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Transforming Traditional Classrooms into Student-Centered 21 st Century Classrooms: A Developmental Process for Professional Development

Monica McCartney

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Transforming Traditional Classrooms into Student-Centered 21st Century Classrooms:
A Developmental Process for Professional Development

Monica McCartney

Dissertation submitted to the College of Education and Human Services

at West Virginia University

in partial fulfillment of the requirements for the degree of

Doctor of Education

in

Instructional Design and Technology

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ABSTRACT

Transforming Traditional Classrooms into Student-Centered 21st Century Classrooms: A Developmental Process for Professional Development

Monica McCartney

This design-based action research study utilized a model of design, implementation, and evaluation across four school semesters to improve the professional development provided to teachers in a new one-to-one computing environment. Data sources collected across all semesters helped guide changes to the design and implementation phases of the professional development. This study had one guiding research question: What are the appropriate professional development sessions and process for designing professional development in order to meet the needs of teachers as they to transform traditional classrooms into student-centered 21st century classrooms?

Keywords: Design-based research, Developmental Research, Instructional Design, One-to-one, 1:1, Professional Development, 21st Century Classrooms, student-centered

Biographical Sketch

Monica McCartney is currently a Technology Integration Specialist and Academic Coach in Morgantown, West Virginia. Monica has lived 36 of her 38 years in Morgantown, leaving briefly to teach outside of the state. Monica graduated with a Bachelor of Science in Elementary Education, specializing in General Science 5-9, from West Virginia University in 1998. She began her teaching career teaching eighth grade science in Charlotte, North Carolina for two years, before returning to Morgantown. In Morgantown, Monica taught sixth grade Mathematics and English. In May 2004, she graduated with a Masters of Arts in Secondary Education, specializing in middle school mathematics. In 2010, she transferred to her current position as a Technology Integration Specialist. Monica can be reached at mlmccart@k12.wv.us.

Dedication

This study is dedicated to all of the school staff who had the vision to transform classrooms into 21st century learning environments: the teachers, school administrators, and county-level technology staff. Thank you for all of your insight, hard-work, and dedication.

Thanks also to my family for all of their support throughout this endeavor. To my parents for instilling a love of learning and my husband for your support as I locked myself in a room to write, I could not have done it without you.

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This action research study could not have been completed without the assistance of the teachers and administrators. Their ability to rally together as a team to both write such a successful grant and implement it is inspirational. Whereas my position in the building is to be there to support them, they have been my support system throughout this process. A special thanks to those who took the first steps in this endeavor: Tracy Chico, Sarah Corder, Abigail Custer, Traci DeWall, Angela Dowling, Chris Maloney, Jim Napolillo, and Cynthia Sweitzer-Pinn. Additional thanks are extended to PJ Bell and Matt Pitek for their support both technically and mentally throughout the process.

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Chapter I – Introduction

Background

The host middle school was a recent recipient of the West Virginia Department of Education's Enhancing Education through Technology (EETT) grant. The objective of the grant was to create a one-to-one computing educational environment over the course of a two year period. At the end of the two year period, a laptop was available for each student attending the middle school. While the staff of educators at the school showed overwhelming support for the initiative during the application process, professional development was needed in order to transform the school into student-centered 21st century classrooms.

Need for the Study and Rationale

Today's businesses are looking for employees who can multi-task, make decisions independently, work collaboratively, and adapt as necessary. Technological changes have made these skills necessary both in and out of the workplace. Additionally, advanced communications have created a global workplace with business associates all over the world. It is no longer enough to be knowledgeable in content areas; employees and citizens need to have the ability to adapt, troubleshoot, cooperate, and seek out new solutions. For these reasons, it has become vital to provide students with the skills necessary to thrive in these environments (Partnership for 21st Century Skills, 2003).

As American businesses alter their expectations of employees, the school systems charged with shaping the future employees must also change. Educators have begun to transition their traditional teaching methods to meet the needs of their current students in the workplaces of the future. For many educators, this change has meant a greater emphasis on incorporating digital technology.

Significance

In response to the call for better preparation of our students in the workplace, many schools, school-districts, and, in some cases, entire states have begun transitioning classrooms to one-to-one computing environments. Providing digital technology for every student in a classroom is not enough. Educating teachers and students on how to use the tools inherent to the technology is not enough. Teachers must integrate the technology seamlessly into their existing curriculum in order to make the technology an effective and real-world tool. In order for a one-to-one technology initiative to be successful, teachers must be provided with professional development to assist them with adequately integrating technology into their existing curricula.

Intervention

This study utilized a design-based action research approach to shape professional development in a one-to-one computing environment. A cycle of developmental research was performed across four school semesters. Core content teachers were granted laptop computers for their classrooms in a phased-in approach throughout the four semesters. Despite this method of laptop distribution, all teachers were provided the same professional development across all four semesters.

Research Question

Developmental Research Question: What are the appropriate professional development sessions and process for designing professional development in order to meet the needs of teachers as they to transform traditional classrooms into student-centered 21st century classrooms?

Summary of the Introduction

Like many schools throughout the United States, the school in this study had been granted the opportunity to transform itself into a one-to-one computing school. The impetus for such a transition was the need for greater student preparation for the future workforce. Providing the equipment was not enough to ensure that real-world skills necessary were imparted to the students in the classrooms. Teacher-learning through professional development was necessary to guarantee that the technology was used effectively. This design-based action research study looks at how such professional development was selected and delivered.

Glossary of Terminology

One-to-one (1:1) Computing: For the purposes of this study, one-to-one computing is defined as one laptop computer available for every student in a given classroom. While teaching methods may vary the exact ratio of students per laptop for each task, in this one-to-one scenario a laptop was available for each student.

Technology Integration Specialist (TIS): The West Virginia Department of Education grants the advanced credential of TIS to educators who have successfully completed 320 hours of WVDE approved training. Educators employed in the role of TIS are utilized as support staff to assist and train teachers on the incorporation of technology within their curriculum.

Implementation Team: As the host school began the process of transforming to 1:1 computing environment, six teachers, administrators, the building-level TIS, and the county-level TIS formed a committee referred to as the Implementation Team. The teachers on this team were made up of two teachers from each grade level (6-8) and were the first in the building to receive laptop carts and begin the process.

Core Content Teachers: Core content teachers are those primarily responsible for delivering instruction in mathematics, science, social studies, English, and reading. At the host school, this accounted for 16 of the 31 full-time instructors. In addition to the 16 core content teachers, 4 of the special educators were also responsible for delivering core content. Over the course of the two-year study, laptop carts were provided to these 20 teachers.

Related Arts Teachers: Related arts teachers are teachers who provide instruction in an area outside of the core content. This content includes (but is not limited to) physical education, graphic arts, musical arts, wood-working, consumer science, world languages, and computer applications. Nine of the 31 instructors at the host school were considered related arts teachers. These nine teachers did not receive a laptop cart for their classroom, but did have opportunities to schedule classes in any of the three stationary computer labs.

Learner Management System (LMS): In this study, learner management system refers to the electronic platform utilized by the school to provide online instruction and track student progress. The county provides access to Edline for such purposes. Applications of Edline include the ability to record and report grades; create and disseminate online quizzes, surveys, homework hand-in assignments, discussion boards, and blogs; post news, documents, and links; and maintain a calendar of events.

Blended Learning: Blended learning refers to the combination of online content delivery and face-to-face content delivery. Prior to this study, all of the teachers at the host school utilized the learner management system for the reporting of grades and providing resources, such as documents and links. For this reason, blended learning will be used to refer to the use of interactive assignments, quizzes, surveys, discussion boards, and blogs.

Chapter II – Literature Review

21st Century Skills

In order to adequately prepare students for life in the 21st century, the Partnership for 21st Century Skills (2003) has identified the specific knowledge and skills necessary. The essential knowledge and skills are organized into three categories, 21st century content (global awareness, financial and business literacy, and civic literacy), learning and thinking skills, and information and communications technology (ICT) literacy.

Perhaps the broadest category of 21st century skills, learning and thinking skills, are those essential in giving learners the ability to connect new information. This broad category, sometimes referred to “knowing how to learn,” covers the areas of critical thinking, problem solving, creativity, self-directional skills, collaboration, communication skills, and information and media literacy. Critical thinking, problem solving, and creativity skills are designed to create learners who crave challenging tasks, look for multiple solutions, and reflect on ideas. Learners should be encouraged to take risks in order to find potential solutions rather than focusing on the “right answer” (NCREL, 2003).

The Partnership for 21st Century Skills (2003) defines “information and communications technology literacy” as the result of combining learning and thinking skills with 21st century technology tools. A student capable of harnessing technology tools to effectively research, problem-solve, collaborate, communicate, and create would be considered ICT literate.

With the understanding that students need to be better prepared for the future workforce, many school districts are attempting to transition towards ubiquitous technology to leverage the use of 21st century tools and increase ICT literacy, thereby increasing student learning and thinking skills (Apple Inc., 2008).

Technology Initiatives' Impact on Teaching Methodology

While the notion of having technology available for every student has gained popularity, it is not a new idea. As early as 1986, the Apple Classrooms of Tomorrow (ACOT) project has been studying the outcomes of students having constant access to technology. Since that time, a multitude of studies have been completed to capture student learning outcomes and changes in teaching methods in technology implementation initiatives. For the purposes of this inquiry, only studies reporting implications to teaching methodology have been analyzed.

In their compilation of laptop initiatives, Dunleavy, Dexter, and Heinecke (2007) stated that teachers in one-to-one laptop environments self-reported that the most frequent use of technology by students and teachers was online research in conjunction with productivity tools. Drill and practice was another frequent use of technology, but unlike many traditional classrooms, the drill and practice was typically individualized and learner-centered.

Learner-centered instruction is commonly reported as an outcome of one-to-one technology environments. Multiple studies report that ubiquitous technology lends itself to a more constructivist approach to classroom instruction, resulting in a student-centered environment with a teacher facilitating (Dunleavy et al., 2007; Muir-Herzig, 2004; Windschitl & Sahl, 2002). Muir-Herzig (2004) reported that “technology brings about changes to the classroom roles and organization. It allows the students to become more self-reliant. Students may use peer coaching, and teachers may function more as facilitators than lecturers.” Additionally, in his 2006 compendium of North American laptop initiatives, Fox recounted that greater than 70% of teachers in a one-to-one computing environment found that they were better capable of individualizing instruction while meeting curriculum goals with the addition of the technology.

Dunleavy et al. (2007) summarized their findings by asserting that one-to-one technology adds value to teaching and learning in six ways: teachers' ability to formally assess learning, the ability to individualize instruction, the capacity for self-guided instruction, access to online resources, the capacity for student interaction and collaboration, and the availability of electronic communication and material management.

While several studies indicate that ubiquitous technology lends itself to student-centered learning, Windschitl and Sahl (2002) maintain that pervasive technology does not have a direct causal relationship with constructivist instruction. They argue that how teachers choose to utilize technology depends on a combination of factors rooted in their personal histories and beliefs about student learning. Opfer and Pedder (2011) agree and take the idea a step further by stating that teachers' willingness to learn new ideas and methods is dependent on the interplay between their past experiences and beliefs about student learning.

Teacher Beliefs

Teachers' beliefs regarding student learning and teaching methods directly affect the instructional decisions that they make (de Vries, Jansen, & van de Grift, 2013). Studies have shown that while teachers' philosophies of student learning may be reformed over time (Pecore, 2013), beliefs established earlier are more difficult to change (de Vries et al., 2013). Additionally, Pecore (2013) points out that changing a teaching philosophy is "unlikely to occur due to a professional development workshop".

Despite the opinion that teachers' beliefs cannot be changed by a single workshop, Windschitl and Sahl (2002) point out that school culture can influence the thinking of the teachers working within its walls; the perceived institutional beliefs of what constitutes "good teaching" influences decisions made by individual teachers. Opfer and Pedder (2011) concur by

stating that “the norms of the school, its structures and practices, both enable and constrain teachers”. In turn, individual teacher and administrator beliefs and experiences are among the components that make up the school culture as a whole. As teachers participate in learning activities and modify their philosophies, they also stimulate the development of the school as a whole (de Vries et al., 2013).

Effective Professional Development

From the research discussed thus far, it is easy to understand why Opfer and Pedder (2011) describe teacher learning as “a complex system rather than an event”. It is clear that there are many dynamics interacting to influence whether teachers will or will not alter their beliefs and practices. In an attempt to gain greater understanding on the factors that have the most significant effect on teacher learning, Desimone, Porter, Garet, Yoon, and Birman completed a three year longitudinal study on teachers’ learning and found that effective professional development comprised of six features: reform type (the activity structure), duration (length of activity), collective participation (groups from the same organization), active learning (hands-on), coherence (aligned to goals), and content focus (emphasis on deepening content knowledge).

Many researchers agree that the duration of professional development activities is essential to ensuring that the activities are effective. Garet, Porter, Desimone, Birman, and Yoon (2001) maintain that “sustained and intensive professional development is more likely to have an impact, as reported by teachers, than is shorter professional development”. Similarly, Brand (1998) indicates that “training must be ongoing and not limited to ‘one-shot’ sessions”. Research completed by both Brand (1998) and Opfer and Pedder (2011) indicated that in order for professional development to be effective, teachers had to be given time to explore,

understand, and practice new ideas. The amount of time needed for such exploration is different for each teacher and is dependent upon the teacher's comfort level with the new knowledge (Brand, 1998).

In addition to the length of professional development and exploration time, coherence to curriculum goals is another important factor to effective teacher learning. This is particularly important when introducing new teaching methods, such as technology integration. Tying new learning to preexisting content knowledge and routines allows teacher-learners to visualize how to integrate the new methods into the classroom (Brand, 1998). This notion was reinforced by Opfer and Pedder in their 2011 study which stated that "teachers learn most effectively when they are required to engage with materials of practice". Although this research suggests that professional development should be framed around curriculum goals, Muir-Herzig (2004) notes that technology training frequently emphasizes how to use the equipment, but often fails to impart how to integrate the equipment into the curriculum.

Collective participation is lauded by many researchers as a key component of any effective professional learning. Groups of teachers from the same school, teaching the same subject, or teaching the same grade who participate in learning activities together are more likely to increase knowledge and change classroom practices (Garet et al. 2001; Levine & Marcus, 2010; Opfer & Pedder, 2011). When teachers from the same school participate in the same professional development opportunities, they are more likely to share with one another to solve problems and share strategies. This creates an environment where changes in teaching strategies become a collective effort (Opfer & Pedder, 2011). Opfer and Pedder (2011) caution, however, that much like the duration of exploration, the amount of collaboration necessary for each instructor will vary based on need.

Technology Training

In research directly related to technology training, researchers again stressed the importance of collective participation. Several studies indicated that technology training was most effective when teachers were surrounded by others who were also experimenting with technology integration (Becker, 1994; Brand, 1998; Dwyer, 1994; Windschitl & Sahl, 2002). Brand (1998) expands to state that learning with a peer “helps teachers overcome the insecurity and fear of applying what they have learned in workshops”. Additionally, a teacher working with a peer who models good technology integration creates more confidence in integrating the technology into their own classroom. Even when collective participation was not a feature of the initial technology training, Dwyer (1994) reported that ACOT teachers began collaborating with one another to share experiences and strategize.

Collaboration and support is a vital component to professional development as school districts begin to transform traditional classrooms to 1:1 teaching environments. Teachers have self-reported that not having adequate support is among the obstacles to effectively integrating technology into their instruction (Fox, 2006). To overcome this, Muir-Herzig (2004) suggests that schools invest in a full-time school-level technology resource coordinator. Brand (1998) agrees and stresses the point by stating that creating such a position is “one of the most effective ways to align staff development with the district/school goals”. He further explains the benefits by describing the potential responsibilities of this role: “ensure school/district objectives are met; take responsibility for aligning and organizing staff development; support teachers both emotionally and technically; work with a core group of teachers representing the district’s subject areas and grades; coordinate time for teachers to explore and learn the new technology;

and act as the essential link for empowering all teachers to effectively use technology and integrate it into the overall curriculum”.

