clear and consumable format. The summarized results and data analysis provide district leaders baseline data a time when they are just starting the process of implementing personalized learning beyond just deploying devices. This may inform district leadership practices targeted to the whole district, or differentiated strategies for particular schools, leaders, or groups of teachers. The recommendation report will help inform and guide continued efforts to implement personalized learning in the district's high schools.

School leaders indicated that personalized learning beyond deploying one-to-one devices was a new initiative that district leaders had recently introduced. Principals and administrative teams determine many of the school-level leadership practices that facilitate or impede the implementation of new initiatives. To make informed decisions on how to focus leadership practices, allocate resources, and build capacity for personalized learning, it will be helpful for them to understand existing leadership practices, teachers' current perceptions, as well as recommendations to guide the implementation of personalized learning at the school level. The school-level reports will contain their schools' teacher perception data for each scale compared to district averages (Appendices A, B, & C of recommendation report) so that they can better target leadership practices, resources, and support.

Purpose of the personalized learning planning guide. The personalized learning planning guide provides guidance based on the literature, the findings, and the recommendations presented in this study. The guide leads users through a series of questions, as well as the development of a logic model and a driver diagram that can then inform action planning for continued implementation of personalized learning in the district and at each high school. A logic model is a systematic and visual way to organize and visualize relationships among the resources needed to implement a program, the activities involved, and the desired changes or results of the program (Kellogg, 2004). A driver diagram is another visualization tool that can be used to plan improvement activities and organize information on proposed activities aimed at a certain outcome (NHS Scotland, 2017). This tool provides school and district leaders a way to determine

key outcomes of personalization with one-to-one devices and identify primary drivers, or set of factors or improvement areas that must be addressed to achieve the desired results and secondary drivers, specific areas to plan changes or interventions that contribute to at least one primary driver (NHS Scotland, 2017). The personalized learning planning guide, as well as the tools such as the logic model and driver diagram may be modified and adapted to existing frameworks, or not used at all if teams do not find them useful. Additionally, users may choose not to answer any questions that they have already answered or that they feel doesn't pertain to their particular context. The personalized learning guide serves merely to as a planning tool for school and district stakeholder teams who are leading the personalized learning initiative.

Format. I will provide the recommendation report and personalized learning guide as a paper document as well as a digital format, along with a transmittal letter and email that explain the nature and purpose of the recommendation report and personalized learning planning guide.

Recommendation Report

Leadership for Personalized Learning in a One-to-One Computing Environment

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Kevin Clark, Ed. D.

Executive Summary

In this study, school and district leaders described their understanding of personalized learning and explained what leadership practices they had enacted to support the one-to-one initiative and personalized learning, while teachers participated in a perception survey about those same leadership practices. The teacher perception data enabled a comparison of teacher perceptions and what leaders described. Using the survey data, I replicated and built upon the path analysis conducted by Inan and Lowther (2010). Using a mixed-methods multi-case study approach, I triangulated district and school leaders' qualitative focus group data with the analysis of the teacher perception survey data to illustrate findings about leadership practices that support teachers in integrating one-to-one devices to personalize learning for students.

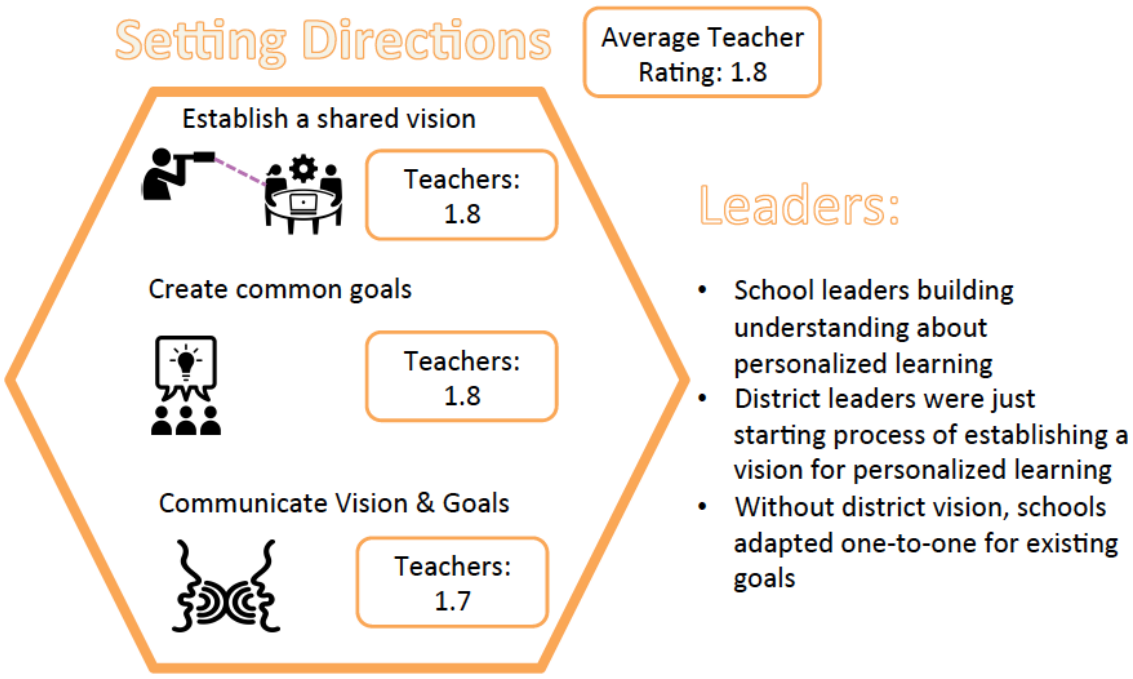
The findings indicate that at the time of the study, leaders had enacted limited leadership practices to implement personalized learning. District leaders had just initiated collaborative efforts to determine the vision of personalized learning, but school leaders had not yet introduced such practices at the school level. Teacher professional development for personalized learning focused primarily on technological tools such as the new devices, and there were insufficient resources available for technical and

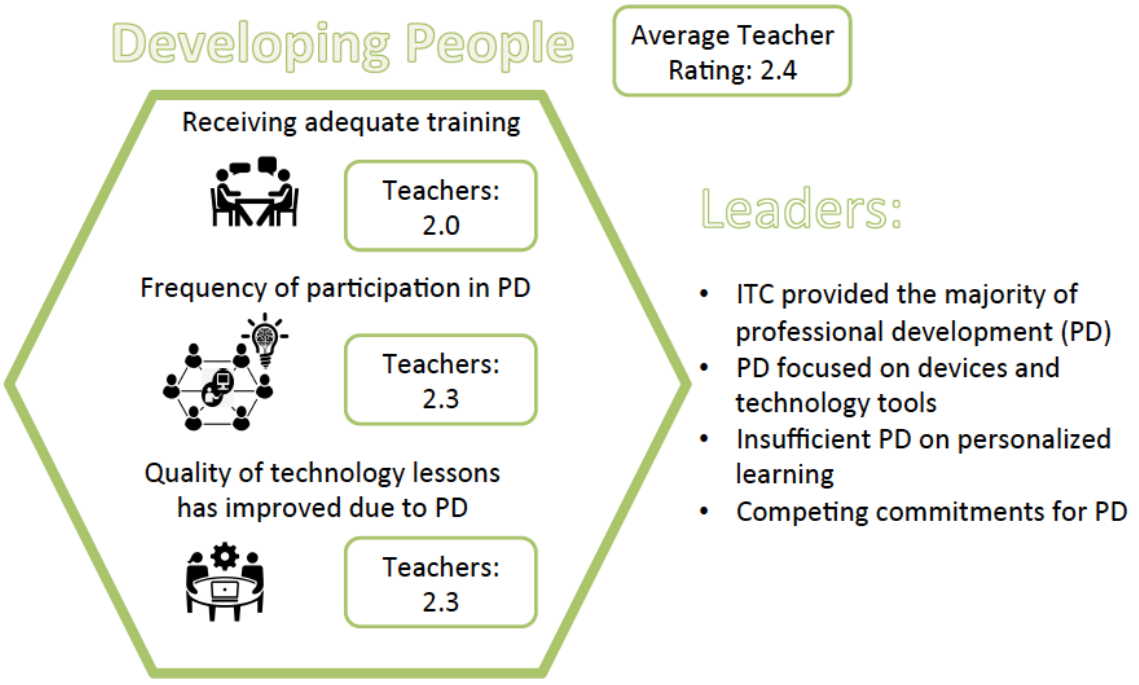
instructional support for teachers integrating one-to-one devices for personalized learning. This study confirmed the importance of teacher beliefs about technology integration as well as the overall support for teachers implementing personalized learning with one-to-one devices.

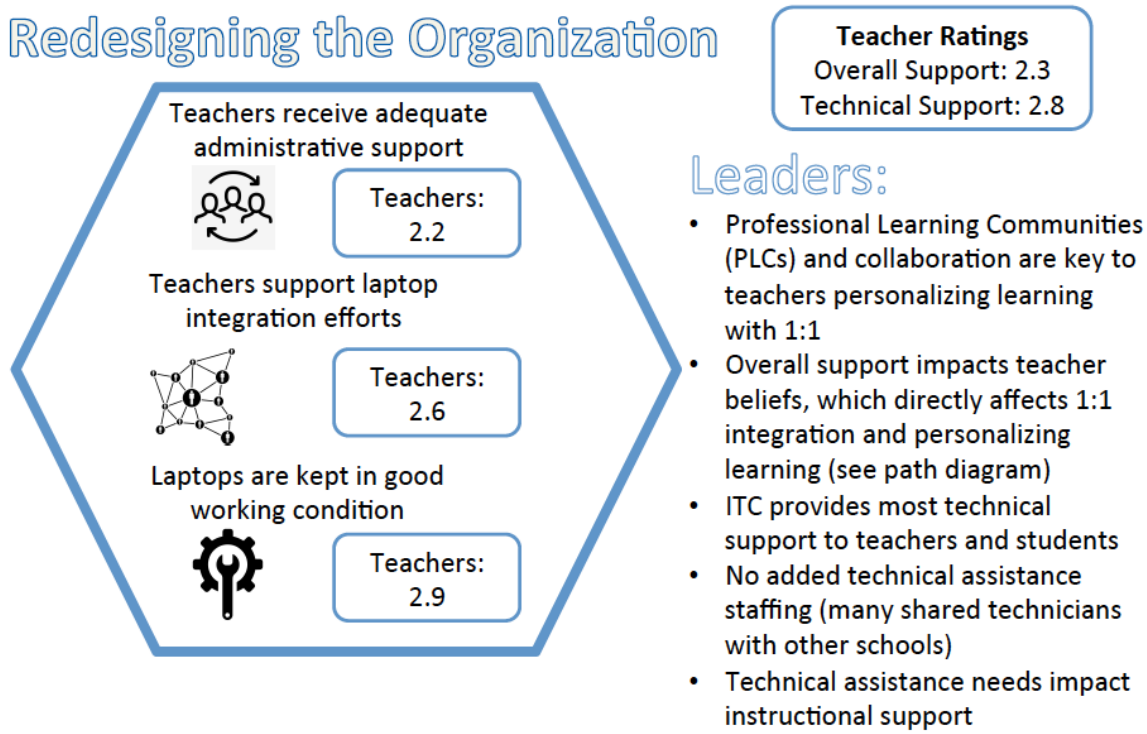
Based on these findings, I recommend creating district-wide vision and goals for personalized learning, developing school leaders' and teachers' capacity to implement personalized learning, and allocating sufficient resources to technical and instructional staffing needs to adequately support the personalized learning and one-to-one initiatives. Implications of these recommendations include budgetary implications, possible community reaction, as well as the need for further research on personalized learning and leadership for technology-based school improvement efforts.

Summary of Findings

The following three infographics organize the findings from the study into the three categories of leadership practices, and show teacher perception survey data as well as leader focus group findings. The teacher ratings reflect average responses to Likert-type questions making up that scale or variable with ratings as follows, 0=Strongly disagree, 1=Disagree, 2=Neither agree nor disagree, 3=Agree, 4=Strongly agree.




Developing People
Average Teacher Rating: 2.4
Receiving adequate training
Teachers: 2.0
Frequency of participation in PD
Teachers: 2.3
Quality of technology lessons has improved due to PD
Teachers: 2.3
Leaders:
• ITC provided the majority of professional development (PD)
• PD focused on devices and technology tools
• Insufficient PD on personalized learning
• Competing commitments for PD


Redesigning the Organization
Teacher Ratings
Overall Support: 2.3
Technical Support: 2.8
Teachers receive adequate administrative support
Teachers: 2.2
Teachers support laptop integration efforts
Teachers: 2.6
Laptops are kept in good working condition
Teachers: 2.9
Leaders:
• Professional Learning Communities (PLCs) and collaboration are key to teachers personalizing learning with 1:1
• Overall support impacts teacher beliefs, which directly affects 1:1 integration and personalizing learning (see path diagram)
• ITC provides most technical support to teachers and students
• No added technical assistance staffing (many shared technicians with other schools)
• Technical assistance needs impact instructional support

Path Analysis of Teacher Perception Survey Data

The path diagram (Figure 1) shows the leadership factors (far left column) and how they influence teacher readiness and teacher beliefs (middle column), which in turn influence teachers' ability to personalize learning with one-to-one devices (outcome variable to the right). The numbers on the paths represent the standardized regression coefficients, which illustrate the magnitude of the effect along any given path. The most important feature to note is the size of the effect teacher beliefs has on personalizing learning, and the impact of overall support on teacher beliefs. This indicates the importance of building in strong collaborative structures, administrative support and community support for teachers implementing personalized learning in a one-to-one computing environment. The path model also shows the less strong, yet statistically significant effects of technical support and professional development on teacher readiness and teacher beliefs, and thus on personalized learning.