Design-Based Research

Educational researchers’ approach to technology integration initiatives and educational research in general is changing. Many in educational researchers have begun promoting design-based research as a better approach to educational research (Collins, Joseph, & Bielaczyc, 2004; Reeves, 2006; van den Akker, 1999). Both Reeves (2006) and van den Akker (1999) suggest that a design-based research approach, with its evolutionary nature, is better suited for reform efforts and large-scale initiatives. As van den Akker (1999) points out, reform efforts “are often multi-layered, including both large-scale policies and small-scale realizations.” Design-based research can make progress in regards to both top-down initiatives and local implementation through its enhancement of both educational theory and educational practice (Collins, Joseph, & Bielaczyc, 2004). Additionally, through this refinement of practice and theory, such research can yield instructional design models that may be utilized for organizational training (Andrews & Goodson, 1980).

As a branch of research, design-based research suffers from a lack of agreement regarding terminology. In literature, design-based research is often referred to as design studies, design experiments, design research, development research, developmental research, formative research, formative inquiry, formative experiments, formative evaluation, and engineering research (van den Akker, 1999). No matter the name, the goal of such research is the same; design-based research aims to study the design, development, and implementation of instructional models, while solving real-world problems in real-world settings (Andrews & Goodson, 1980; Design-Based Research Collective, 2003; Richey, Klein, & Nelson, 2004; Wang

& Hannafin, 2005). Such studies are conducted utilizing iterative models of design, implementation, and evaluation (Andrews & Goodson, 1980, Design-Based Research Collective, 2003; Richey, Klein & Nelson, 2004; Wang & Hannafin, 2005). Through successive cyclic or spiral iterations, the designed interventions can be refined (Collins, Joseph, & Bielaczyc, 2004; Richey, Klein, & Nelson, 2004; van den Akker, 1999; Wang & Hannafin, 2005). Due to its cyclic nature, outcomes from each iteration can be evaluated and utilized to redesign the next iteration, providing focus to the implementation (Wang & Hannafin, 2005).

As previously noted, design-based research provides an approach for solving real-world problems in real-world settings. Such studies focus on practical problems in education to inform educational practice (Brown, 1992; Reeves, 2000; Richey, Klein, & Nelson, 2004; van den Akker, 1999). Additionally, setting such research studies in naturalistic settings, allows for immediate application of solutions that benefit all stakeholders (Barab & Squire, 2004; Richey, Klein, & Nelson, 2004; Reeves, 2000). As stated by Barab & Squire (2004), “Research paradigms that simply examine processes as isolated variables within laboratory settings will lead to incomplete understanding of their relevance in more naturalistic settings.” Similarly, Reeves (2000) points out that “Design research is not an activity that an individual researcher can conduct in isolation from practice.”

A key component of context-specific research is the ability for the researcher to interact and collaborate with educators and other practitioners. This collaboration among researchers and practitioners is essential in identifying the problems and evaluating the efficacy of interventions (Design-Based Research Collective, 2003; Reeves, 2000; Reeves 2006; van den Akker, 1999; Wang & Hannafin, 2005). Collaboration with practitioners also means that the research goals and outcomes will be suitable for the local need(s). Whereas the researchers’ design agenda may

initiate from a more generalized focus, collaboration in the naturalistic setting will ensure that local needs are met (Design-Based Research Collective, 2003). It is important to note, however, that due to the cyclic nature of design-based research, one study will involve multiple cycles of design, implementation, and evaluation. As such, it is imperative that all stakeholders have a commitment to continued collaboration over an extended period of time (Design-Based Research Collective, 2003).

Due to the context-specific nature of design-based research, concern over the ability to generalize findings to other settings may arise. In fact, Collins, Joseph, & Bielaczyc (2004) point out that “the effectiveness of a design in one setting is no guarantee of its effectiveness in other settings.” However it is important to reiterate that the goal of design-based research is to advance practical local applications as well as generalized learning theories (Barab & Squire, 2004; Design-Based Research Collective, 2003; Reeves, 2000; Richey, Klein, & Nelson, 2004). As such, van den Akker (1999) maintains that practitioners in other locales should be encouraged to attempt incorporating theoretical findings into their own context.

In addition to concern over the ability to make generalizations to a larger population, design-based research methodology may also be called into question. Unlike traditional research methods, designed-based research does not isolate variables, but instead attempts to investigate many interrelated aspects of the research simultaneously in realistic settings leading to an apparent lack of control (Collins, Joseph, & Bielaczyc, 2004; van den Akker, 1999; van den Akker, Gravemeijer, McKenney, & Nieveen, 2006). Brown (1992) points out this reduction in experimental control is a “trade-off” for the richness of the natural context.

Additionally, Barab & Squire (2004) note that design-based researchers are likely to be deeply invested in all stages of the development cycle; as such, objectivity may become difficult.

In order to increase objectivity, multiple sources should be analyzed at each stage of the development cycle (Barab & Squire, 2004; Design-Based Research Collective, 2003; Richey, Klein, & Nelson, 2004; Wang & Hannafin, 2005). Design-based research utilizes mix methods to analyze sources (Design-Based Research Collective, 2003). Specific sources and methods should be selected based upon the specific research tasks and questions (Reeves, 2000).

Summary of Literature

Despite the research showing the significance of collaboration and support in teacher learning, it is important to reiterate that professional development and teacher learning do not have a simple cause-and-effect relationship. As noted earlier, “teacher learning is a complex system” and as such there are many factors contributing to its success or failure. Opfer and Pedder (2011) note that due to this dynamic system, “there are many ways of achieving the same learning effects. The specific sets of activities, systems, and supports for learning we use in one context, with one set of teachers, may be quite different from those that would be necessary to achieve the same end in another context with a different set of teachers.”

Design-based research aims to close the gap between theory and practice. Through the process of producing and refining a model of intervention in an authentic setting, researchers attempt to generate broad theories that may be generalized to new settings. While the specific activities and supports may not carry over to a new context, the process of design, implementation, and analysis of such activities may be generalized and thus, provide the support necessary for problem-solving in a new context.

Chapter III – Methodology

Setting

This design-based action research study was conducted at a middle school housing grades six through eight located in a small urban community in West Virginia. The student population of the host school is approximately 500 students. Both the seventh and eighth grade teaching teams contain one teacher for each core content area (English, reading, mathematics, science and social studies). The sixth grade teaching team consists of six teachers, each teaching multiple content areas.

In the fall of 2010, the school received a West Virginia Department of Education (WVDE) Enhancing Education through Technology (EETT) grant providing funding for one-to-one technology over the course of two school years. The grant application was written by the building's teachers, support staff, and administration, as well as county-level technology staff.

Participants

Teachers. While the developmental action research studied the transformation of the entire school, much of the research was focused on six middle school teachers. These six teachers were selected by means of purposive sampling based upon their inclusion in the school's "Implementation Team," or the teachers selected to be the first in the building to begin the one-to-one computing initiative. These six teachers, two at each grade level, were selected to begin the implementation process based on their technology literacy skills and willingness to adapt their instruction to integrate technology on a regular basis.

Technology specialists and administrators. Four specialists and/or administrators were directly involved in planning and implementing the weekly professional development sessions.

- **School Technology Integration Specialist (TIS)/Academic Coach** (primary researcher for this study): The school's TIS and Academic Coach, was responsible for collaborating with the rest of the support staff and administration to provide appropriate professional development. The building-level TIS holds an authorization/credential as a Technology Integration Specialist through the West Virginia Department of Education (WVDE).
- **County Technology Integration Specialist (TIS)**: At the time of this study, the county school system hired one TIS who was available to assist at all schools throughout the county, as well as the board offices. This county TIS held an office at the middle school being studied during the 2010-2011 school year, in order to facilitate the requirements of the WVDE EETT grant. Along with the school's TIS, other support personnel, and administrators, she was responsible for providing professional development to the school's instructors. The county TIS holds WVDE TIS credentials.
- **County Technology Director**: The Technology Director for the county school system was actively involved in steering the professional development and EETT grant requirements.
- **Principal**: The principal of the school also collaborated with the technology staff to guide the direction of the school-wide professional development.

Instructional Design

The study was a design-based action research study utilizing a systematic process (instructional design model) of design, implementation, and evaluation to shape professional development. Figure 1 illustrates the instructional design model utilized in this study. A cycle of developmental research with the data sources for each stage is visualized in Table 1.

Figure 1. Instructional design model utilized in study.

Needs Assessment: The initial needs assessment, conducted in the fall of 2010, was the focus for the design structure, providing data that drove the initial design, as well as redefining the overall project goal through each iteration of the process.

Design. The initial design of professional development sessions was based upon the goals expressed within the needs assessment. Each subsequent cycle was redesigned based upon analysis of data at the evaluation stage and the overall goals of the needs assessment.

Implementation. Due to the existing structure of the WVDE EETT grant received by the school, it was necessary to implement professional development and research in phases. The grant document outlined a specific phased-in approach, in which classroom sets of laptops were to be provided to small portions of each grade level team across four semesters. A timeline of the grant dictated phases can be seen in Table 3.

Prior to 2010-2011 school year, the staff received 30 minutes of professional development on technology resources during their team planning periods once per month. This

professional development was provided by the school's previous technology instructor and focused on introducing teachers to various online resources and understanding benchmark assessment programs.

Beginning in the fall of 2010, the school's newly hired Technology Integration Specialist provided job-embedded professional development. During the first semester of the 2010-2011 school year, professional development sessions were held for 30-45 minutes once per week for core subject teachers and 30-40 minutes every other week for the school's related arts instructors, during team planning periods. During the second semester, professional development sessions were held for 30-40 minutes every other week for all teaching staff members. Additional sessions were held throughout the year before and after school, as well as during the school's Instructional Support and Enhancement (ISE) days. Table 3 details the frequency of professional development for the school's instructors.

Evaluation. Data collected from teachers and support staff was analyzed for efficacy. Based upon the evaluation of the implementation phase, the design for professional development was revised, and the cycle continued with all teachers across four semesters.

Table 1: *Data Sources for the Developmental Research Cycle for Each Semester*

	Design:	Implementation:	Evaluation:
2010-2011 Semester 1	Data Sources: • Teacher focus groups • Teacher survey • Classroom observations • Discussion groups • Computer lab calendars	Data Sources: • Teacher focus groups • Teacher interviews • Professional development training materials and artifacts • Professional development agendas • Discussion groups • Classroom observations • Anecdotal records	Data Sources: • Anecdotal records • Teacher created artifacts • Discussion groups
2010-2011 Semester 2	Data Sources: • Teacher focus groups • Discussion groups	Data Sources: • Teacher focus groups • Teacher created artifacts • Professional development training materials and artifacts • Professional development agendas • School-wide policies • Discussion groups • Classroom observations	Data Sources: • Teacher interviews • Anecdotal records • Teacher created artifacts • Discussion groups
2011-2012 Semester 1	Data Sources: • Teacher focus groups • Discussion groups • Teacher interviews from spring 2011	Data Sources: • Teacher focus groups • Teacher created artifacts • Professional development training materials and artifacts • Professional development agendas • School-wide policies • Discussion groups • Classroom observations	Data Sources: • Anecdotal records • Teacher created artifacts • Discussion groups
2011-2012 Semester 2	Data Sources: • Teacher focus groups • Classroom observations • Discussion groups	Data Sources: • Teacher focus groups • Teacher interviews • Teacher created artifacts • Professional development training materials and artifacts • Professional development agendas • School-wide policies • Discussion groups • Classroom observations	Data Sources: • Anecdotal records • Teacher survey • Teacher interviews • Teacher created artifacts • Discussion groups

Table 2: WVDE EETT 1:1 Computing Implementation Timeline

2010-2011 Semester 1	All teaching staff will receive a laptop for school use.		
	All teaching staff will receive professional development for 1:1 computing and 21 st century classroom transformation.		
2010-2011 Semester 2 (Implementation Team)	Two sixth grade classrooms (both science teachers) will receive 1:1 computers	Two seventh grade classrooms (English and science) will receive 1:1 computers	Two eighth grade classrooms (English and social studies) will receive 1:1 computers
	All teaching staff will receive professional development for 1:1 computing and 21 st century classroom transformation.		
2011-2012 Semester 1	Two sixth grade classrooms (both math teachers) will receive 1:1 computers	Two seventh grade classroom (social studies and reading) will receive 1:1 computers	One eighth grade classroom (math and science) will receive 1:1 computers
	All teaching staff will receive professional development for 1:1 computing and 21 st century classroom transformation.		
2011-2012 Semester 2	Two sixth grade classrooms (both social studies teachers) will receive 1:1 computers	One seventh grade classroom (math) will receive 1:1 computers	One eighth grade classroom (reading) will receive 1:1 computers
	All teaching staff will receive professional development for 1:1 computing and 21 st century classroom transformation.		

Table 3: *Frequency of Professional Development Sessions by Teaching Teams*

	6 th Grade Teaching Team	7 th Grade Teaching Team	8 th Grade Teaching Team	Related Arts Teaching Team
Fall 2010	• 30-40 minutes once per week during team planning period • Occasional before and after school sessions • ISE sessions	• 30-40 minutes once per week during team planning period • Occasional before and after school sessions • ISE sessions	• 30-40 minutes once per week during team planning period • Occasional before and after school sessions • ISE sessions	• 30-40 minutes every other week during team planning period • Occasional before and after school sessions • ISE sessions
Spring 2011	• 30-40 minutes every other week during team planning period • Occasional before and after school sessions • ISE sessions	• 30-40 minutes every other week during team planning period • Occasional before and after school sessions • ISE sessions	• 30-40 minutes every other week during team planning period • Occasional before and after school sessions • ISE sessions	• 30-40 minutes every other week during team planning period • Occasional before and after school sessions • ISE sessions
Fall 2011	• 30-40 minutes every other week during team planning period • Occasional before and after school sessions • ISE sessions	• 30-40 minutes every other week during team planning period • Occasional before and after school sessions • ISE sessions	• 30-40 minutes every other week during team planning period • Occasional before and after school sessions • ISE sessions	• 30-40 minutes every other week during team planning period • Occasional before and after school sessions • ISE sessions
Spring 2012	• 30-40 minutes once per month during team planning period • Occasional before and after school sessions • ISE sessions	• 30-40 minutes once per month during team planning period • Occasional before and after school sessions • ISE sessions	• 30-40 minutes once per month during team planning period • Occasional before and after school sessions • ISE sessions	• 30-40 minutes once per month during team planning period • Occasional before and after school sessions • ISE sessions

Data Sources and Instruments

To answer the research question, five data sources were used, including teacher surveys, interviews, observations, discussion groups, and artifacts. While all teachers in the school were solicited to complete teacher surveys, record formal interviews, and participate in discussion groups, members of the Implementation Team received much of the focus due to the phased-in nature of the grant. Each of the data sources are described below, as well as data collection procedures and analysis procedures. Table 4 summarizes each data source.

Teacher surveys. Teacher surveys were conducted in an effort to obtain information regarding instructional practices and appropriate professional development. These surveys were administered during the first nine weeks of the 2010-2011 school year and the end of the 2011-2012 school year to all of the school's staff. Electronic surveys were delivered to instructors through the school's learner management system (Edline). Open response questions were used in an effort to gather adequate information. The teachers' survey responses were exported to an Excel file and saved by the date they were collected. Survey responses were analyzed for common themes; each response was coded by theme and then tallied to determine which themes reoccurred most frequently. The surveys included before and after versions of the following questions:

- How do you foresee the laptops being used in your classroom?
- What impact will a classroom set of laptops have on your instructional practices?
- What impact will a classrooms set of laptops have on the rigor and relevance of content?
- What impact will a classrooms set of laptops have on student achievement?
- What will be the impact on your individual classroom culture?
- What obstacles do you see to full implementation of one-to-one computing?