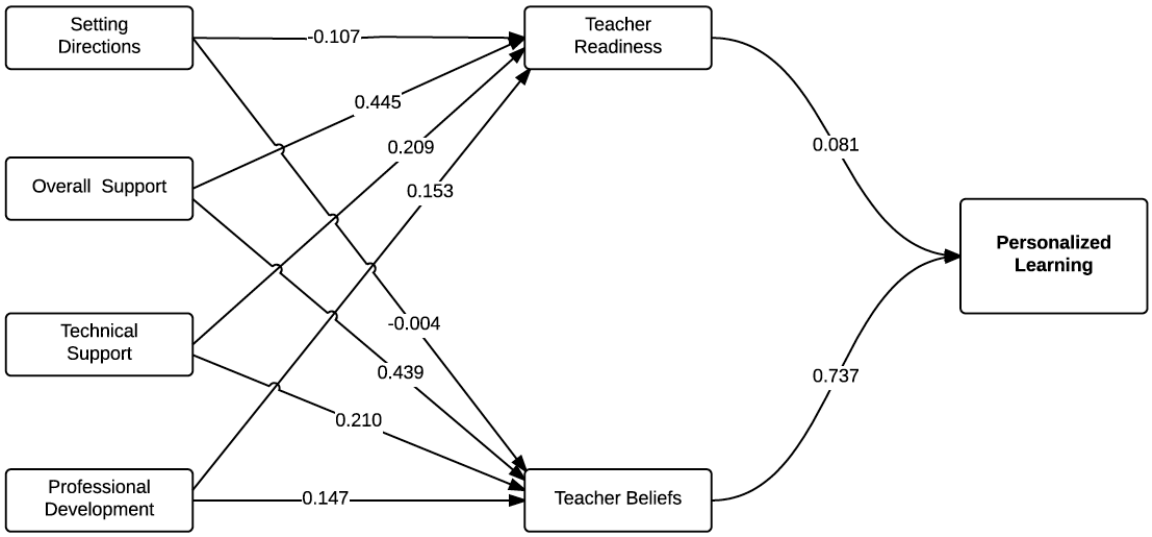
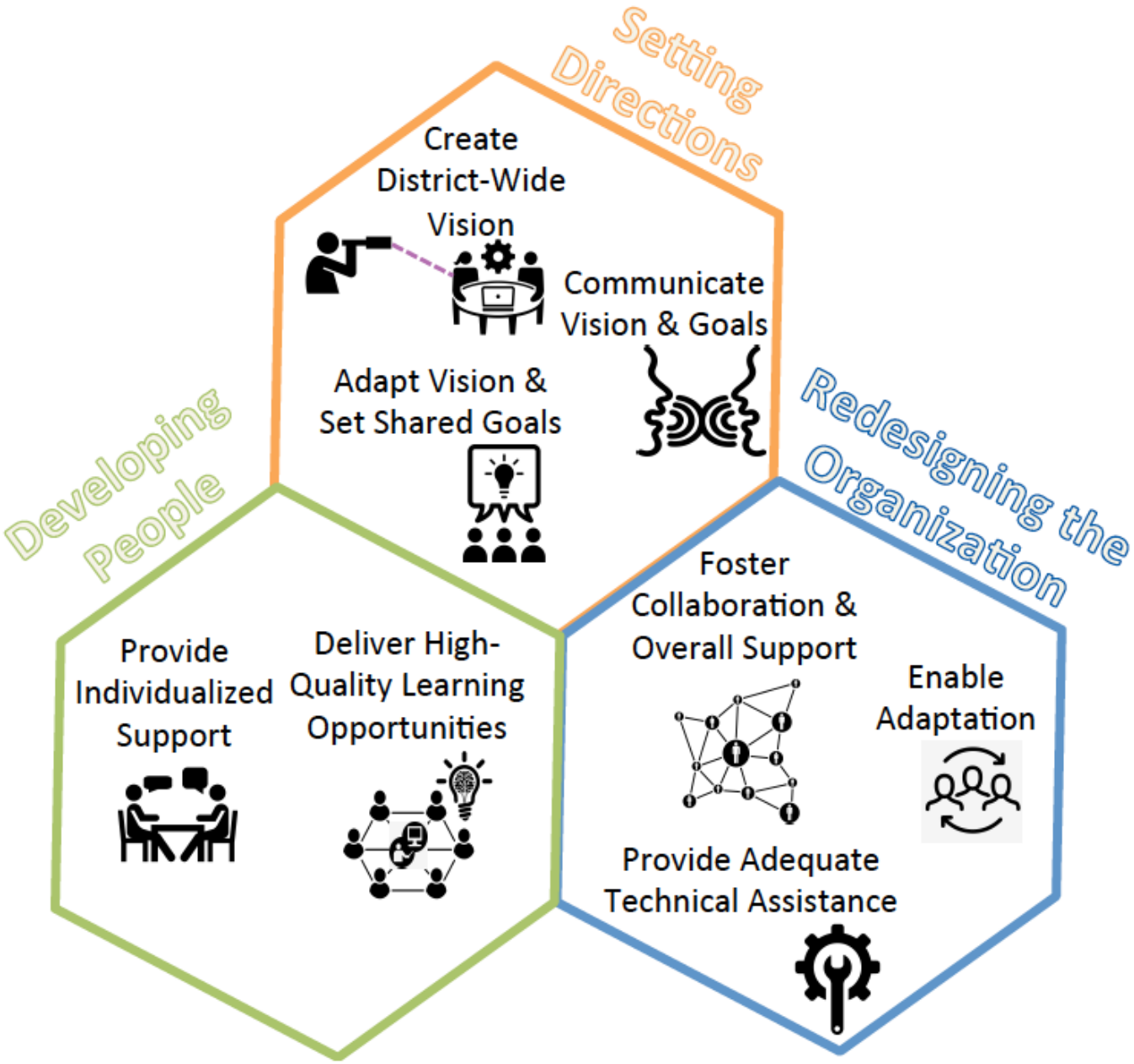


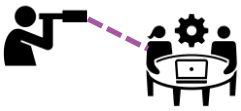
Figure 6. Leadership path model with personalized learning outcome.

Visualizing the Recommendations



Recommendations

1) Establish personalized learning vision and goals.



a. *Create a district-wide vision for personalized learning*. Establish clear district vision and goals for the personalized learning initiative, and delineate the flexibility schools have for further shaping this for their school-context.

b. *Help school leaders establish shared goals based on their context.* School leaders need a clear understanding of personalized learning, as well as how to implement personalization with one-to-one devices.

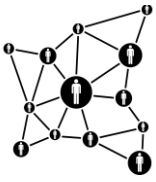
c. *Communicate the vision and goals widely to stakeholders.* Generate widespread stakeholder support for personalization to foster shared vision and goals.

2) Build Teachers' Capacity to Implement Personalized Learning.

a. *Provide individualized support to teachers.* ITCs and/or other school staff work with individual teachers and teacher teams to provide instructional support on how to personalize learning.

b. *Deliver high-quality professional growth opportunities.* District and school leaders should provide training and professional growth opportunities on personalized learning strategies.

3) Redesign the organization to foster overall support for teachers



a. *Foster collaboration and overall support.* Teachers perceived overall support as key to implementing one-to-one devices to personalize learning. Continue to foster professional learning communities (PLCs) and teaming structures and ensure teams focus efforts on personalized learning.

b. *Provide adequate technical support*. This requires additional staffing to address technical and instructional support needs.

c. *Allow for evolving organizational context necessary for personalization.* Adapt district plans to school context, and establish a path for long-term evolution of school organizational structures (i.e. calendars, scheduling, facilities, testing, and accountability procedures) to enable personalization.

Summary

This study considered how leadership practices influenced teachers' beliefs and readiness to integrate one-to-one devices and implement personalized learning. The findings summarized above indicate the importance of a shared vision, district guidance to school leaders, effective professional development, adequate technical and instructional support, and collaborative structures to help foster support and learning for personalized learning with one-to-one devices.

Recommendation Report Appendix A

Mayorsville High School Data Sheet

Table 1
Teachers' perceptions of leadership practices at Mayorsville and district averages

Scales	Mayorsville	District Average
Average of Set Direction Scale	1.6	1.8
Average of Overall Support Scale	2.4	2.3
Average of Technical Support Scale	3.0	2.8
Average of Professional Development Scale	2.3	2.4
Average of Teacher Readiness Scale	3.1	2.9
Average of Teacher Beliefs Scale	2.6	2.3
Device Integration	2.9	2.7
Personalized Learning	2.7	2.3
n	39	168

Note. The LTTQ-PL includes Likert-type items from the entire FTL-TTQ (Lowther, et al., 2007), as well as additional leadership items (1-4) and one additional personalized learning item.

Recommendation Report Appendix B

Coral High School Data Sheet

Table 1
Teachers' perceptions of leadership practices at each school site, and overall

Scales	Coral	District Average
Average of Set Direction Scale	1.9	1.8
Average of Overall Support Scale	2.4	2.3
Average of Technical Support Scale	2.8	2.8
Average of Professional Development Scale	2.6	2.4
Average of Teacher Readiness Scale	2.9	2.9
Average of Teacher Beliefs Scale	2.4	2.3
Device Integration	2.6	2.7
Personalized Learning	2.4	2.3
n	81	168

Note. The LTTQ-PL includes Likert-type items from the entire FTL-TTQ (Lowther, et al., 2007), as well as additional leadership items (1-4) and one additional personalized learning item.

Recommendation Report Appendix C

Rocky Heights High School Data Sheet

Table 1
Teachers' perceptions of leadership practices at each school site, and overall

Scales	Rocky Heights	District Average
Average of Set Direction Scale	1.6	1.8
Average of Overall Support Scale	2.1	2.3
Average of Technical Support Scale	2.5	2.8
Average of Professional Development Scale	1.9	2.4
Average of Teacher Readiness Scale	2.8	2.9
Average of Teacher Beliefs Scale	1.9	2.3
Device Integration	2.7	2.7
Personalized Learning	2.0	2.3
n	48	168

Note. The LTTQ-PL includes Likert-type items from the entire FTL-TTQ (Lowther, et al., 2007), as well as additional leadership items (1-4) and one additional personalized learning item.

Personalized Learning Planning Guide

Table of Contents

Personalized Learning Planning Guide

This personalized learning planning guide features questions related to key leadership practices for implementing personalized learning. Questions are organized by research-based leadership practices (Leithwood 2012a), and lead users to the creation of a logic model and driver diagram that provide the basis for action planning at the district and school levels. Leaders may adapt or adjust this guide based on district practices, documents, or existing plans. This guide also acknowledges that leaders may have already answered some of these questions, or that they may be just beginning to implement personalized learning in a one-to-one environment. The questions do not have to be answered in order, nor must users answer each question. Teams should use this guide in their particular context to advance their implementation of personalized learning.

1) Why personalize learning?

This section will help teams identify the underlying purpose and directions for personalized learning.

- Why is it important that schools and teachers personalize learning?
- What evidence in the research literature supports this decision?
- How will personalized learning solve problems facing schools?
- What local data, evidence, or tools would help determine this vision and goals? e.g.:
    - Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis
    - Root-cause analysis

2) Who is on the team?

Research illustrates the importance of widely distributed leadership to support high performing schools that impact student outcomes (Harris, 2008; Leithwood et al., 2004; Leithwood, 2012a; Spillane, 2006). Involving district, school leaders, and other stakeholders in implementing personalized learning is essential to creating a widely established and supported vision and goals for the initiative, as well as to foster distributed leadership.

- Who will establish the vision for personalized learning district-wide and at each school?
- What will be the role of the district-wide team and the role of the school-level teams?
- Who will be responsible for establishing goals, outcomes, and performance expectations?

3) Setting directions for the personalized learning

This section will help you determine the vision and goals for personalization, as well as a key data and metrics that will help evaluate the goals.

- What is the vision for personalized learning?
- What are the goals of personalized learning?
- How will school leaders be able to adapt district-level vision and goals to their current school context?
- What data (qualitative and quantitative) will help determine whether those goals are being met? In what time frame? (**short- and long-term outcomes**)
- How will the vision and goals be communicated to stakeholders (students, teachers, parents, community members, school-leaders)?

4) Building the capacity to lead

School-leaders including the principal, administrators, ITCs, teacher leaders, and other

school leaders enact key leadership practices to implement personalized learning. This section guides teams to build school-leader capacity. This starts with identifying key elements of personalization, necessary resources, and practices that will facilitate the implementation of personalized learning.

- How will school and district leaders identify essential elements of personalization? See existing models:
  - LEAP
  - Bill & Melinda Gates Foundation
  - Marzano Research Competency-Based Personalized Education
- What learning opportunities do school leaders need to determine what personalized learning strategies they will implement in their schools?
- How can school leaders adapt the district goals and timeline to school sites, teachers' current levels of technology proficiency, and schools' existing goals?

5) Building teachers' capacity to personalize learning

Teachers ultimately will be implementing strategies to personalize learning for their students, and will need significant learning to understand how and develop the necessary skills to do so. School-leaders provide time and resources for school-level learning opportunities for teachers, but also rely on district leaders to providing learning opportunities as well.

- What are ways that district leaders can provide high-quality professional development on personalized learning? (**activities**, **routines, and practices**)
- What school and district resources will be needed to provide professional learning opportunities? (Consider staff, time, resources, external and internal) (**inputs**)

- How can the district support schools in providing individualized support to teachers both for technical issues as well as instructional concerns related to personalized learning?
- How will district leaders partner with school-leaders to monitor whether teachers are implementing personalization strategies effectively? What data will be needed? (**outputs**)

6) Redesigning the organization to enable personalization

Teachers learn to implement technology and new instructional strategies in collaborative teams, as well as independently by applying strategies they have learned in formal learning opportunities (Jones & Dexter, 2014). Furthermore, personalization may represent departures from traditional modes of instruction and schooling (Patrick et al., 2016a). This study reaffirmed the need for widespread support from students, teachers, administrators, parents, and the community to foster personalized learning and one-to-one device integration.

- What collaborative structures exist in schools, and how are they currently being harnessed (or not being harnessed) to support teachers' implementation of personalized learning? Which are most effective?
- What tools, routines, or resources are needed to facilitate teacher collaboration to personalize learning? (**inputs**)
- How will personalized learning supplement, complement, or replace other district or school initiatives?
- What role will one-to-one devices and other digital tools play in personalizing learning? (**inputs**)
- How can the community provide resources, support, partnerships and input in building the infrastructure for personalization? (**inputs**)

Assembling the Personalized Learning Logic Model & Driver Diagram

Logic Model

Use your answers to the questions above to assemble a logic model (Appendix A) and/or a driver diagram (Appendix B). These tools can serve as the basis for district and school action plans for personalized learning.