Interviews. Classroom teachers from all grade levels and content areas, (not limited to those providing the first phase of 1:1 computing), were interviewed during the second semester of 2010-2011 and the second semester of 2011-2012 regarding professional development needs and school-wide policies. Formal interviews were recorded and transcribed, while informal discussions were paraphrased in anecdotal notes. Each formal interview was saved electronically as an mp4 file and as a transcribed Word document with the name of the instructor and date of the interview. Much like the survey responses, the interviews were analyzed for common themes; each response was coded by theme and then tallied to determine which themes reoccurred most frequently. Interviews consisted of before and after versions of the following questions:

- What changes will you make to your content delivery in a 1:1 computing environment?
- What changes will you make to your classroom management in 1:1 computing environment?
- On what topics do you feel you need professional development, in order to facilitate a 1:1 computing environment?
- What concerns do you have regarding implementing a 1:1 computing environment in your classroom?

Observations. Formal and informal classroom observations were conducted by the primary researcher, the school's TIS/Academic Coach. Formal observations took place in the classrooms of the teachers from the Implementation Team (the first six teachers to receive classroom sets of laptop computers). The observer took hand-written field notes that were titled with a teacher alias to protect confidentiality. Observations were conducted during the first and second semesters of the 2010-2011 school year, in an effort to discover the following:

- How the laptops are being used within individual classrooms
- What changes have been made to classroom instruction
- What professional development needs to be provided in order to make the content delivery and classroom management more efficient

In addition to observations conducted by the TIS, classroom teachers made observations and provided anecdotal information regarding their individual and school-wide needs. As with the surveys and interviews, observations and anecdotal records were analyzed for recurring themes.

Discussion and Focus groups. Teams of teachers met regularly to discuss professional development and school-wide policy needs. Grade level teams met daily to discuss school and grade-level concerns. The school and county TIS periodically met with the grade level teams in an attempt to better understand their needs. Additionally, members of the school's "Implementation Team," shared key points from the grade level team meetings during regular Implementation Team meetings. The Implementation Team met once per month after school to share their progress and concerns. Anecdotal notes from these meetings were used to guide professional development planning.

Artifacts. Teacher resources used to record or manage a student-centered classroom design were collected. These classroom resources, along with materials from professional development sessions, including agendas and calendars for professional development, were collected and analyzed as to purpose, use, and benefits of each artifact. Additionally, screenshots from teachers' electronic pages on the school's learner management system (LMS) were taken in the spring of 2011 and the spring of 2012 and saved by teacher name and date. The screenshots were later compared to assess the changes in content and activities provided to students electronically.

Table 4: *Data Collection Sources*

RQ: What are the appropriate professional development sessions and instructional design process needed in order to transform traditional classrooms into student-centered 21 st century classrooms?			
Data source	Purpose	Data collection procedures	Data analysis procedures
Teacher surveys	used to shape and guide changes in professional development content and delivery methods	electronic surveys through the school's learner management system (Edline)	surveys were exported to an Excel file, saved by date, and analyzed for recurring themes
Teacher, administrator, & technology staff interviews	used to shape and guide changes in professional development content and delivery methods	audio recorded interviews and informal discussions with the school's instructors, administrators, and technology staff	interview notes and recordings were analyzed for recurring themes
Classroom observations	conducted in an attempt to gain greater understanding of the outcomes	direct observation of classroom structure and management; anecdotal observations were gathered from instructors	observation notes were analyzed for recurring themes across all observations
Teacher discussion and focus groups	used to shape and guide changes in professional development content and delivery methods	group discussions directly observed by researcher or reported on by members of the focus group	discussion notes were analyzed for recurring themes across all groups
Artifacts	collected and analyzed for their effectiveness	teacher lesson plans, posts to learner management system (Edline), graphic organizers to assist classroom transformation, professional development agendas and handouts, TIS calendars	artifacts were analyzed for need, change over time, organization techniques, and other themes may have manifested

Data Collection Timeline

Each data source was collected across both school years. Table 5 visualizes the collection of data during the study period.

Table 5: *Timeline of Data Collection*

Data Source:	Fall 2010	Spring 2011	Fall 2011	Spring 2012
Teacher surveys	September 2010			May 2012
Interviews	Informal--ongoing	Informal--ongoing Formal--May 2011	Informal--ongoing	Informal--ongoing Formal--May 2012
Observations	November 2010	April 2011	November 2011	April 2011
Discussion and focus groups	Monthly Implementation Team meetings Daily grade level team meetings Weekly technology professional development with all grade level teams	Monthly Implementation Team meetings Daily grade level team meetings Bi-weekly technology professional development with all grade level teams	Daily grade level team meetings Bi-weekly technology professional development with all grade level teams	Daily grade level team meetings Monthly technology professional development with all grade level teams
Artifacts	On-going: Collected throughout the year	On-going: Collected throughout the year	On-going: Collected throughout the year	On-going: Collected throughout the year

Limitations of Methodology

The WVDE EETT grant that provided the funding for one-to-one computing dictated a phased-in approach. For this reason, only six teachers were observed implementing one-to-one computing during the first year of this study. Despite this, all staff was provided the same professional development opportunities and many of those who were not on the Implementation Team found it easier to access the school's stationary computer labs with an increase in classroom computers.

Conducting this study in a public school created some additional limitations. The existing schedule created an inequity in the number of professional development session that could be provided to core content teachers and related arts specialists. Fortunately, the related arts teachers were able to meet once per week before school started and received the same professional development opportunities every other week.

Finally, it is important to note that this study required observations in classrooms containing minor children. The observations focused solely on the classroom methods of the classroom instructors. No student names were used in field notes and teacher names were replaced with aliases on hand-written notes to protect confidentiality.

Table 6 itemizes the limitations of the study and the strategies used to address each limitation.

Table 6: *Study limitations and strategies to circumvent*

Limitation	Strategy to Circumvent
Due to the nature of the EETT grant, only six teachers were observed implementing 1:1 computing during the 2010-2011 school year.	- Professional development was provided for all staff members. - Interviews and teacher surveys assisted me in gaining further information and making generalizations to a larger population. - The increase in classroom computers resulted in easier access to the school's computer labs for the rest of the staff.
Unlike the grade level teams (6 th , 7 th , and 8 th grade teachers), the related arts teachers did not have a common team planning period with which to participate in professional development.	- The related arts teachers met before school once per week to discuss school-wide issues. - Related arts teachers were provided with professional development every other week, instead of once per week. - Materials and important information from grade level teams' professional development was posted on the school's learner management system (Edline) for use by the related arts teachers.
As a matter of ethical consideration, it should be noted that observations will be conducted in a classroom of 28-30 minor students.	Confidentiality was maintained throughout the study in order to ensure that no harm would come to the students in the instructors' classrooms.

Summary of Methodology

This design-based action research study allowed the utilization of an instruction design model of design, implementation, and evaluation across four school semesters to improve the professional development provided to teachers in a new one-to-one computing environment.

Data sources collected across all semesters, as well as the initial needs assessment, helped guide changes to the design and implementation phases of the professional development plan.

Chapter IV – Findings

2010-2011 Semester I

Design. While planning professional development during the first semester of the school's transition to one-to-one technology, it was important to keep in mind the overall goal of the project. The teachers, administration, and support staff who served on the grant writing committee had a very clear mission to develop students' 21st century learning and thinking skills. One-to-one technology was merely one tool that they intended to use to achieve that goal. Most of the school staff was aware of that goal and had heard “buzz” words such as “student-centered”, “teacher-as-facilitator”, and “project-based learning” throughout the grant-writing process.

For that reason, it was no surprise to find these and similar phrases appear frequently throughout the initial needs assessment survey conducted in the fall of 2010. According to the initial survey, a large number of teachers in the school found these to be the desired outcomes from the one-to-one transformation. These survey results directly influenced the planning of the professional development sessions for the fall 2010 semester; if teachers were interested in transforming to student-centered classrooms, then professional development would focus on the resources and methods to do so. Table 7 details the most frequent themes emerging from each data source. The frequency of each theme appearing in surveys can be found in Table 11.

The school had an existing structure in which grade-level teams met daily to collaborate in Professional Learning Communities (PLC). Due to the school-day schedule, related arts teachers were only able to meet weekly for PLC meetings. Professional development sessions were designed around this existing structure by providing sessions during PLC meetings once per week for grade-level teams and once every other week for the related arts team. In addition

to the existing PLC meetings, the group of teachers who had been selected as the first in the building to receive classroom sets of laptops, known as the Implementation Team, would meet monthly after school to discuss their progress and needs.

Finally, during the first semester of the two-year transformation, no student laptops were distributed. All full-time teachers were provided with a teacher laptop for professional use to encourage the exploration of resources.

Implementation. During the first meetings with grade-level PLCs, it became apparent that initial understanding from the needs assessment surveys needed to be re-evaluated. While the surveys indicated that an overwhelming number of teachers wanted assistance moving towards constructivist methods, face-to-face meetings with grade-level teams revealed that each team had very different expectations and needs.

As a whole, the eighth grade team felt that they were already exhibiting constructivist teaching methods; all they needed was the laptops to push their methods to the “next level”. The first professional development session was formatted as a discussion group. The results of the needs assessment survey were shared with the team and suggestions for reaching the apparent school-wide goal of student-centered learning were solicited. During this session, members of the eighth grade team continually brought the conversation back around to logistical concerns. They were more interested in how they would rearrange their classrooms and the location of the classroom electrical outlets than discussing teaching methods. Additionally, when asked what needs they had for professional development sessions, among the responses were “student laptop contracts”, “policies for repeat offenders”, and “an easier method to type math symbols”. While all of those topics needed to be discussed, they were not the expected direction for the first meeting.

The seventh grade team seemed to have the most difficulty imagining the transformation. During their first session wherein they were provided with the survey results and suggestions for professional development were solicited, members of the team were non-committal in regards to their needs and desires. Finally, Mrs. Archer¹, a member of the Implementation Team, said “I just need to see it in action. I don’t know what to expect.” At this point other members of the team agreed with her indicating that while they had been hearing about transforming to a one-to-one computing environment and utilizing project-based learning, they were still unsure about what that meant for their classrooms. They could not predict what professional development they needed until they had a better understanding of what it meant to be student-centered.

The first meeting with the sixth grade was the most enlightening in understanding the direction of professional development. Upon sharing the anonymous survey results, Ms. Patel offered that she had been the author of a particular comment and it was a concern that she would like to discuss. On the survey, Ms. Patel expressed a concern that in a one-to-one computing environment, students would have “less social interaction” and that “some cooperative skills may be lost”. This came as a surprise since the overwhelming theme from the survey indicated that most teachers wanted to transform to student-centered projects. In order to better understand her concern, the sixth grade team members were asked to describe the laptop activities they imagined utilizing in their classroom. The majority of the team members described traditional teacher-centered activities that simply replaced paper, pencil, and textbooks with a computer. Some suggestions included “doing worksheets and study guides on the computer to fill in answers”, “typing notes instead of writing them”, “viewing PowerPoints at their seat instead of the front of the room to increase focus”, and “completing writing tasks on a computer instead of

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¹ All names within this text are pseudonyms.

paper”. It was apparent that although this team had heard the school-wide discussion about moving towards a student-centered environment, much like the seventh grade team, they did not understand the impact on their classrooms.

It was apparent that Mrs. Archer was right, they needed to see the results of a transformation in action. However, while Mrs. Archer was simply concerned with seeing one-to-one computing in action, it was more important that the teams see constructivist teaching with some technology integration. For the second professional development session, each team was shown a TED Talk video (2010) in which the presenter, Sugata Mitra, presents a series of problems to a groups of 3-4 elementary aged students. In the video, the students work cooperatively with one computer to solve the problems without any further direction from the adults. Following the viewing of the video, each team discussed the implications in their classrooms. It was at this point that Ms. Patel, the teacher who feared a loss of socialization, interjected “I get it now!” Actually seeing students working collaboratively and aided by technology to solve problems, made the theoretical discussions real to Ms. Patel and the other teachers who needed to see it before they could imagine the changes to their own classrooms.

Professional development sessions for the remainder of the semester focused primarily on introducing the teachers to technology resources and discussing how such resources could be integrated into their individual curriculums. Resources were presented in a hands-on manner. Teachers were expected to bring their teacher laptops to the professional development session and explore the resources that were presented. During each session, time was also provided to discuss their current needs or concerns. Because student laptops would not begin to be distributed until the following semester, it was rare that a need was expressed by anyone who was not on the Implementation Team.

The Implementation Team continued to meet monthly to discuss preparations for the second phase of the laptop implementation. During the second semester, the members of the Implementation Team would receive a classroom set of laptops. Unlike the grade-level team professional development sessions, the Implementation Team meetings were not a time to explore or share resources. Instead, the time was devoted to sharing, discussing, and questioning classroom methods, procedures, expectations, and concerns. While there were two members from each grade level on the Implementation Team, the most vocal members of this committee were both from the eighth grade, one social studies teacher and one English teacher. As such, the conversation was dominated by their grade-level's vision of laptop implementation. Both of the sixth grade members and one of the seventh grade members of the Implementation Team, all three science teachers, shared a similar vision of student collaboration. One member of the committee, Mrs. Archer, was comparatively quiet during the Implementation Team meetings, but appeared to be in agreement with the direction that the committee had taken. A few weeks before the laptops were expected to be placed in the classrooms, Mrs. Archer privately shared some concerns. She was visibly upset and worried because she was uncomfortable with the direction that the Implementation Team had taken. Specifically, all of the other members of the Implementation Team wanted tables in their classrooms to facilitate student collaboration and she wasn't certain that she wanted to give up individual desks. It became clear that as a member of the Implementation Team, she felt pressured to conform to the perceived school-wide expectations. After a one-on-one discussion about her personal vision for her transformed classroom, she came to the realization that she could meet the school-wide expectation of student-centered instruction, while still maintaining her individual teaching beliefs.

Towards the end of the semester, as initial implementation drew closer, each grade-level team was asked to brainstorm a list of procedures and policies that they felt were necessary when using laptops in the classroom. The grade-level lists of expectations were examined by the Implementation Team and edited to create one school-wide set of policies and procedures. The team felt strongly that the expectations should be consistent across all classrooms and grade-levels to ensure that students understood and followed the expectations. In addition to creating clear expectations for the students, this also created guidelines for the staff to follow and provided some security for those teachers who needed to focus on the logistics of implementation.

Evaluation. The end of the first semester marked the end of theoretical implementation. The laptop carts would roll out to six classrooms at the beginning of the following semester. Reflection of the professional development during the first semester began to illustrate what worked for this group of teachers and what needed to be tweaked. Already, it was apparent that collaboration was a necessary for the success of the transformation. All three grade-level teams had begun to share, plan, and discuss outside of weekly professional development sessions. Additionally, teachers were sharing ideas vertically through content area meetings as well. This was particularly true of science and English teachers who often met informally to discuss ideas for activities and lessons.

During the first semester, it became apparent that not everyone had the same vision of transformation. While some needed only reassurance that there were multiple ways to do things, others needed to be shown what 21st century skills looked like. Although it was not in the original plan for professional development, restating the school-wide goals and providing a visual depiction of the final product was necessary. In retrospect, the need to see constructivism

in action actually reinforced the phased-in approach that the school was taking with the laptop implementation. Teachers needed to see others utilizing these tools successfully in order to both understand the school-wide vision and to embrace change in their own classroom.

When designing and envisioning professional development sessions for the first semester, it was expected that the majority of the time would be spent sharing resources and teaching methodology with the teacher-learners. While this was a common occurrence, more time was actually spent discussing logistical concerns, such as classroom arrangement and storage. Looking back, these were necessary components to assuage fears over change and helped provide action steps that teachers could take immediately.

Table 7: *Recurring Themes for Each Data Source during 2010-2011 Semester 1*

Data Source	Recurring Theme(s)
Surveys	1. Student engagement 2. Teacher as facilitator 3. Student-student collaboration 4. Student as researcher 5. Differentiation
Interviews (formal)	None: no formal interviews were conducted during this semester
Interviews (informal/anecdotal)	1. Finding new resources (time) 2. Logistical concerns 3. Policies
Discussion/focus groups	1. Time (locating resources and teacher-teacher collaboration) 2. Logistical concerns 3. Procedures 4. Policies
Observations	1. Student-student collaboration 2. Note-taking 3. Direct instruction 4. Project-based learning
Artifacts	1. Procedures 2. Policies

2010-2011 Semester II

Design. The spring semester of the 2010-2011 school year was the first semester in which teachers received classroom sets of laptop computers. Driven by experiences from the first semester, it was decided that the planned method of professional development delivery would be continued. During the spring semester, grade-level teams would receive professional development every other week and the Implementation Team would continue to meet monthly.

At this point in the school year, policies and procedures were in place for student handling and utilization of the laptops, logistics such as charging stations and room arrangements had been selected, and teacher buy-in appeared to be established. For that reason, the content during professional development sessions was planned around resources and transitioning to project-based learning.

Implementation. Throughout the second semester, professional development sessions were provided with grade-level teams every other week, as planned. During that time, teachers were highly receptive to sessions that allowed them time to explore online resources. As teachers explored resources, discussion naturally occurred among team members. Teachers would be overheard discussing their plans for using the resources presented, suggesting uses to peers, and planning cross-curricular activities using the resources.

The idea of collaborating with peers really began to take hold during the spring semester. Discussions regarding cross-curricular projects and thematic planning began to occur more regularly in the eighth and sixth grade team meetings. Similarly, all three grade levels found that the two teachers on each team who had received classrooms sets of laptops were now considered implementation experts. They were sought out and asked to discuss their experiences regularly

both in and out of grade-level team meetings. As fellow teachers were preparing for their turn with the laptops, they wanted advice from those who had already attempted the transition.

It was during this semester that the level of fear and anxiety was noticeably lowered, thus eliminating the need to discuss logistical concerns during professional development sessions. Teachers saw members of the Implementation Team have success transitioning and began to believe that they were ready to make changes too. Gone also were the concerns over room arrangements and the need for tables to replace desks. Mrs. Archer had proven that she did not need tables to successfully integrate technology, nor did she need to utilize the same classroom arrangement to encourage collaborative learning activities.

The monthly Implementation Team meetings began to change their focus from “What do I need to do to be prepared for one-to-one technology?” to “What do they need to do to be prepared for one-to-one technology?” Team members began reflecting on the changes they had made, both expected and unexpected, to share with the rest of the staff in order to better prepare them to make changes to their content delivery. The overwhelming theme seemed to be time. It was already apparent that they needed time to collaborate and time to explore resources, but the team members stressed that they were unprepared for amount of time necessary to plan and implement projects. While they felt the projects were beneficial and led students to higher level thinking skills, they feared that some of their peers would be turned off to changing their teaching methods once they realized the time commitment to a project.

Evaluation. As the second semester came to an end, participants were interviewed regarding their growth, the changes in their classrooms, and the direction of professional development throughout the past year. Additionally, data was collected from the school’s learner management system to inform how the LMS was being used by teachers throughout the

school. Table 8 details the most frequent themes emerging from each data type collected during the second semester. Table 12 indicates the frequency at which each theme occurred during interviews. The frequency of themes and purposes emerging from the learner management system can be seen in Table 13.

Analysis of the learner management system showed that most teachers in the building were using the LMS to report grades and share resources, such as class notes, with students. A small portion of teachers, primarily those who had begun one-to-one implementation, were utilizing the platform to provide blended delivery through the use of online quizzes, assignments, and discussion boards. There was very little indication from analyzing the teachers' LMS sites that they were using the platform to differentiate or provide opportunities for student collaboration. Examining the platform provided evidence that the teachers who had the capability of blending instruction regularly were willing to do so, but were doing so while modeling traditional classroom techniques; they had not yet embraced the learner management system to deliver student-centered instruction.

Unlike the findings from the LMS, teacher interviews indicated that there was a classroom shift occurring. Multiple teachers indicated that they found differentiation easier in a one-to-one computing environment. Mrs. Scott, a sixth grade science teacher, was particularly excited by this revelation when she noted the following:

It freed me to go from group to group or child to child and be able to talk and actually interact more than had we not had them. There's more of the student taking ownership of their own learning. There's more ease in differentiation. For example, there was one science simulation we were using and I was able to go to different students and sit down and talk with them and let them tell me what they were doing and it was a much better

assessment than I could have gotten paper/pencil or even just reading a lab sheet because as they came up with answers, I could delve further into it. I felt I had a much better, clearer, understanding of what they were understanding or where they were having problems.

Similar experiences were noted by teachers at other grade levels as well. Mrs. Todd, an eighth grade social studies teacher, highlighted the change in her classroom by indicating that students were able to take ownership of their learning:

The classroom culture has changed to where I am no longer the end-all-be-all. I'm now just the facilitator. It has allowed the student to become the teacher, more so than them just believing that everything I say is just the gospel truth.

Another eighth grade teacher, Mrs. Adams, pointed out that as the students became comfortable in a student-centered environment, they began to see the computers as simply another tool to aid their learning and progress. She commented, "They feel more comfortable just going and getting them and pulling them out to do something. It's like having a textbook available in the classroom. It's another resource in the classroom that they feel free to use."

During interviews, teachers also commented on their own growth in regards to their comfort level making such transitions. Mrs. Archer reflected on her concerns and distress during the first semester and stated

I've had to learn to be more flexible and to not worry so much. I think a lot of the things that I worried about, looking back now, they seem silly and I don't really worry about it. If there is something that comes up, I just deal with it and move on. Like dropping a laptop or running out of battery, so many little things that I stressed about, my classroom set up, logistical concerns, all of the little things, planning and day-to-day basics. Things

will happen and it's okay. It's been a learning process, but I think it's just getting better and better and I'm excited for next year.

Mrs. Cooper, a sixth grade teacher, made a similar note about being flexible when she provided the following advice for teachers who would be implementing one-to-one technology for the first time the following semester:

The technology is your tool. It's a way to get to someplace else. It's not the be-all-end-all. Take it in baby steps, because you can build on baby steps and you'll have what you want in the end. You don't have to do it all immediately and think it has to be polish perfect. It's a work in progress.

Finally, the interviews reinforced the belief that collaboration among teachers was both desired and necessary. Throughout the interviews, teachers indicated that having the support of their peers was the greatest piece of the professional development that they were provided. Mrs. Todd summarized this prevailing opinion when she stated, "That was the key to success. Having the time to talk to your co-workers that were going through the same process or those who were about to go through the implementation was essential."

In analyzing the second semester, it is hard not to look at the year as a whole. The first group of teachers who implemented one-to-one computing benefitted greatly from time exploring resources and sharing strategies with peers. This collaboration was necessary during the first semester, before the technology was employed, and throughout the second semester, as teachers began attempting to utilize the technology in their classrooms.

While the second semester proved that teachers were ready to transform their classrooms into student-centered learning environments, it also showed that when it came to online delivery, teachers were still using traditional methods.

Table 8: *Recurring Themes for Each Data Source during 2010-2011 Semester 2*

Data Source	Recurring Theme(s)
Surveys	None: no formal survey responses were solicited during this semester
Interviews (formal)	1. Time (locating resources and teacher-teacher collaboration) 2. Student engagement 3. Differentiation 4. Project-based learning 4. Student as teacher 5. Procedures 5. Teacher flexibility 5. Technical difficulties
Interviews (informal/anecdotal)	1. Logistical concerns 2. Blended delivery 2. Finding new resources (time) 3. Outside professional development
Discussion/focus groups	1. Time (locating resources and teacher-teacher collaboration) 2. Logistical concerns 3. Project-based learning 3. Procedures 4. Differentiation 5. Grading Practices
Observations	1. Student-student collaboration 2. Differentiation 3. Note-taking 3. Direct instruction
Artifacts	1. Grading practices 2. Note-taking 3. Use of LMS for blended learning 4. Procedures

2011-2012 Semester I

Design. As the second year of the study began, experiences and reflections from the previous year drove the professional development plan. Success had been seen through collaboration among teaching teams with regular opportunities to discuss implementation issues and strategies. For that reason, it was determined that grade-level teams would continue to meet with the Technology Integration Specialist (TIS) every other week. The content of the sessions would continue to be driven by staff needs. Previous end of year surveys and other data

collected, indicated that teachers should continue to be exposed to new resources and provided time to explore and collaboratively plan with new resources.

Because teachers seemed to benefit from having laptop implementation modeled through the phased-in approach, it was determined that teachers would continue receiving classroom sets of laptops as a cohort. This semester an additional six teachers were expected to receive laptops.

The six teachers beginning implementation this semester would need support as they began putting into practice the suggested classroom changes. For that reason, it was determined that professional development sessions should continue to encourage cooperative student learning and other constructivist teaching methods.

At the end of the previous year, data indicated that while teachers were shifting their face-to-face classroom teaching methods, they were remaining traditional with online class delivery. During this first semester of the second school year, it would be necessary to revisit the LMS platform during professional development sessions and share suggestions for creating an online student-centered learning environment.

Implementation. The first semester of the second year was plagued with technical difficulties. The second round of laptops received by the school contained faulty wireless cards, causing frequent disconnects from the school's virtual server and in many cases it was impossible for students to log in to the new computers at all. By the time the problem was identified and the new wireless cards were shipped and installed, the semester was almost over. When the laptop carts did finally roll out to their classrooms, a decision had been made to advance the final phase of the implementation and provide laptops to the teachers slated to receive them during this first semester of the year and the second semester of the year.

During this semester many teachers became very frustrated as they tried to change their content delivery, but became distrustful of the technology tools they were asked to utilize. Others showed amazing patience as they assisted the technicians with trials designed to pinpoint the problems and then test the thresholds once a solution was discovered. Whether they were frustrated by the technology or actively testing the limits, all of the teachers were forced to demonstrate the flexibility hinted at during the previous semester. Teachers were heard commenting that they made sure they had a plan A, plan B, and a plan C, because they weren't sure what aspects of the technology would be working each day.

At the start of the semester, several of the grade-level professional development sessions had to be cancelled due to the technical difficulties. Despite this, grade-level teams continued to discuss the school's progress and their concerns during daily meetings. A common occurrence during this time was for a teacher to express his or her frustration over not knowing how to plan a particular unit or lesson because he or she did not know what technology would be available. Typically this frustration led to grade-level conversations providing the teacher with alternative suggestions for lesson ideas. In this way, the technical difficulties and frustration became an impetus for creating collaboration, preparation, and change.

As the semester continued and working laptops were distributed among all of the core content teachers, trust began to replace their frustration and teachers again embraced the use of the laptops. Towards the end of this semester, related arts teachers, who had not been provided with classroom sets of laptops began utilizing the carts during the core teachers' planning periods. Both the physical education teacher and the Spanish teacher began borrowing the laptop carts to integrate technology into their lessons.

Bi-weekly professional development sessions also resumed with the delivery of working laptop carts to the classrooms. Sessions completed at the end of this semester included a review of the blended learning capabilities of the learner management system and new resources that could be utilized in the classroom.

Evaluation. While technical difficulties caused some professional development sessions to be cancelled, those that were offered provided some enlightening information. It was during this semester that all core content teachers were provided with classrooms sets of laptops. For that reason, it was easier to see the effects of the professional development sessions, as they now were being applied by a greater number of teachers.

In the previous two semesters, teachers praised the idea of sharing online resources during professional development sessions. However, during this semester it became clear that providing only one resource during a session should be done so with caution. Teachers began to utilize the resources to the point of overkill. For example, if a new resource was shared with the eighth grade team, it was not unusual for the reading teacher, the science teacher, the social studies teacher, and the English teacher to try it with their classes immediately. This caused the students to burn out on the resource and not want to use it when they were given the option. Additionally, the use of the resource did not appear to be organic to a need; when all of the teachers used it at the same time, use of the resource seemed forced and isolated, and did not demonstrate real-world reasons to use such a resource.

As the semester came to an end, one teacher proved that despite the problematic start to the year, teachers were actually changing their beliefs and their classroom teaching methods. Ms. Patel, the sixth grade teacher who stated during the first semester that students would lose

socialization skills as they completed their worksheets and watched PowerPoints individually at their seats, shared the following:

I can't tell you how much better and richer my teaching is because of those laptops. The kids are focused, tuned in. I am less stressed. When I used them all day, every class was less stressful, calmer; they were on task. I didn't have to motivate them, they were motivated. I also feel like when I use the laptops, the kids' opinion of my abilities is elevated. I love them, even when they are not working! They have changed my teaching for the better.

Ms. Patel went on to explain that she felt she was able to provide higher leveling thinking opportunities for her students due to the inclusion of technology in her classroom. The engagement of her students in the student-centered activities she had given them had created an environment where they were involved in more analysis and evaluation tasks than ever before.

Despite the rocky start to the semester, it provided some informative data. Teachers were still opting to collaborate and learn from one another. A community of learners had emerged that allowed teachers to feel comfortable venting their frustrations, and others comfortable offering suggestions. Additionally, it became apparent that while providing resources was still desired, it needed to be done strategically.

Table 9: *Recurring Themes for Each Data Source during 2011-2012 Semester I*

Data Source	Recurring Theme(s)
Surveys	None: no formal survey responses were solicited during this semester
Interviews (formal)	None: no formal interviews were conducted during this semester
Interviews (informal/anecdotal)	1. Technical difficulties 2. Blended delivery 2. Logistical concerns
Discussion/focus groups	1. Technical difficulties 1. Finding new resources (time) 2. Student ownership of learning 3. Procedures 4. Differentiation
Observations	1. Technical difficulties 2. Blended learning 2. Student as researcher 3. Student as teacher 4. Direct instruction 4. Note-taking
Artifacts	None: themes from meeting agendas and calendars included in discussion groups, observations, and anecdotal notes

2011-2012 Semester II

Design. As the second semester of the second year began, all core content teachers were utilizing one-to-one computing in their classrooms. As such, no teachers in the building were preparing for a transition to one-to-one computing. For this reason, it was no longer necessary to meet every other week and instead professional development sessions were held monthly for grade-level teams. This change in need, combined with reflections from the previous school year and the previous semester, drove the professional development plan.

The previous semester had illustrated a need to reevaluate the method and frequency in which new resources were shared with instructors. While teachers appreciated the introduction to such resources, the sites became overused across multiple content areas. To combat this, professional development sessions would be thematic and include multiple resources to achieve the same objective. For example, one professional development session would focus on

presentation methods, at which time teachers would be introduced to multiple ways that students could present projects.

As with all previous semesters, teachers would be encouraged to share concerns and suggestions during these structured professional development sessions, daily team meetings, and informal collaboration. Given the problems encountered with the equipment during the prior semester, this collaboration had proven to be a necessary component.

Implementation. Unlike the semester before, this final semester of the study was implemented as planned. Grade-level teams met for professional development sessions monthly, while continuing to plan and problem-solve during daily meetings. Collaboration became more organic, as teachers discussed the technology when issues arose or when discoveries were made. Teachers often came to team meetings and stated, “Let me tell you what I learned today...” as an opening to share a shortcut, program, or problem encountered during a class period.

During this semester, professional development sessions became a time for teachers to explore. At the start of the semester, the school took part in a Continuing Education day, which gave the teachers an opportunity to meet by content area, instead of grade levels. At this time, teachers were provided with a database of online resources to explore. Together, the content area teams, explored the sites and offered suggestions to one another for their use. As a follow up to this session, a site was developed on the school’s LMS for teachers to share and suggest resources they discovered with the rest of the staff.