- How will you share this plan to stakeholders, school-leaders, and teachers?
- How will school-level leaders and teams adapt and interpret this logic model for the contexts of the school site?
- What are the budgetary implications of this logic model?
- How will district leaders evaluate the personalized learning initiative? What data will be necessary?

Driver Diagram

Use your answers to the questions above and guiding questions below to complete the driver diagram found in Appendix B. A driver diagram can be used to plan improvement activities to organize information on proposed activities aimed at a certain outcome (NHS Scotland, 2017). It is included in this planning guide as a way for leaders to determine key outcomes of personalization with one-to-one devices and identify **primary drivers**, or set of factors or improvement areas that must be addressed to achieve the desired outcome. Next, **secondary drivers** are specific areas to plan changes or interventions that contribute to at least one primary driver (NHS Scotland, 2017).

- What outcome or goal does the team seek? Consider setting a SMART goal (Specific, Measurable, Attainable, Relevant, Time-bound).
- What are primary drivers to meeting the outcomes?

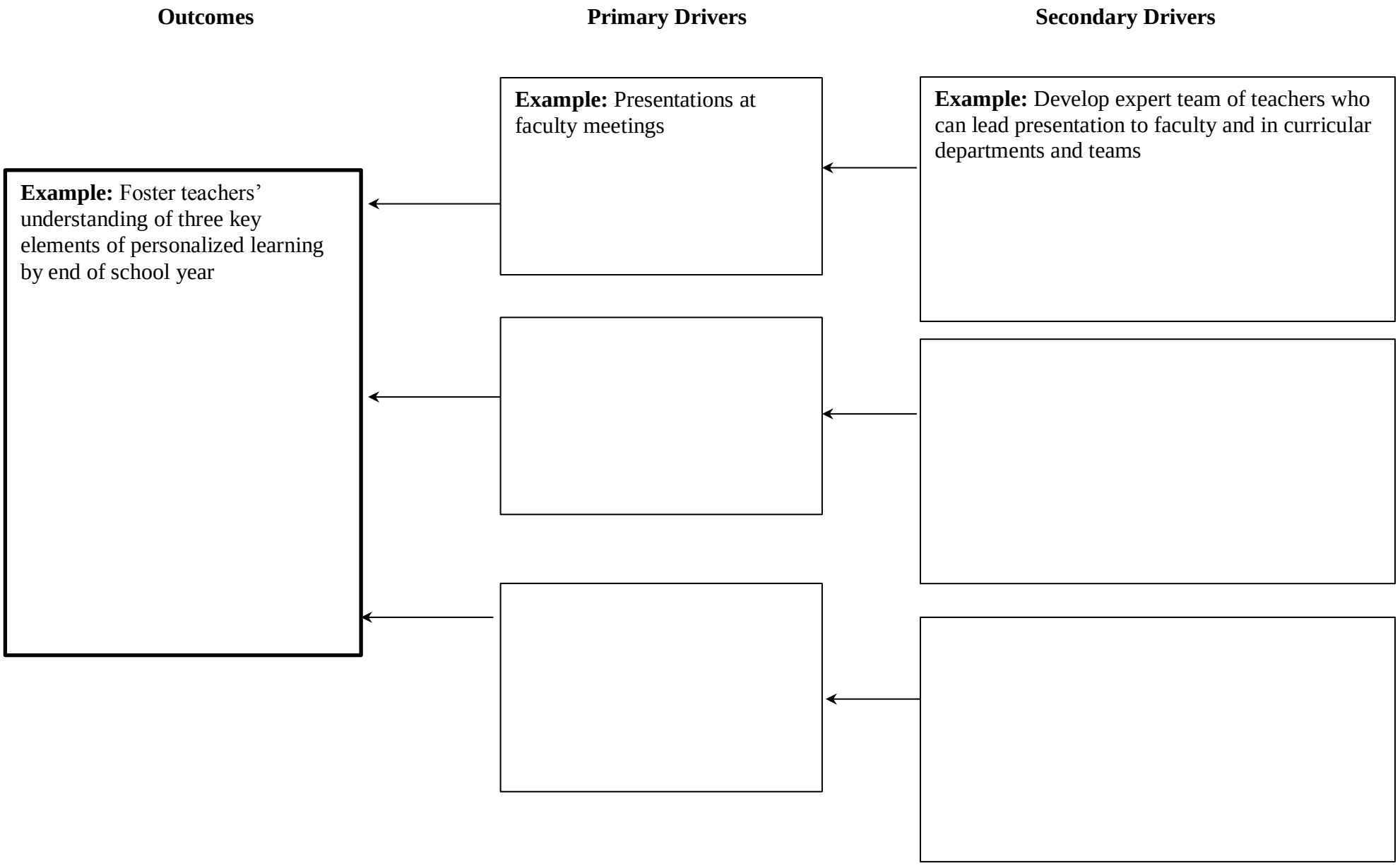
- What are secondary drivers that contribute to at least one primary driver and help lead to the desired change or outcome?

Appendix A: Logic Model for Personalized Learning

Transfer from your responses to the questions above the key participants, activities, inputs (resources), outputs (teacher practices), and outcomes (short- and long-term) to this logic- model to guide action planning and monitoring of the plan. This logic model may provide the framework for establishing a personalized learning plan for the district and for each school site.

Who	Resources	Activities	Outputs	Outcomes	Long-term Impacts
		•	•		
		•	•		
		•	•		
		•	•		
		•	•		
		•	•		

Appendix B: Driver Diagram for Personalized Learning



Personalized Learning Planning Guide

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Appendix A

Focus Group Protocol for District and School Leaders

Introduction

Thank you for taking the time to participate in this focus group. Just to remind you of the context for this focus group, I am in a doctoral program in education leadership through the University of Virginia, and I am conducting a dissertation study on the Personalized Learning Initiative in the comprehensive high schools in Park Gables. This focus group should take about an hour. You are free to choose not to answer any of the questions, or exit the focus group at any time. I will maintain anonymity of your responses and your school by using pseudonyms your school. I will not include any identifiable information in the report. I will give you a moment to read and sign the informed consent form. If it is ok, I will start audio recording the focus group now. Please introduce yourselves and your position at this school.

Questions

1. What is the vision for the personalized learning initiative?
    a. How was a shared vision developed? Were teachers and administrators involved? What about students and their families?
    b. Tell me some ways in which you fostered support for the vision?
2. What are the goals of the personalized learning initiative?
    a. How do you define personalized learning?
    b. After two years of implementation, to what extent do you see personalized learning occurring in classrooms? Do you have any specific examples?

3. Tell me about the things different members of the school community have done to help implement the personalized learning initiative.

    a. How have teachers supported one another in implementing Personalized Learning?

    b. What about administrators and the ITC?

    c. How about students and their families?