Evaluation. As this semester came to an end, it was necessary to not only look back over the progress made during this portion of the study, but also the project implementation as a whole. At this time, all teachers were asked to complete an online survey regarding their utilization of the laptops in their classrooms, teachers were interviewed regarding laptop use and

professional development sessions, and the learner management system was again analyzed for changes in instructional practices. Table 10 illustrates the most common themes appearing in each of these data sources. Tables 11, 12, and 13 note the frequency of each theme emerging from the surveys, interviews, and LMS analysis, respectively.

Analysis of the learner management system showed that throughout this school year, teachers were using the platform more robustly than the previous school year. While it was no surprise that the most common use of the platform was still for posting grades (after all, every teacher was required to post grades to the LMS), the frequency of usage for blended learning was almost equal to the frequency of usage for posting grades. Teachers across all grade levels, were utilizing the LMS for completing online assignments, taking quizzes, and holding online discussions. Additionally, analysis showed that there was an increase in online student-centered activities. The teachers' LMS sites showed evidence that they were using the platform to encourage project-based learning and student collaboration.

Teachers throughout the building were transforming to student-centered learning and focusing on teaching 21st century skills. Across all three grade levels, teachers in English, reading, social studies, and science regularly provided opportunities for student choice in presentation and research methods. Not all choices were digital, despite having access to laptops in every classroom, students were still given the option to select analog resources; the students were given the freedom to select the best tool for the problem and the tool that best fit their individual learning styles. On the anonymous surveys completed at the end of the semester, teachers commented on the transformation that took place in their classrooms. One teacher stated:

The computers have become just as much a part of the classroom as textbooks or any other learning tool. Students have learned to respect the computers, but also realize they are a learning tool. I feel this gives students a better appreciation for their resources and helps them understand what kind of skills they will need to have to keep up with our ever changing world.

Another teacher pointed out how the transformation in the classroom created an environment where the teacher had become the facilitator of learning, allowing the students to delve deeper into topics, “Instead of dishing out outdated material, I can bring current topics and information into my students' hands. I see evidence of higher level thinking skills (evaluation, analysis, etc.) in their questions and products.”

While the prevailing opinion of these changes were positive, there were some members of the faculty who expressed concern regarding the changes they saw taking place throughout the building. The school's assistant principal feared that transforming middle school classrooms was not the best practice. While she agreed that the students were benefitting from the changes, she stated that “We are setting them up for failure because the way they learn here is not how they will learn in high school or college.” As the purpose of this study is not to determine the level of benefit for the students, but to determine the benefit of the professional development for the teachers' transition, the assistant principal's comment is included only to illustrate that the teachers' beliefs and instructional practices were changing from traditional classroom methods.

As was found in previous semesters, teacher collaboration played a large part in the teacher interview responses. Almost every teacher interviewed commented on the importance of collaborating with peers and having time to explore resources with peers. Mrs. Adams, the

eighth grade science teacher, pointed out that the collaboration and exploration time did not need to be formal professional development sessions in order to be effective:

What has helped me a lot is more of the informal professional development, where if I'm trying to plan a unit out I can go and ask "Help me brainstorm. This is what I want to do, do you have any ideas as to how I can do it?" Sharing with the other science teachers.

The seventh grade science teacher, when we have vertical teaming, we both are one-to-one so she might find resources and I might find resources that she could use and we share them. It's not even necessarily waiting until we have vertical teaming, we're only one room away, so we can share every day, if we want to.

This thought was echoed by many teachers. Having someone with which to share and problem-solve, was a priceless piece of professional development necessary for transitioning classroom teaching methods.

Table 10: *Recurring Themes for Each Data Source during 2011-2012 Semester 2*

Data Source	Recurring Theme(s)
Surveys	1. Technical difficulties 2. Differentiation 3. Student as researcher 4. Student engagement 5. Use of learner management system for blended learning
Interviews (formal)	1. Time (locating resources and teacher-teacher collaboration) 2. Procedures 3. Student engagement 3. Teacher as facilitator 4. Differentiation 4. Specific resource 4. Student-student collaboration
Interviews (informal/anecdotal)	1. Finding new resources (time) 2. Blended delivery
Discussion/focus groups	1. Finding new resources (time) 2. Technical difficulties
Observations	1. Technical difficulties 1. Student-student collaboration 2. Student as researcher 2. Blended learning 3. Differentiation 4. Note-taking
Artifacts	1. Grading practices 2. Use of LMS for blended learning 3. Note-taking 4. Project-based learning 4. Student as researcher

Table 11: *Common Themes from Pre- and Post-surveys*

Pre-Survey Fall 2010		Post-Survey, Spring 2012	
Response Theme	Frequency	Response Theme	Frequency
Student engagement	20	Technical difficulties	17
Teacher as facilitator	15	Differentiation	14
Student-student collaboration	10	Student as researcher	13
Student as researcher	9	Student engagement	11
Differentiation	8	Use of LMS for blended learning	10
Note-taking	7	Grading practices	4
Student ownership of learning	7	Lesson planning	4
Inequity	6	Student as teacher	4
No change will occur	6	Student-student collaboration	4
Project-based learning	6	Teacher as facilitator	4
Student responsibility	6	Depth of student learning	3
Problem-solving	5	Finding new resources (time)	3
Depth of student learning	4	Project-based learning	3
Multi-disciplinary learning	4	Real-world applications	3
Finding new resources (time)	4	Student ownership of learning	3
Student isolation	3	Higher student achievement	2
Teacher buy-in	3	Lack of student computer skills	2
Teacher-teacher collab. (time)	3	Necessity of a back-up plan	2
Textbook resources	3	Teacher flexibility	2
Grading practices	2	Procedures	1
Increased teacher workload	2	Reteach	1
Lesson planning	2	Teacher-teacher collab. (time)	1
Real-world applications	2		
Technology dependent	2		
Lack of teacher control	1		
Logistical concerns	1		
Pressure to improve	1		
Procedures	1		
Reteach	1		
Special education	1		
Student as teacher	1		
Time	1		

Table 12: *Common Themes from Teacher Interviews*

Interviews Spring 2011		Interviews Spring 2012	
Response Theme	Frequency	Response Theme	Frequency
Student engagement	8	Finding new resources (time)	14
Teacher-teacher collab.(time)	8	Teacher-teacher collab. (time)	13
Differentiation	6	Procedures	9
Finding new resources (time)	6	Student engagement	7
Project-based learning	5	Teacher as facilitator	7
Student as teacher	5	Differentiation	5
Procedures	4	Specific resource	5
Teacher flexibility	4	Student-student collaboration	5
Technical difficulties	4	Logistical concerns	4
Depth of student learning	3	Pressure to improve	4
Grading practices	3	Technical difficulties	4
Lesson planning	3	Use of LMS for blended learning	4
Real-world applications	3	Monitoring	3
Student as researcher	3	Student as researcher	3
Higher student achievement	2	Student as teacher	3
Laptop available at all times	2	Outside professional development	2
Logistical concerns	2	Reteach	2
Multi-disciplinary learning	2	Special education	2
Reteach	2	Time management	2
Student ownership of learning	2	Classroom flipping	1
Student-student collaboration	2	Grading practices	1
Use of LMS for blended learning	2	Informal PD	1
Classroom flipping	1	Lack of use in math class	1
Necessity of a back-up plan	1	Necessity of a back-up plan	1
Noise level	1	Noise level	1
Outside professional development	1	PD with content area	1
Special education	1	Project-based learning	1
Specific resource	1	Student achievement	1
Student as teacher	1	Student as behavior manager	1
Student as behavior manager	1		
Student learning styles	1		

Table 13: *Common Themes from Learner Management System*

Learner Management System Spring 2011		Learner Management System Spring 2012	
Response Theme	Frequency	Response Theme	Frequency
Grading practices	17	Grading practices	18
Note-taking	10	Blended learning	15
Blended learning	7	Note-taking	9
Project-based learning	5	Project-based learning	6
Differentiation	1	Student as researcher	6
Student as researcher	1	Student-student collaboration	4
Student-student collaboration	1	Student responsibility	2
Textbook resources	1	Textbook resources	2
		Differentiation	1
		Policies	1

Chapter V – Discussion

Professional Development for Transforming Classrooms

The purpose of this study was to determine the appropriate professional development and design process necessary to transform traditional classrooms into student-centered 21st century classrooms. While the study was conducted utilizing a design-based action research model in which needs assessments and evaluation was done in a cyclic fashion to better inform decisions, when viewed as a single study, recurring themes emerge across all research cycles. For this particular staff, four components of professional development yielded the greatest response: collaboration, modeling, exploration, and choice.

Collaboration. Without question, collaboration was the key to successful transformation at this school. Teachers were given ample opportunity to share through daily team meetings, regular professional development sessions, and informal discussions. Teachers utilized one another to gain knowledge and vent frustrations both before and after implementation of one-to-one computing. Whether the collaboration was done in a structured environment or an informal one, teachers sought out suggestions and solutions. Knowing that other teachers in the building were going through the same transition or had recently transformed their classroom, created a sense of comradery, which allowed for ease in collaboration. As noted in the review of literature, collective participation is a necessary component of professional development. The participants in this study concurred with the findings of Garet, Porter, Desimone, Birman, and Yoon (2001) in citing peer collaboration as a factor for success.

Modeling. In the same way that having others transitioning in the same building provided someone with whom to discuss issues, having someone one else in the same building transitioning their classroom provided the opportunity to see it in action. Similar to the findings

of Brand (1998), noted earlier in the review of literature, teachers in this study who expressed discomfort over changing their teaching styles became much more at ease once they were able to see the results in other classrooms. The school's phased-in approach to classroom laptop implementation assisted greatly in this regard. By allowing a small group of teachers to take the lead and then adding additional classroom teachers each semester, those not selected to be among the first cohort to change had the opportunity to learn from their predecessors.

Exploration. Providing time for teachers to be exposed to new ideas and resources is a necessary component to facilitating change in instruction. However, exposure is not enough. Exploration of resources should be done hand-in-hand with collaboration. Teachers need to have the opportunity to discuss how they can utilize new resources within their curriculum and teaching methods. Teachers can benefit from discussion among instructors who are teaching the same grade or those who are teaching the same content. No matter the manner in which the exploration occurs, it should be done in regards to how to best utilize new tools and ideas in the existing curriculum.

Choice. In this study, teachers benefitted from having many resources from which to choose. When choices were limited, teachers were forced to select the same tools, stifling classroom creativity, creating learner burnout, and not allowing for real-world problem-solving. Once teachers had a robust "toolbox" from which to select resources, they began sharing multiple resources with students, and eventually allowing students to choose the best tool for each task. Providing teachers with many resource options meant students were given the opportunity to embrace 21st century skills.

In her interview at the end of the second year, Ms. Patel described the importance of all four of these components on her professional development during the two-year implementation cycle:

The most helpful thing, I think, was from (Mrs. Scott) and (Mrs. Cooper) because they had gotten their feet wet. They were the experimental guinea pigs. So when I was not sure how to do this or that, I would go to them “How do you do this? How do you do that?” Talking with other teachers about how things worked, that helped a lot.

Oh, that time we were in (Mrs. Todd)’s room, and we had a chance to just go through that plethora of sites. You know, “Look at this. Look at that. That’s what you need.” You need time to experiment and plus somebody there as a guide, “Go here. Go there. Try this. Try that.” That was very helpful and I used a lot of things that popped up there. At the time I thought, well, even if I don’t know how to use that, I had a handle on it so that I could explore it a little bit more. That time to be able to explore is priceless. Time to explore in a group. Plus it was another one of those things where someone said “Try such and such site.” or “So and so, I know you do a unit on this.” or “You teach that, this is something you can use.” Having other teachers in that room at the same time was really helpful.

Design-Based Action Research

The design-based action research structure of this study greatly supported the learning of the teachers. Teachers benefited from fact that professional development sessions were planned and selected based on an instructional design model of needs assessment, design, implementation, and evaluation. By analyzing an initial needs assessment and evaluating the implementation in four cycles across two years, the professional development sessions were able

to be tailored to the needs of this particular staff. As noted in the review of literature, Opfer and Pedder (2011) pointed out that the professional activities that work with one staff will not necessarily work with a different staff. Through the utilization of the instructional design model, successful professional development for this staff was able to be determined and improved upon.

Limitations

This study was limited to one middle school with teachers who had already expressed an interest in transitioning their traditional classrooms to 21st century classrooms; for this staff, the “buy-in” was already present. As stated, future initiatives may be able to circumvent this limitation by completing a needs assessment prior to implementation and establishing clear goals throughout the building. Utilizing the cyclical instructional design model of needs assessment, design, implementation, and evaluation may also assist in ensuring professional development sessions fully meet the needs of the unique staff. A diagram of the proposed instructional design model can be seen in figure 1.

Additionally, the thoughts of the assistant principal in this study should not be completely overlooked. Her concern that middle school students were provided instruction using constructivist strategies, but would be expected to learn via traditional methods in high school may have merit. Research on student flexibility in classrooms of varied teaching methods may be an area for future study.

Implications for Policy

As schools, school districts, and states begin to transition to one-to-one computing to better enable the delivery of 21st century skills, it is tempting to think that providing laptops to every student will create environments where such skills will thrive. Hardware alone cannot provide students with the skills necessary for the future. Teachers must be provided with the

professional development necessary to effectively transition their teaching practices to environments which nurture student problem-solving, cooperation, and higher level thinking.

In addition to the necessity of professional development, this study indicates that large scale initiatives should be completed in design phases for optimal success. The instructional design model utilized in this study, a cyclical model of needs assessment, design, implementation, and evaluation, may allow implementation to be tailored to the specific needs of a school's staff (see figure 1). While it may be tempting to create a "one-size-fits-all" professional development plan for a school, school-district, or state, the varied needs of each school staff can be considered and met through the use of this instructional design model, while still meeting the large-scale goals of the state or school district.

Finally, as suggested by Muir-Herzig (2004) and Brand (1998), the availability of an on-site Technology Integration Specialist (TIS) was instrumental in offering professional development and support to the staff as they transitioned their teaching methodologies. The school-level TIS in this study was able to utilize the instructional design model to effectively tailor the professional development to the needs of the school staff. Providing support personnel to design, implement, and evaluate professional development is a necessary aspect of transitioning traditional classrooms to 21st century classrooms.

Discussion Summary

For the school participating in this study, the developmental cycle allowed professional development to be tailored across four semesters to meet the teachers' needs. Specifically, this study found that those needs included time for collaboration, opportunities to explore resources, choices for instructional delivery, and a phased-in approach which allowed modeling to occur.

When transitioning from traditional classrooms to 21st century classrooms, the needs of each staff will be unique. Utilizing a cyclical instructional design model of needs assessment, design, implementation, and evaluation allows the needs of each staff to fully inform the professional development sessions.

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Appendices

Appendix A: Data Sources

RQ: What are the appropriate professional development sessions and instructional design process needed in order to transform traditional classrooms into student-centered 21 st century classrooms?			
Data source	Purpose	Data collection procedures	Data analysis procedures
Teacher surveys	used to shape and guide changes in professional development content and delivery methods	electronic surveys through the school's learner management system (Edline)	surveys were exported to an Excel file, saved by date, and analyzed for recurring themes
Teacher, administrator, & technology staff interviews	used to shape and guide changes in professional development content and delivery methods	audio recorded interviews and informal discussions with the school's instructors, administrators, and technology staff	interview transcripts were analyzed for recurring themes
Classroom observations	conducted in an attempt to gain greater understanding of the outcomes	direct observation of classroom structure and management; anecdotal observations were gathered from instructors	observation notes were analyzed for recurring themes
Teacher discussion and focus groups	used to shape and guide changes in professional development content and delivery methods	group discussions directly observed by researcher or reported on by members of the focus group	discussion notes were analyzed for recurring themes across all groups
Artifacts	collected and analyzed for their effectiveness	teacher lesson plans, posts to learner management system (Edline), graphic organizers to assist classroom transformation, professional development agendas and handouts, school and classroom policies	artifacts were analyzed for need, change over time, organization techniques, and other themes may have manifested

Appendix B: Sample from Teacher Surveys

Teacher surveys were completed in the fall of 2010 and the spring of 2012. The initial survey served as the school's needs assessment. Surveys were distributed and collected electronically. Completed surveys were exported to an Excel spreadsheet. Teacher responses were analyzed for recurring themes. Such themes were noted using Microsoft's comment feature and tallied for frequency.

The sample below indicates the question, teacher responses, and coding used for teacher surveys completed in the fall of 2010.

Submitter ID	How do you foresee the laptops being used in your classroom?	
1	Hopefully we will be able to access the book website when having trouble with certain concepts or when trying to set up various word problems. Also, I hope to be able to have the daily notes right in front of the students as well as the quizzes and reviews.	Comment [M1]: Textbook resources
2	Researching background information at the beginning of a unit and when completing lab activities. Students can access copies of my notes, keep their notes and a journal log in their student folders	Comment [M2]: Note-taking Comment [M3]: Student as researcher
3	Laptops in the classroom would be used for project based learning in my classroom. I would hope for different outcomes from different groups of students because they were being given a problem to solve yet several different resources to use yet all would come to understanding our world better because of it. Much more could be done with computer access for each student.	Comment [M4]: Note-taking Comment [M5]: Project-based learning
4	Many of my special education students have trouble keeping their attention on task. I hope that with the use of the computers, they will be able to focus on their own learning rather than those of others. Another weakness for my sp. ed. students includes abstract thought. I am hopeful that using the computers as a tool will create a more concrete/visual learning environment.	Comment [M6]: Differentiation Comment [M7]: Special Education students Comment [M8]: Student ownership of learning
5	I see the laptops as being used to help my students visually see how a problem is being worked out for them.	
6	I foresee group work, research, and project-based learning. I see the teacher as the facilitator, not as the moving mouth the entire period.	Comment [M9]: Student as researcher
7	For story publication information gathering and searching (research) web site games/reinforcement activities blogs shared story writing evaluating written materials/debates	Comment [M10]: Project-based learning Comment [M11]: Teacher as facilitator Comment [M12]: Student as researcher
8	I see my laptops in my classroom being used as a way for students to self-learn and go at their own pace. Once of the problems I'm finding is that one class has an assortment of learners at different levels. My hope is to use my laptops in a way that will allow my students to progress at their own pace and see a more substantial improvement. I would facilitate the room and allow students to problem-solve for themselves with my guidance and support.	Comment [M13]: Differentiation Comment [M14]: Teacher as facilitator
9	Students will have the opportunity to complete assignments, research, and problem solving activities that are specifically designed to meet individual ability levels.	Comment [M15]: Student as researcher
10	Students will receive problems, such as a food borne illness and can as individuals or small groups research the types of illnesses.	Comment [M16]: Problem-solving
11	I see a student-centered classroom. Teacher is facilitator and NOT the "giver of ALL knowledge". I feel 1:1 is the best place for "discovery" learning to take place which is what science is all about. I see more student-centered communication...and the teacher circulating around the classroom touching base with students and helping when needed but otherwise the students are "in charge".	Comment [M17]: Differentiation Comment [M18]: Student as researcher Comment [M19]: Teacher as facilitator Comment [M20]: Student ownership of learning
12	I. I would like to see students able to work on the computer to solve in-class problems and then show/explain solutions on the whiteboard, without leaving their seats. a. laptops connected to whiteboard b. 4 mobile presenters around room c. a way to use math symbols w/o having to use equation editor II. Problem solving projects for group work once or twice a week III. Competition type sites/problems/games	Comment [M21]: Problem-solving
13	I plan to use my laptops in a PBL situations that are cross-curricular. I want to become the facilitator of knowledge.	Comment [M22]: Project-based learning
14	As tools for learning. As doors to other experiences. As devices to extend literacy. I could go on and on with various metaphors/similes for laptops in the classroom.	Comment [M23]: Multi-disciplinary learning
15	access online textbook and extra features online that come with the textbook. projects	Comment [M24]: Teacher as facilitator
16	I can see the students taking notes on them, doing research, creating projects, making videos, and learning lesson interactively.	Comment [M25]: Textbook resources
17	One way that laptops can be used in my classroom is for interactive websites that I project on my Intelliboard. Students can perform the activity on their personal laptops instead of using time to let students take turns on the Intelliboard.	Comment [M26]: Note-taking Comment [M27]: Student as researcher
18	I hope to implement project based lessons that will be assisted with the use of the laptop.	Comment [M28]: Project-based learning
19	ENGLISH CLASS: ALL WRITING WILL BE CONVERTED FROM PAPER PENCIL TO COMPUTER. SOC STUDIES: GUIDES, NOTES COMPLETED WITHOUT PAPER POWER POINTS, WHITE BOARD MATERIALS PUT ON LAP TOPS AS WELL AS PROJECTED ON WALL ACUITY BENCH MARK TESTING AND LESSONS DONE ON LAPTOPS.	Comment [M29]: Note-taking
20	The subject that you teach will have an impact on how to utilize the laptops in the classroom. For Math- Having the accessibility to note taking is a must! I would use the laptops as a note taking tool. Notes could be saved and easily recovered. Accessing textbooks online as well as utilizing powerpoints to reteach critical skills. Daily during independent practice would be helpful. Other possibilities would include educational math sites that would enhance mathematical skills. Ex. Right now many 6th graders don't know multiplication tables. Timed quizzes online may help in this situation. English/Language Arts- How wonderful to access WV Writes, Plato and similar sites in the classroom as compared to traveling to a lab. Keeping a daily writing journal would enhance keyboarding skills for the Writing Assessment.	Comment [M30]: Note-taking Comment [M31]: Textbook resources Comment [M32]: Reteach
21	I can see the laptops being used in various writing activities and with projects, but not necessarily as a tool that will be used on a daily bases.	

Submitter ID	What will be the impact on teachers' instructional practices?	
1	I will definitely have to change my way of teaching from whole class instruction with some individual class participation to the majority of individual class participation.	Comment [M33]: Differentiation
2	When completing lab activities, I frequently include a paragraph in the lab instructions providing background information, with laptops, the students could quickly do their own research and discuss what they have discovered about the topic of the lab.	Comment [M34]: Student as researcher
3	Teacher as facilitator has always been a standard. Instructional practices would now have to include a better teacher knowledge base of technology and a willingness to be a continual learner.	Comment [M35]: Teacher as facilitator
4	As we are introduced to a new way of teaching, we will rely on each other for advice/guidance/suggestions for best instructional practices. We'll all be in the same boat, so we must be able to try something new and report back to others what has worked and what has not worked.	Comment [M36]: Pressure to improve
5	It will make it easier for me if a student misses a day of notes because it will be easy to e-mail them the notes at the start of class so they are not behind the rest of the class.	Comment [M37]: Teacher-teacher collaboration
6	I feel that my instructional practices will need to be adjusted quite a bit in order to incorporate the laptops into my classroom. Some things will remain the same, but I believe that my planning will be more focused on discovery learning and letting the students have more freedom to "run with the content."	Comment [M38]: Note-taking
7	to reinforce or enrichment classroom CSO's and not to add to the workload (to enhance)I want it to truly benefit the lesson and not just do something to do it.	Comment [M39]: Student ownership of learning
8	Instructional practices will need to be more project and problem solving-based. Teachers will not lecture and students take notes off a PowerPoint; students will have more opportunities to learn how to use technology in a way that supports their learning.	Comment [M40]: Project-based learning
9	There will be less lecture/teacher directed instruction and more student/learner based self-paced instruction.	Comment [M41]: Teacher as facilitator
10	More student hands-on experiences, and less teacher talking.	Comment [M42]: Differentiation
11	Teacher instructional practices will have to become more student-centered and teachers will have to be willing to give up control of their classroom and to open up to making mistakes. We all can learn from our mistakes... teachers and students alike.	Comment [M43]: Teacher as facilitator
12	Since I've always had students actively involved in every lesson, I'm not sure how that would change. My goal would still be to be the facilitator rather than the "giver of all knowledge." By the way, this is not new educational psycho-babble. I have articles that I wrote 15-20 years ago using the same words. It will definitely be more time consuming for me to be sure that students are not only doing problem solving, but also continue to build their toolbox of tools/skills.	Comment [M44]: Teacher as facilitator
13	The use of laptops will change the role of the teacher in the classroom and thus change instructional practices that will best meet the needs of the students.	Comment [M45]: No change
14	It will greatly change the way I plan and facilitate learning, now that access will be at student finger tips. I will now be able to plan more active learning experiences for my students, which will naturally depend upon more collaborations and problem solving. Opportunities for student and teacher collaboration are endless and have yet to be dreamed.	Comment [M46]: Teacher as facilitator
15	less direct instruction, more responsibility on students.	Comment [M47]: Teacher as facilitator
16	My instructional practices would not change overnight. I would start slow and add new items or change parts of lessons as I would go. I would find what works and what does not work and make the changes.	Comment [M48]: Teacher as facilitator
17	I manipulate technology in a lot of my teaching already, so I believe I will be able to incorporate laptops for my students with ease, not much direct impact on my instructional practices. I believe it will make more time for things to be accomplished in one class session because students won't be wasting valuable time walking to and from the board. (That time adds up!)	Comment [M49]: Student-student collaboration
18	The delivery of the curriculum will be enhanced by opening opportunities for students to learn beyond just paper and pencil and without limitations within the classroom.	Comment [M50]: Student-teacher collaboration
19	I WILL NEED TO SPEND MORE OF MY TIME CHECKING DROP BOX TO GIVE FEEDBACK TO STUDENTS' WORK.	Comment [M51]: Teacher as facilitator
20	Teacher's instructional practices would need to be modified at times. Delivery could be the same at times but a more hands-on lesson would be available using laptops.	Comment [M52]: Student ownership of learning
21	Given more freedom with the use of technology, but also adding to the demands that are always being added to teachers' jobs.	Comment [M53]: Lesson planning
		Comment [M54]: No change
		Comment [M55]: Grading practices
		Comment [M56]: Increased teacher workload

Submitter ID	What will be the impact on the content and rigor of curriculum and instruction?	
1	Hopefully students will be able to grasp concepts better using something they have grown up with and are familiar with.	
2	The content should be the same, but hopefully we would be able to make it more rigorous and relevant.	Comment [M57]: Depth of student learning
3	Hopefully students will have more time and ample opportunity to participate in more complex skills.	Comment [M58]: Problem-solving
4	Easy access to the computer at school AND at home will allow students to work with the necessary tools outside of the school setting.	Comment [M59]: Real-world applications
5	It will help the students understand how to solve harder problems and hopefully make the content more clear to the students.	Comment [M60]: Student responsibility
6	I think that more content standards will be covered at once, and then within that, will need to be broken down individually (mini lessons, etc.).	Comment [M61]: Multi-disciplinary learning
7	to remain true to the CSO's, yet to bring it to real life situations and more relevant to today's student.	Comment [M62]: Teacher-teacher collaboration
8	I think the content will progress in a way that will enhance every child's learning-- as long as they have the ambition to work hard and correctly with this 1:1 computing.	Comment [M63]: Real-world applications
9	There will be an opportunity for more cross-curricular collaboration with teachers from other content areas. This will provide students an opportunity to see how practices are utilized in real-world situations.	Comment [M64]: No change
10	Content and CSO lessons will remain the same.	Comment [M65]: Multi-disciplinary learning
11	1:1 will make it easier to recover the content needed because...at least for science...true integration of different areas can take place. Rigor will definitely increase.	Comment [M66]: Depth of student learning
12	In mathematics, I will monitor closely to be sure that the impact will indeed be positive. My goal would be to keep rigor at a high level and even increase in-depth understanding and application.	Comment [M67]: Depth of student learning
13	I feel that the content will be impacted greatly and this will allow students to learn to apply, adapt, and interpret information. This in turn will help them prepare for a future where their problem solving skills will be greatly needed.	Comment [M68]: Problem-solving
14	Rigor will increase. A natural by-product. More big picture and cross-curricular connections. Extended learning.	Comment [M69]: Multi-disciplinary learning
15	less rigor for teacher, no change in content just delivered differently.	Comment [M70]: No change
16	The content would not change but how I deliver the content would. I can see the students making the instruction more meaningful than as they create projects that help each other learn.	
17	The impact on the content would be positive because the students will have so much more access to great resources online. Some students don't have computers/internet at home so this may be their only exposure. Curriculum will be taught in the same way, however, I believe I will be able to relay the information easier because each student will be engaged with his/her own laptop rather than pulling for their attention to be completely focused on the Intelliboard for the entire class period.	Comment [M71]: Student engagement
18	The content rigor will be greater because the students will be completing learning tasks that require multiple steps to complete.	Comment [M72]: Student isolation
19	STUDENTS WILL BECOME MORE RESPONSIBLE INDIVIDUALLY RATHER THAN "WHOLE CLASS" DYNAMICS. THERE WILL BE MORE INDEPENDENT WORKING SKILLS NEEDED. RATHER THAN KIDS "VEGGING" OUT IN CLASS. THEY WILL EACH BE INTERACTIVELY INVOLVED.	
20	Content and Curriculum would not change. The CSO's would need to be followed and required skills taught.	Comment [M73]: No change
21	The expansion of research based projects.	Comment [M74]: Student as researcher

Submitter ID	What will be the impact on student achievement?	
1	Hopefully the impact will be significant with student achievement and understanding. Perhaps assessment will be easier.	Comment [M75]: Grading practices
2	Hopefully, there will be increase student engagement which should result in higher achievement.	Comment [M76]: Student engagement
3	Students would be better prepared to participate in today's economy and culture with skills that they acquire. Hopefully achievement would improve.	
4	The consistent availability of resources will allow students to achieve success in the classroom. They will be working toward an individual goal at their own pace.	Comment [M77]: New resources Comment [M78]: Differentiation
5	Hopefully it will help the students understand the content better which will lead to better grades.	
6	I feel that the students achieve more when we are at the lab, because they are more comfortable with the technology, and are therefore more willing to complete the lesson activities.	Comment [M79]: Student engagement
7	more confidence on the computer higher achievement basic and more indepth skills conquered	Comment [M80]: Depth of student learning
8	Hopefully, with this integration of technology, students will have more of an intrinsic motivation. Perhaps they will become more involved in what they are learning and take more leadership in the classroom.	Comment [M81]: Student engagement Comment [M82]: Student ownership of learning
9	Hopefully, students will have a more personal desire to succeed since they are more in control of their own learning.	Comment [M83]: Student ownership of learning
10	Students that are skilled in self control and self motivation and are fast readers will achieve at a higher level.	Comment [M84]: Inequity
11	Student achievement will increase and I think it will increase much faster than most think it will.	Comment [M85]: No change
12	Our students will continue to be successful in math.	
13	The sky is the limit, but essentially we will be preparing for the workplace of the future, one we cannot even fathom at this time. I think we will see a drop in scores and then a gain after we have our practices in place and allow ourselves some time to change the way we currently teach.	
14	It should rose. Barriers should become more active, collaborative, and internalized.	Comment [M86]: Student engagement
15	some may struggle, others may shine	
16	I would think that the student achievement would get better. The students like to use technology and if they are happy at school then hopefully they will learn more and do better.	Comment [M87]: Student engagement
17	Student achievement will increase due to engaging activities and curriculum that computers provide. Students may find educational sites that they like through the Teacher's curriculum and it's hopeful that they may continue using these sites at home.	Comment [M88]: Student engagement
18	I think and hope that it will raise because students will be more motivated to complete assignments with the technology readily available.	
19	MORE 21ST CENTURY SKILLS PREP.	
20	I would hope that student achievement would soar.	
21	Students will be able to research and access information they need, think outside the box in exploring ideas and have the ability to complete task quicker. Students will become more dependent on technology to function in their everyday lives. Students will become more dependent on technology and less able to function without it. This might not seem so bad, but technology is a thing, not a mind and if the "thing" is not available the mind needs to be able to retrieve information. Who is going to build our houses if they can't read the plans or know if one ' (mark) stands for feet or inches, or other basic facts. You general laborers do not carry or use computers as their tools and we must have people in that area of our work force. Computers can not replace them.	Comment [M89]: Student as researcher Comment [M90]: Technology dependent