4. What opportunities for teacher learning were provided to teachers to support integration of laptops into instruction? Which did you think were the most helpful and why?

    a. What individual support was provided to teachers as they sought to implement personalized learning?

    b. How have you fostered collaboration among teachers to support teachers' ability to integrate laptops into instruction?

    c. What additional learning opportunities do you see as necessary for successful integration of technology in the classrooms?

5. What supports were developed to mitigate technical issues experienced by teachers and students?

    a. How is technical support provided to teachers? Is it effective?

6. What activities do you think were most key to supporting teachers' ability to implement personalized learning?

Appendix B

Informed Consent Form for Leader Focus Groups

Informed Consent Agreement

Please read this consent agreement carefully before you decide to participate in the study.

Purpose of the research study: To investigate the relationship between leadership practices, teacher learning and support for teachers, and enhanced teaching and learning in the "Personalized Learning" one-to-one initiative.

What you will do in the study: You will participate in a focus group regarding the leadership for the "Personalized Learning" one-to-one initiative, teacher learning for integrating one-to-one technology, teacher readiness for integrating technology, technical and instructional support, and enhanced teaching and learning using one-to-one technology. You are free to skip any question that makes you uncomfortable and can exit the focus group at any time by notifying the moderator.

Time required: This focus group will last about one hour.

Risks: There are no anticipated risks in this study. If negative perceptions of leadership emerge in the study, findings could be used to discredit or disparage district and school leaders, as well as to exert political pressure with regards to technology integration.

Benefits: The study may help us understand leadership practices related to enhanced teaching and personalized learning with laptops as well as teacher perceptions about the personalized learning program. This may also inform leadership practices to support teachers in implementing personalized learning.

Confidentiality: The information that you provide in the focus group will be handled confidentially. However, due to the small number of focus group participants it will not be possible to guarantee the confidentiality of your statements. I will use pseudonyms for the schools and for your names to minimize the risk of being able to identify you as a participant. To ensure confidentiality, please refrain from repeating what was discussed in this focus group. I will be recording the focus group using Quicktime on my work computer, which is password-protected, and on this recording device as a backup. Once the data is analyzed, all audio and transcribed focus group files will be destroyed.

Voluntary participation: Your participation in the study is completely voluntary.

Right to withdraw from the study: You have the right to withdraw from the study at any time.

How to withdraw from the study: You may withdraw from the study at any time by notifying the researcher.

Payment: You will receive no payment for participating in the study.

If you have questions about the study, contact:

Kevin Clark
7124 Leesburg Pike
Falls Church, VA, 22043

Telephone: (703) 248-5506
kclark@fccps.org

Sara Dexter, Faculty Advisor
Curry School of Education
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Email address: sdexter@virginia.edu

If you have questions about your rights in the study, contact:
Tonya R. Moon, Ph.D.
Chair, Institutional Review Board for the Social and Behavioral Sciences
One Morton Dr Suite 500
University of Virginia, P.O. Box 800392
Charlottesville, VA 22908-0392
Telephone: (434) 924-5999
Email: irbsbshelp@virginia.edu
Website: www.virginia.edu/vpr/irb/sbs

Agreement:

I agree to participate in the research study described above.

Signature: _____ Date: _____

You will receive a copy of this form for your records.

Appendix C

Coding Scheme for Focus Groups with School and District Leaders

Leadership domains (Leithwood, 2012a)	School-based factors (Inan & Lowther, 2010)
1. Setting Directions 1.1. Building a shared vision 1.2. Identifying shared, specific, short-term goals 1.3. Creating high performance expectations 1.4. Communicating the vision and goals	A. Overall Support for School Technology • Support from administration, peers, students, parents and the community for laptop integration
2. Develop People 2.1. Providing support and demonstrating consideration for individual staff members 2.2. Stimulating growth in the professional capacities of staff 2.3. Modeling the school's values and practices	B. Technical Support • Adequacy of technical support • Availability of support • Assistance with laptops
3. Redesign the Organization 3.1. Building collaborative cultures and distributing leadership 3.2. Structuring the organization to facilitate collaboration 3.3. Building productive relationships with families and communities 3.4. Connecting the school to its wider environment	C. Professional Development • Amount and adequacy of professional development and training opportunities provided in the school regarding laptop integration into classroom instruction

Appendix D

Script for Personal and Email Communication with School and District Leaders

Hi <name>.

I am excited to invite you to participate in a survey that may help us understand more about leadership and support for teachers implementing the "Personalized Learning" initiative. I am a doctoral student in the Ed. D. program at the University of Virginia, and I am starting to collect data for my dissertation. The study is a mixed-methods investigation of the "Personalized Learning" initiative specifically at the high school level.

To understand what leadership practices have been key to implementing personalized learning, the first phase of my research includes a focus group with district leaders and a focus group with school leaders at each high school. Would it be possible to conduct a focus group with you and your leadership team about the vision for the personalized learning program, the goals for teaching and learning, the support provided to teachers for technology integration, and the opportunities for teacher learning during the first year and a half of the program? The focus groups should take less than one hour and you will be free to pass on and not answer any questions. Prior to starting the focus group, I will provide you an informed consent form describing in further detail the study, the focus group procedures, and how the data will be treated.

I hope that this research will provide district and school leaders some guidance and recommendations regarding leadership practices related to enhanced instruction and personalized learning. Please let me know the best day and time to conduct the focus group. Thank you for your time and support of my dissertation research.

Sincerely,

Kevin Clark

Appendix E

Informed Consent for Teacher Online Survey

Please read this consent agreement carefully before you decide to participate in the study.
Purpose of the research study: To investigate the relationship between leadership practices, teacher learning, support for teachers, and student use of laptops for personalized learning.
What you will do in the study: At the end of this message you will find a link to participate in a survey of all comprehensive high school teachers regarding the leadership, technical and instructional support, and professional development for the Personalized Learning Initiative as well as your beliefs about and readiness to integrate one-to-one technology into instruction. The survey will also ask you about your implementation of personalized learning to enhance instruction and improve student achievement.
Time Required: The survey contains 10 questions, with a total of 36 items, and should take no more than 15 minutes to complete.
Risks: There are no anticipated risks in the study.
Benefits: There are no direct benefits to you for participating in this research study. The study may help us better understand leadership practices related to personalized learning in order to improve the ongoing Personalized Learning Initiative.
Confidentiality: The information that you give in the study will be **anonymous** which means that your name will not be collected or linked to the data. When the study is completed and the data have been analyzed, all data will be destroyed.
Voluntary participation: Your participation in the study is completely voluntary.
Right to withdraw from the study: You have the right to withdraw from the study at any time. In addition, you are free to skip any question that makes you uncomfortable and can stop the survey at any time.
How to withdraw from the study: Once the survey has been completed, it will be impossible to withdraw from the survey, as the data is anonymous.
Payment: No payment is associated with this study.
If you have questions about the study, contact:
Kevin Clark
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Falls Church, VA, 22043
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Sara Dexter, Faculty Advisor
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If you have questions about your rights in the study, contact:

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Email: irbsbshelp@virginia.edu
Website: www.virginia.edu/vpr/irb/sbs

Agreement:

When you receive the survey, a question will ask you if you agree to participate in the research study described above. Please click yes to agree to participate in the survey.