Submitter ID	What will be the impact on school culture?	
1	I think students may gain confidence and apply their knowledge more on a computer as opposed to being verbal to the whole class.	Comment [M91]: Student engagement
2	We should have fewer behavior problems as students become more involved and more successful.	Comment [M92]: Student isolation
3	School culture will change in that some students will take this opportunity seriously and bring more to the table than previously. It is necessary to think about students who don't have the economic opportunities also. Here's hoping that it doesn't create a culture of haves versus have nots.	Comment [M93]: Student engagement Comment [M94]: Inequity
4	Technology will be a huge impact on the school. Students will not only be responsible for books and planners, but they will also be responsible for a laptop. This is a huge responsibility for a 6th grader.	Comment [M95]: Student responsibility
5	It may help combine all the cultures in the school because students may have an easier way to interact with each other and help all of us understand someone else's culture.	Comment [M96]: Student-student collaboration
6	The culture of the school may change as students are surrounded by the "tech savvy" background of each class.	
7	I don't know.	
8	I think many of the behavior issues in class are due to the fact that students do not want to be in school. If we can use technology to make learning interesting for them, misbehaviors will show less and less, ultimately creating a more positive culture for our school.	Comment [M97]: Student engagement
9	Students may be more willing to share their findings and experiences with their peers.	Comment [M98]: Student engagement
10	A positive attitude and increased respect within the community.	Comment [M99]: Student-student collaboration
11	School culture will become more open. It will also become more social but in a good way since students who normally would not interact in front of others will do so more when it is not an actual face-to-face situation.	Comment [M100]: Student-student collaboration
12	There will be a spike in student participation until the novelty wears off. But I am not being negative. This will level off and students will be able to achieve much more than in the past by having the technology in each classroom. Teachers will become more creative. Students will become more creative.	Comment [M101]: Student engagement
13	Everything will change. I think we will see the students become more engaged and they will become the teachers. We will be a guide instead of the end all, be all to the classroom.	Comment [M102]: Student engagement
14	Students will be able to approach things at school as they do at home (for the most part). The culture will be more collaborative, extended, etc.	Comment [M103]: Student as teacher
15	may become too dependent on technology	Comment [M104]: Teacher as facilitator
16	The school culture should change. The school will be filled with high tech learners. I would think that the students will be better problem solvers. Also, there should be people that are comfortable with computers and being able to use them as tools for learning.	Comment [M105]: Student-student collaboration
17	I believe this will have a great impact on the school culture. Students will become more responsible and take pride in the benefit of having their own laptop.	Comment [M106]: Technology dependent
18	Teachers and students will need to be flexible. We will need to emphasize the importance in using technology appropriately in today's world.	Comment [M107]: Problem-solving
19	LESS SOCIAL INTERACTION... SOME COOPERATIVE SKILLS MAY BE LOST.	Comment [M108]: Teacher flexibility
20	School culture would grow in all areas. Students would gain a sense of pride about the grant and laptops. They would begin to gain an understanding of responsibility. Excitement would enhance learning daily because of the many different, new techniques that would be utilized in the classroom.	Comment [M109]: Student responsibility Comment [M110]: Student isolation
21	Uncertain whether it will lessen or cause a greater divide among students.	Comment [M111]: Student engagement Comment [M112]: Inequity

Submitter ID	What will be the impact on your individual classroom culture?	
1	I can check individual performance perhaps more closely by monitoring student progress on the computer. Most students will be more apt to type answers or opinions rather than write them out.	Comment [M113]: Differentiation
2	Students will become less dependent on me for the answers and realize that they can all contribute. Hopefully, everyone including the quiet ones will find their voice.	Comment [M114]: Teacher as facilitator
3	Globally expanding in the classroom and cooperating in the classroom also.	Comment [M115]: Student-student collaboration
4	More interactive learning in the resource room.	
5	I think it will connect the students more to one another and they will become more familiar with one another. They will be able to understand each other better if it is hard to understand someone in the classroom.	
6	I hope that my individual classroom culture will reflect a team-like atmosphere where everyone knows that their input is valued. Rules will be even more important as students take on leadership roles.	Comment [M116]: Student-student collaboration
7	positive learning hands-on (one-on-one computing) motivational	Comment [M117]: Procedures
8	Students will take more action and leadership roles. I hope to see more engagement from my students, and they will be more attentive to the material being covered in class. I see students being able to use more of their individual talents to enhance student projects and other instructional activities with this 1:1 computing.	Comment [M118]: Student engagement
9	Students will be less intimidated to answer questions.	Comment [M119]: Student ownership of learning
10	Student involvement will take on a new meaning.	Comment [M120]: Student engagement
11	My individual classroom culture will become a true global culture with more acceptance of each other and empathy and tolerance for others increasing.	Comment [M121]: Differentiation
12	Please see number 1.	Comment [M122]: Student engagement
13	PBL learning with the teacher as a facilitator and the students as leaders.	Comment [M123]: Student engagement
14	Addressed in other items.	Comment [M124]: Student-student collaboration
15	I will use technology more if it is available for my use.	Comment [M125]: Project-based learning
16	I think the classroom will change as I change. If I am slow to develop lessons that incorporate the new technology, the students will be slow to accept it as part of the classroom. I want my classroom culture to remain similar but have a new flare to it. I can see more computer based projects and depending on software available, maybe new ways to teach the same old concepts.	Comment [M126]: Teacher as facilitator
17	Students will feel very responsible and will feel more "mature" in technology. My classroom will be even more inviting for students because instead of 3 PCs, each student will have a laptop they can call "their own."	Comment [M127]: Lesson planning
18	I will need to be flexible as well as my students.	Comment [M128]: Student engagement
19	LESS TEACHER CONTROL OF EVERY MOMENT IN THE CLASS	Comment [M129]: Teacher flexibility
20	Continued excitement daily with each new lesson. A sense of pride and accomplishment at times when students may take a lead in instruction as they begin to teach classroom teachers new ways of utilizing the technology in the classroom.	Comment [M130]: Lack of teacher control
21	Availability of resources. Students sharing information and being in touch globally.	Comment [M131]: Student engagement
		Comment [M132]: New resources
		Comment [M133]: Student-student collaboration

Submitter ID	What obstacles do you see to full implementation of 1:1 computing?	
1	I am worried that student will try to get out of showing work more in math if they do everything on the computer. I am a believer in paper and pencil work for students to check for understanding. I also believe note taking is a very important part of success in college and I fear that too much computer usage may detract from that.	Comment [M134]: Note-taking
2	Trying to fit it into the curriculum and having it supplement not replace any of the CSOs	Comment [M135]: Increased teacher workload
3	Cooperation in sharing our resources and ability to use the technology effectively as quickly as possible.	Comment [M136]: Teacher-teacher collaboration
4	How will students be responsible for a laptop?	Comment [M137]: Student responsibility
5	The obstacles can be how are the laptops going to be monitored during the class time to make sure all the students are on task and not searching the web or chatting with each other over the laptops. Also in a mathematics class it could be hard for some students to visually see like the others.	Comment [M138]: Student responsibility
6	Monitoring student behavior and website usage is a concern that I have, especially if programs like AB tutor are not available on the laptops.	Comment [M139]: Student responsibility
7	Just knowing what is out there to do I'll need ideas and training/playtime to work with the programs I like to be prepared and I will not be able to teach and stay sane if I don't know what I am doing or if I worry about a method or activity all night.	Comment [M140]: New resources
8	I worry about students at the middle school level being able to take care of a laptop, especially if computers are going to be sent home. I think with anything new, we will find more obstacles as we start this journey.	Comment [M141]: Student responsibility
9	Lack of Internet access for some students at home	Comment [M142]: Inequity
10	All must be committed to learning and experimenting.	Comment [M143]: Teacher buy-in
11	Obstacles... Access at home when students want to continue their learning at home. There are more students without access than most would like to believe. Teachers themselves will become an obstacle in cases of those who will not be willing to "let go" of some of the control in their own classroom. Teachers will have to be much more open to change and learning and this will be difficult for some.	Comment [M144]: Inequity Comment [M145]: Teacher buy-in
12	I will address math only. Hardware- laptops connected to whiteboard or multiple mobile presenters Software - something better than equation editor or the ability to "write" directly on the laptop	Comment [M146]: New resources
13	Time is my main concern.	Comment [M147]: Time
14	Space, electricity, classroom size (numbers of students) etc. More physical in nature.	Comment [M148]: Logistical concerns/physical space
15	its availability to everyone and all classrooms	Comment [M149]: Inequity
16	I can see teachers not embracing the implementation to its fullest extent. Some teachers may use the computers but are still teaching, just from the online book. I can see where it would be hard to create meaningful lessons everyday that use the computers. I can also see people being frustrated with students still acting the same way.	Comment [M150]: Teacher buy-in
17	I see special education students having a tough time traveling with laptops (if that happens) and remembering to save information daily so nothing gets "lost."	Comment [M151]: Student responsibility
18	I think that an obstacle will be to overcome fear. I also think that taking on too much too fast can be detrimental.	
19	SPACE FOR COMPUTER STORAGE. SERVER BAND WIDTH INSUFFICIENT. QUICKLY OUTDATED SOFTWARE BECOMING OBSOLETE. Space, storage, safety, responsibility, outlets for computers that are not fully charged?????	Comment [M152]: Logistical concerns/physical space
20	Laptop carrying cases would be allowed to transport equipment from class to class and school to home. Adequate plan time to restructure lessons that would be enhanced using the computers. Sharing links, sites etc... through a blog with other staff would help introduce new ideas. Time and ability to monitor what students are doing on the computers.	Comment [M153]: Student responsibility Comment [M154]: Logistical concerns Comment [M155]: Time
21	Time to redesign our lessons, add information and lessons to the server, as well as time for task such as open individual folders for grading. Dealing with technical problems.	Comment [M156]: New resources Comment [M157]: Time Comment [M158]: Student responsibility Comment [M159]: Planning Comment [M160]: Technical difficulties

Appendix C: Sample from Staff Interviews

Staff interviews were completed in the spring of 2011 and the spring of 2012. Interviews were recorded and saved digitally. Interviews were transcribed from the recordings and transcripts were saved by alias and date. The transcripts were analyzed for recurring themes. Such themes were noted using Microsoft's comment feature and tallied for frequency.

The sample below is the transcription from one full interview conducted in the spring of 2012. All names mentioned in the recording have been replaced with an alias.

Interview Transcription: Ms. Patel, 6th Grade Social Studies and English
Spring 2012

What changes did you make to your content delivery when you changed to a one-to-one computing environment?

Much less use of text, much more use of, of course, the technology. And the ease at which you could get it, just walk across the room and everybody gets a laptop, enabled me to use that in all kinds of activities. I started rethinking, "How am I going to present this? How am I going to teach that?" and thinking "How am I going to use the laptops for this? How can I use laptops for that?" It just kinda changed a whole way of thinking about it. And kids were more motivated because it was not, even if it was the same material, it wasn't paper/pencil, it wasn't in a book, it was on a laptop.

Comment [M66]: Student engagement

So you said you were looking for ways to present the material, do you feel that still did a lot of the presentation of the content or did that change as well?

I probably did less but I still included my presentation. Sometimes I used it as a reinforcer afterwards to maybe reteach what I had gone over or as an introduction or even as a plain old "let's spark their interest" by tossing that out to them.

Comment [M67]: Reteach

What changes have you had to make to your classroom management style or your classroom management in a one-to-one classroom environment?

Probably the fact that they were collaborating more, but I can't say that necessarily. It's just that that was the tool that brought them together. Otherwise it might have been, in the old days, some other tool. So I don't know that my management really changed much. You know we had to have specific rules for how you get them, how you use them, what's okay, what's not, but I had those same rules, you know, tweaked a little bit, for the use of any kind of materials in here. So classroom management... Maybe one of the things that probably got looser was that if a student had difficulty or had an idea, or found something that worked that they could share with somebody else, or they were having difficulty, they might call out more. They might say "Oh, I got it! I got it! Try this way!" Where that probably wouldn't have happened so much in the older technique. But, well, one aspect of classroom management has to do with grades and evaluation, and so on. That, of course, changed. I, especially at the end of the year, used more of the Edline interactive quizzes, kinds of things. Homework hand-ins, automatically were connected into the gradebook. That had changed quite a bit. I had never done that before, and I want to do more of that next year.

Comment [M68]: Student-student collaboration

Comment [M69]: Procedures

Comment [M70]: Noise level

Comment [M71]: Grading practices

Comment [M72]: Use of LMS

What topics that were covered by professional development were helpful in facilitating one-to-one?

The most helpful thing, I think, was from Mrs. Scott and Mrs. Cooper because they had gotten their feet wet. They were the experimental guinea pigs. So when I was not sure how to do this or that, as far as every day handling of things, I would go to them "How do you do this? How do you do that?" So, talking with other teachers about how things worked, that helped a lot. Oh, that time we were up in Mrs. Todd's room, and we had a chance to just go through this plethora of sites. You know, look at this, look at that. That's what you need. You need time to experiment and plus somebody there as a guide. "Go here. Go there. Try this. Try that." That was very helpful and I used a lot of things that popped up there. You know, I thought, well, even if I don't know how to use that, I had a handle on it so that I could explore that a little bit more. That time to be able to explore is priceless. Time to explore in a group. Plus it was another one of those things where someone said "Try such and such site" or "So and so, I know you do a unit on this" or "You teach that, this is something you can use." Having other teachers in that room at the same time was real helpful.

Comment [M73]: Teacher-teacher collaboration (grade level)

Comment [M74]: New resources

Comment [M75]: Teacher-teacher collaboration (content area)

Comment [M76]: Teacher-teacher collaboration

What professional development topics do you feel you still need?

Maybe more of when the computer, when the laptop isn't functioning what kinds of troubleshooting things I can do before I have to call in the experts. I'm sure there are more things I can do. Even to have like a handout or a handbook of "When you see this, try this. When you see it doing this, try that." Because I just feel like, first of all, I feel guilty because I'm constantly sending an email "Such and such isn't working" and then I find out it was a simple thing. You know, maybe something like that would be helpful, a little more of the technology troubleshooting. I think, especially the fact that they are always coming up with new sites, new things, new stuff, to periodically have that experience like we had, with everybody together. "Let's explore some more. Let's find out what's out there." Because, I have a feeling that like every six months that's just unbelievably increased.

Comment [M77]: Technical difficulties

Comment [M78]: Teacher-teacher collaboration

Comment [M79]: New resources

Did you have concerns when we started one-to-one computing? And if so, have they changed or do you still have concerns?

Before we started, my biggest concern... I had visualized a kid sitting in front of a laptop, totally closed off from the rest of the class and just going into it like "cyber-mode." And I thought that was not a good idea, but I thought "This is what's coming. This is what's going to happen." And I found that the opposite was true. There is more of the kids collaborating with each other because of the laptops, learning together, especially the range of ability levels in a social studies classroom, because we get 'em all, from the extremely genius down to the total other end, being able to work together to do a product and they work together and I am more on the sidelines. And then I kind thought, I think part of it, I was kinda concerned I would be replaced. No. I will not be replaced. And I wasn't replaced. I was just part of them, exploring and trying to figure things out together. I taught them, they taught me. It was very enriching.