Thank you for your time and consideration.

Sincerely,
Kevin Clark

Appendix F

Leadership Teacher Technology Questionnaire for Personalized Learning

Q1) Please indicate your consent to participate in the study by answering yes to this question. If you do not agree to participate, please close this browser window.
- o Yes
- o No

Selecting "No" exits the survey

Q2) Years of teaching experience
- o Less than 1 year
- o 1-2 years
- o 3-5 years
- o 6-10 years
- o 11-15 years
- o 16+ years

Q3) The subject area in which I work is (select all that apply)
- o English and Language Arts
- o Mathematics
- o Science
- o Social Studies
- o Foreign Language
- o Visual and Performing Arts
- o Health and Physical Education
- o Computer Science
- o Special Education
- o ESOL
- o Reading
- o Career and Technical Education (CTE)
- o Library/Media

Q4) The school in which I work is
- o Mayorsville High School
- o Coral High School
- o Rocky Heights High School

Q5) To what extent do you agree or disagree with the following statements regarding the Personalized Learning initiative?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Leaders established a shared vision for the initiative	○	○	○	○	○
Leaders help identify specific, shared goals for the initiative	○	○	○	○	○
Leaders establish high performance expectations for teachers, students and themselves for the initiative	○	○	○	○	○
Leaders effectively communicate the vision and goals for the initiative	○	○	○	○	○

Q6) Indicate the extent to which you agree or disagree with each of the following items.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Laptops are kept in good working condition.	○	○	○	○	○
I can readily obtain answers to technology-related questions.	○	○	○	○	○
The use of laptops has increased the level of student interaction and/or collaboration.	○	○	○	○	○
Parents and community members support our school's emphasis on technology.	○	○	○	○	○
I know how to meaningfully integrate technology into lessons.	○	○	○	○	○
My students have adequate access to up-to-date	○	○	○	○	○

technology resources.					
Materials (e.g. software, printer supplies) for classroom use of laptops are readily available.	○	○	○	○	○
The integration of technology has positively impacted student learning and achievement.	○	○	○	○	○
I am able to align technology use with my district's standards-based curriculum.	○	○	○	○	○
Most of my students can capably use laptops at an age-appropriate level.	○	○	○	○	○

Q7) Indicate the extent to which you agree or disagree with each of the following items.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I have received adequate training to incorporate laptops into my instruction.	○	○	○	○	○
My computer skills are adequate to conduct classes that have students using laptops.	○	○	○	○	○
Teachers receive adequate administrative support to integrate laptops into classroom practices.	○	○	○	○	○
My teaching is more student-centered when laptops are integrated into the lessons.	○	○	○	○	○
Our school has a well-developed technology plan that guides all technology	○	○	○	○	○

integration efforts.					
I routinely integrate the use of laptops into my instruction.	○	○	○	○	○
Teachers in this school are generally supportive of laptop integration efforts.	○	○	○	○	○
Laptop integration efforts have changed classroom learning activities in a very positive way.	○	○	○	○	○
The use of laptops has improved the quality of student work.	○	○	○	○	○
My teaching is more interactive when laptops are integrated into the lessons.	○	○	○	○	○

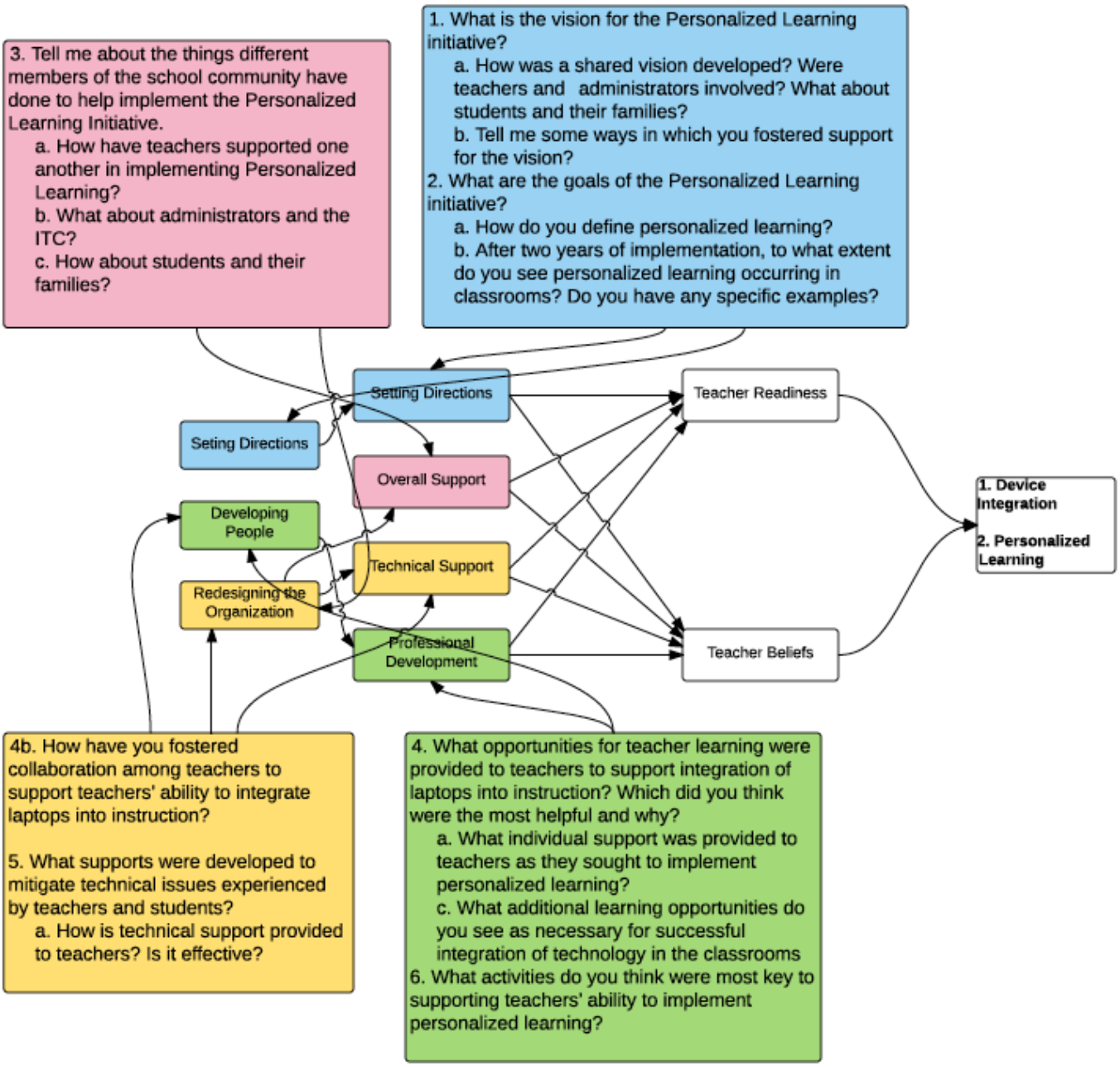
Q8) Indicate the extent to which you agree or disagree with each of the following items.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I have frequently participated in professional development that was planned by or provided by the Instructional Technology Coordinator (ITC) or by the school district	○	○	○	○	○
I more frequently integrate technology into my instruction as a result of participating in professional development planned or provided by the ITC or by the school district	○	○	○	○	○
The quality of my technology integration lessons has improved as a result of participating in professional	○	○	○	○	○

development planned or provided by the ITC or by the school district					
Overall, our ITC has been a valuable asset to our school's laptop program	○	○	○	○	○
Student access to one-to-one laptops in the classroom allows me to personalize instruction for my students	○	○	○	○	○

Appendix G

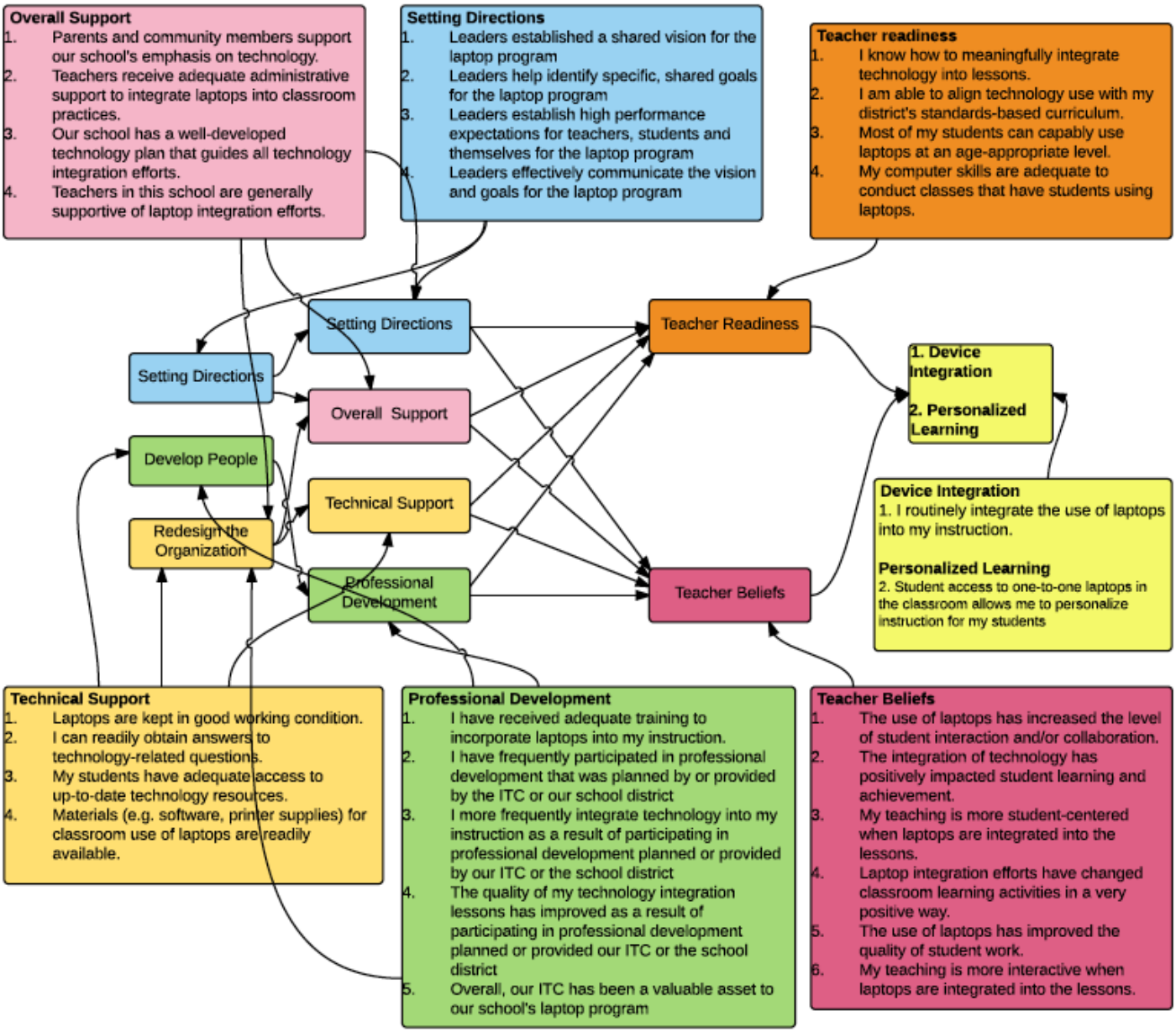
Leadership Focus Group Question Map



Appendix H

Leadership Teacher Technology Questionnaire for Personalized Learning Survey

Item Map



Appendix I

Average District Ratings on Teacher Perception Survey Items

Table 11
Average District Ratings for Each Item on Teacher Perception Survey

		District Average
Setting Directions	Leaders established a shared vision	1.8
	Leaders established shared goals	1.8
	Leaders set high performance expectations for students, teachers, and themselves	1.9
	Leaders effectively communicated the vision and goals	1.7
Overall Support	Parents and community members support our school's emphasis on technology.	2.5
	Teachers receive adequate administrative support to integrate laptops into classroom practices.	2.2
	Our school has a well-developed technology plan that guides all technology integration efforts.	1.9
	Teachers in this school are generally supportive of laptop integration efforts.	2.6
Technical Support	Laptops are kept in good working condition.	2.9
	I can readily obtain answers to technology-related questions.	2.9
	My students have adequate access to up-to-date technology resources.	3.0
	Materials (e.g. software, printer supplies) for classroom use of laptops are readily available.	2.2
Professional Development	I have received adequate training to incorporate laptops into my instruction.	2.0
	I have frequently participated in professional development that was planned by or provided by the Instructional Technology Coordinator (ITC) or by the school district.	2.3
	I more frequently integrate technology into my instruction as a result of participating in professional development planned or provided by the ITC or by the school district.	2.3
	The quality of my technology integration lessons has improved as a result of participating in professional development planned or provided by the ITC or by the school district.	2.3

	Overall, our ITC has been a valuable asset to our school's laptop program.	3.0
Teacher Readiness	I know how to meaningfully integrate technology into lessons.	2.9
	I am able to align technology use with my district's standards-based curriculum.	2.8
	Most of my students can capably use laptops at an age-appropriate level.	3.0
	My computer skills are adequate to conduct classes that have students using laptops.	3.1
Teacher Beliefs	The use of laptops has increased the level of student interaction and/or collaboration.	2.3
	The integration of technology has positively impacted student learning and achievement.	2.5
	My teaching is more student-centered when laptops are integrated into the lessons.	2.4
	Laptop integration efforts have changed classroom learning activities in a very positive way.	2.2
	My teaching is more interactive when laptops are integrated into the lessons.	2.3
	The use of laptops has improved the quality of student work.	2.1
	I routinely integrate the use of laptops into my instruction	2.7
	Student access to one-to-one laptops in the classroom allows me to personalize instruction for my students.	2.3
	Average of Set Direction Scale	1.8
	Average of Overall Support Scale	2.3
	Average of Technical Support Scale	2.8
	Average of Professional Development Scale	2.4
	Average of Teacher Readiness Scale	2.9
	Average of Teacher Beliefs Scale	2.3
	n	168