Comment [M80]: Student-student collaboration

Comment [M81]: Student as teacher

Are there still any concerns?

I don't think so. Every time I think, like I'm thinking of next year's class, the class we just sent on, they were wonderful and I thought, "I hope that the ones coming up are as responsible, they follow the AUP, they do what they're supposed to do, as well as the class we just had." Because I don't want to spend my time, going around and monitoring "Are you on the correct site? Are you doing what you're supposed to do? Are you going somewhere you're not supposed to be?" You know, it was relaxing being able to trust those kids, knowing they're doing what they're supposed to do. And I hope that continues. So it's always that same kind of feeling you get every time a new class is coming up. So that would be it.

Comment [M82]: Procedures

Appendix D: Sample from Classroom Observations

Classroom observations were completed in the fall of 2010, the spring of 2011, the fall of 2011, and the spring of 2012. Field notes from formal observations were typed following the observation and saved by teacher alias and date. Aliases were used for all teachers on all field notes and typed notes. The typed observations were analyzed for recurring themes. Such themes were noted using Microsoft's comment feature and tallied for frequency.

The sample below is the typed observation from one formal observation of a full class period in the spring of 2011.

Classroom Observation of Mrs. Archer
 Date: February 15, 2011 Time: 5th period Subject: English Grade Level: 7th Grade

Comments:	Observations:	
	As students enter, warm up on board titled "Writing into the Day".	
	Seating is set up in 5 rows (3 rows of 6 and two rows of 7).	
	At the front of the room is a computer connected to a digital projector and a virtual whiteboard.	
Students appear to have a specific laptop number assigned to them.	Teacher is at the front of the room as the student enter.	
	As students enter, she reminds them to get out their laptop, turn it on, and log onto the server.	Comment [M1]: Procedures
Activity 1: Book discussion	While students turn on and log in to laptops, the teacher continues to give verbal directions. "While you get out your laptops, let's talk about what you read in <i>Flush</i> last night."	Comment [M2]: Direct instruction
Students seem unbothered by sound, but as more laptops start up, the music becomes loud	Students volunteer to share what they read. As students share, others add to the discussion.	
	--Windows start up music begins playing from laptops as students engage in book discussion.	
	The teacher remains at the front of the room while students share and set up their laptops.	
	One student asked a question about the reading and another student offered an explanation. Several students are overheard saying "Oh!" indicating that they had a similar question, but now understood what occurred in the novel.	
	The teacher regains focus by stating "That was an exciting ending to our story." She reminds them that next week they will be completing a book report on the novel using <i>Wordle</i> and encourages them to finish the book by next week if they haven't already.	Comment [M13]: New resources
3 mins elapsed	The teacher turns the class attention to the creative writing prompt on the board at the front of the room. She reminds them that for "Writing into the Day" they have the option to write on paper or type on a laptop.	
Activity 2: Writing prompt	Prompt: Write from the point of view of a clean sock accidentally put in the hamper. How do you feel about this situation? Who put you there? Will you be able to get out of a repeat wash?	Comment [M3]: Direct instruction
	Many of the students have not finished logging into their computers yet. Most opt to hand write their prompt, others wait for the laptop.	
	Teacher: "Everybody should be writing"	
	The teacher walks through the room to observe writing.	
	A late student enters the room and gives the teacher a note. He begins logging into the computer and immediately starts hand writing his prompt.	
	As the teacher walks through the room monitoring, she talks to two students who have questions about another assignment.	
6 mins elapsed	Teacher: "Okay, go ahead and finish your last thought."	
	A student volunteered to share his story. The teacher invited him to sit in the "author's chair" at the front of the room. He sat in the chair and read his response to the prompt.	
	Following his reading, the class clapped and the teacher commented on his use of onomatopoeia and character voice.	
	Teacher: "Who is ready to share now?"	
	No student volunteers, so she selected one. The student reads her response, but opts to stay in her seat.	
	--More Windows start up music from the late student's computer during her sharing	
	The class again claps for her.	
	The late student raises his hand to share, but the teacher selected a student who did not volunteer. This student opts to sit in the author's chair. The writing is very humorous causing the class to giggle and clap. The teacher comments that it was very well written.	

Students selected boy-girl-boy-girl. Intentional?	A fourth student is chosen to share (a volunteer). She also comes to the front of the room to share. Her story is not related to the prompt in any way. The teacher questions her trying to make the connection, but the students explained that she wrote a scary story instead.	
9 mins elapsed	Teacher to whole class: "Okay, put that away. Thanks for sharing."	
Procedures for laptops when not in use have been established	Teacher: "In a little while we are going to work on the laptops, but for now, 45 those. We are going to do a punctuation review."	
	Students are told that they will be working with a partner on an activity. They will be given 10 sentences and asked to identify the sentence type.	Comment [M4]: Procedures
	Teacher: "What are the four types of sentences?"	
	A student volunteers the answer.	
Each student has a graphic organizer to track pre-established rotating partners.	The teacher goes over an example of the activity they will be doing. She pulls a sentence from bag, reads it aloud, and asks the class to identify the sentence type.	
	She then prompts the class to join their partner and complete the activity.	Comment [M5]: Procedures
13 mins elapsed	The class moves to sit with their pre-established partner.	
	The students begin reading the sentences to one another and guessing the sentence types.	Comment [M14]: Low-level thinking skills
Activity 3: Review activity	The teacher moves throughout the room and monitors the activity.	Comment [M15]: Teacher as facilitator
	The teacher does not intervene with any of the groups	Comment [M6]: Student-student collaboration
The students do not seem to have any difficulty with the activity	All of the students are involved in either reading the sentence or identifying the sentence type.	Comment [M16]: Student engagement
	Teacher: "When you finish, put your sentences back in the bag."	
	The teacher claps to get their attention and asks students to return their sentences.	Comment [M17]: Procedures
	Teacher: "So, how did your partner do?"	
	Several students in unison: "Good."	
	Teacher: "How did you do?"	
	Several students: "Good."	
	Teacher: "Were there any questions about the sentences?"	
	Several students: "No."	
Link as a file on server—why not as a link on LMS?	The teacher then prompts the students to fully open their computer and navigate to a set of links she has placed on the server for them.	Comment [M18]: New resources
	Teacher: "Today we are talking about literacy in the digital age."	Comment [M7]: No use of LMS
Activity 4: Introduction to new material	She then began a class discussing asking what the term literacy meant.	Comment [M8]: Direct instruction
	Students began guessing the meaning of the word based on the root "lit" and making connections to "literature"	
	The teacher then proposed that they look up the word online. She opened a link on her computer/projector that she had ready to an online dictionary to define the term.	
	She asked the students to consider that given the technology they have today, is it more important, less important, or just as important to have literacy skills.	
The student was not asked to justify her answer	One student answered that it was "just as important"	Comment [M9]: Low-level thinking skills
	The teacher agreed and stated that it was definitely just as important. She asked if anyone felt it was more important to have literacy skills today.	
	No one responded.	

20 mins elapsed	Teacher: "Well, we will find out today."	
	The teacher prompted the students to again look at the front of the room.	
	She explained that they would be looking at websites and judging their credibility and appropriateness.	Comment [M19]: Higher-level thinking skills
	She then led the class through the steps to locate the specific link they would be using.	
	She prompted the class to look at the board when they were ready.	
	The teacher explained that they would go through one example together and then work with their partner on the rest of the sites.	
	She explained that the site they would be using had a list of other website links. They would be exploring each site and then taking notes about the site.	
	She led them through exploring the first site. "What do you notice about the site?" She then showed them how to use the note-taking template to write down what they noticed.	
	After taking notes, she led them through answering a sample question about the site.	
	One student raised her hand and stated "I need help with my computer."	Comment [M20]: Technical Difficulties
26 mins elapsed	The teacher stopped the discussion and walked over to the student to help.	
	After helping the student, she came back to the front of the room and continued the discussion.	
	She reminded the students to answer the questions regarding the sites in complete sentences and led them through an example.	
	Some students began to lay their head on their desks or rest their heads on their hands	
	The teacher prompted the students to sit with their partner and try evaluating the sites	
	The students moved to sit with their partners again. This time, they had to carry their laptops to their new seats.	Comment [M10]: Student-student collaboration
	While moving, the teacher prompted the students to have one person type and the other partner explore the sites.	Comment [M21]: Logistical concerns
	The students immediately began exploring and sharing.	
	The teacher circulated through the room to monitor and assist the students.	Comment [M22]: Teacher as facilitator
	The teacher answered questions and helped troubleshoot technology issues.	
30 mins elapsed	The students appeared to be engaged in exploring the sites and discussing the site appropriateness.	Comment [M23]: Student engagement
	Some "cross talk" between groups began to occur	
	A student was overheard saying "Here, let me. I can type fast." Another student was observed taking over typing duties from a peer.	Comment [M24]: Lack of student computer skills
	The teacher continued to monitor and prompted the students to use complete sentences.	
	One group with three members was observed as one member typed and the other 2 chatted about an unrelated topic and playing with a student's glasses.	
	The teacher was observed approaching a group who appeared to no longer be sharing with each other. She asked "Who is answering the questions?" The typist showed her the work that they completed.	
	The teacher clapped to get the attention of the class.	Comment [M11]: Inequity
	She complemented the class on having good discussion with their partners.	
	She then announced that they would have a whole group discussion about this activity.	Comment [M12]: Direct instruction
40 mins elapsed	She selected a site that most of the groups had visited and reviewed the questions with the whole class. Four students shared their group's answer to the first question. One of the four students was asked to justify their answer.	Comment [M25]: Low-level thinking skills
	The teacher continued to go over each question for this website.	
	Following the review of questions, she stated "These are the things you need to think about when you are online. You need to use your literacy skills."	
	Teacher: "Did you guys enjoy this activity?"	
	Several students in unison: "Yes."	
	The teacher then prompted the students to shut down their computer and return to their assigned seat. She reminded the students to leave the laptop on their desk for the next class.	
	Teacher: "If you are logged off and the lid is closed you may push in your chair and go."	Comment [M26]: Procedures
	The students began exiting the classroom for their next class.	

Appendix E: Sample from Discussion Groups

Discussion groups were held with the Implementation Team once per month to assist in determining school-wide needs and progress. Similar discussions were held with each grade-level team during professional development sessions or as stand-alone meetings throughout all four semesters of the study. Pre-determined agendas provided the format of the meetings, and hand-written notes were added to the agendas. Following grade-level or Implementation team meetings, notes were typed onto the existing agenda and saved by date. Aliases were used for all teachers on typed notes. The typed notes were analyzed for recurring themes. Such themes were noted using Microsoft's comment feature and tallied for frequency.

The sample below includes the original agenda and the agenda with compiled notes from grade-level team discussions held on September 1, 2010. The purpose of the meeting was to review the findings of the initial needs assessment survey and begin planning the direction of professional development.

Planning with the Big Picture in Mind

Grade-Level Team Agenda 9/1/10

- What is the “Big Picture”?
  - A look at the survey results: where do we want to go?
- School-wide Goals:
  - Personalizing student learning (taking charge of their own learning)
    - Student centered v. teacher centered
    - Project Based Learning (PBL)
  - Blended learning/Edline interactive classroom

Overall Goals:

Needs	
Wants	

Professional Development Needs:

Teacher concerns	
PD input from teams	
Multi-disciplinary curricular collaboration	

Planning with the Big Picture in Mind

Grade-Level Team Agenda 9/1/10

- What is the “Big Picture”?
  - A look at the survey results: where do we want to go?
- School-wide Goals:
  - Personalizing student learning (taking charge of their own learning)
    - Student centered v. teacher centered
    - Project Based Learning (PBL)
  - Blended learning/Edline interactive classroom

Overall Goals:

	6 th Grade	7 th Grade	8 th Grade
Needs	• Project-based learning environments • Method to help track SRs/ABCs (computerized)	• “I just need to see it in action. I don’t know what to expect.” • Video of 1:1?	• Student contracts for computer use • Revisit the AUP (reteach 2nd semester) • Policy for repeat offenders
Wants	• Note-taking on computer • Less books, paper, pencils to carry • Writing across the curriculum as a blog/collaboration • Worksheets, study guides on computer to fill in answers • Type notes • View PPT at seat instead of front of room (increase focus) • Writing tasks on computer instead of paper	• Unsure	• Tables for PBL • Additional electrical outlets • Want to see group work • Want to see teacher as facilitator • Varied methods for student presentation • Easier method to type math symbols (user-friendly)

Professional Development Needs:

	6 th Grade	7 th Grade	8 th Grade
Teacher concerns	• “How long will it take to change curriculum?” ***Don’t change curriculum, change delivery**	• Need to see PBL and 1:1 computing	
PD input from teams	• PBL	• Videos or visiting schools implementing PBL or 1:1 computing	• Webinars on how to use tools • Social networking for students
Multi-disciplinary curricular collaboration			• Vertical PD based on content • Time and PD for collaborating on projects • Webcams to collaborate from class to class

Sample F: Sample from Collected Artifacts

Various artifacts were collected over the course of the four semesters studied. Most of the artifact collected were digital in nature and could be saved by artifact type, date, and if applicable, teacher name. All artifacts were analyzed for purpose and were code based on theme. For digital documents, such themes were noted using Microsoft's comment feature and tallied for frequency. Documents existing in hard-copy only were described in a Microsoft Word log and coded for theme.

The sample below is a series of screenshots from the school's learner management system. Screenshots were collected from all core classes during the spring of 2011 and the spring of 2012. The screenshots below came from the eighth grade science classroom. All text indicating the name of the school, teacher, or class code has been redacted. The first image is the class homepage, followed by the list of documents and applications from the "Assignments" folder, and finally a list of the items found within one unit of study.

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Welcome to Science 8.

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[Level 1,2, and 3 Exit Quiz Answers for Geology and Waves](#)
Answers to exit quizzes to help study for the test on Wednesday!

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Links

- 🔗 _Immune System Defender Game
- 🔗 _Learn Genetics
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- 🔗 Build a Bridge Online
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- 🔗 Chem4Kids
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Comment [M1]: Grading practices

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- 📁 [Wave Properties and the Doppler Effect Level 3](#)
- 📁 [Porch Dissection Links](#)
- 📁 [Answers to Geology and Waves Levels 1,2 and 3 Exit Quizzes](#)
Use this to study for the test on Wednesday!
- 📁 [Level 4: ElectroCity](#)
This level is for fun and is not graded. You can only work at this level if the previous levels have been completed!
- 📁 [Geology Level 2](#)
- 📁 [Geology Level 1](#)
- 📁 [Astronomy](#)
- 📁 [Cell Cycle Game](#)
- 📁 [Genetics](#)
- 📁 [Cells and Body Systems Unit](#)
- 📁 [Chemistry](#)
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- 📁 [Roller Coasters](#)
All materials for the roller coaster project can be found here.
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Comment [M4]: Note-taking

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Cells and Body Systems the Chutes and Ladders Way!

[Level 1 and 2 Exit Ticket Answer Key](#)

[Level 1 Hand-In](#)
Turn in any digital products for Level 1 here!

[Level 1 of the Game](#)
01/18/12 Mon - 02/10/12 Fri

[Level 2 Body Systems Extra!!!](#)

[Level 2 Hand-In](#)
Hand in any digital products for Level 2 here!

[Level 2 of the Game](#)
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[Level 3 Hand-In](#)
Hand in any digital products for Level 3 here!

[Level 3 of the Game](#)
01/27/12 Fri - 02/01/12 Wed

[Pre-Test and Answer Key](#)

[Presentation Rubric](#)
02/02/12 Thu - 02/06/12 Mon

Comment [M5]: Blended learning

Comment [M6]: Differentiation

Comment [M7]: Student as researcher