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Student Perceptions Of Digital Resources And Digital Technology In A Flipped Classroom

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STUDENT PERCEPTIONS OF DIGITAL RESOURCES AND DIGITAL TECHNOLOGY IN A FLIPPED CLASSROOM

by

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ABSTRACT

The purpose of this study was to analyze student perceptions of flipped classroom instruction strategies, and student perceptions of their learning experience using digital resources and digital technology in a flipped classroom. Although perceptions are important, student achievement is a common tool used by policy-makers and judged by the general public as a means to evaluate and achieve continuous improvement in K-12 public education.

This case study may be a beneficial illustration for school administrator practitioners to consider prior to implementation or utilization of flipped classroom instructional strategies. The study provides a review of a high school that first implemented a flipped classroom in 2010-2011. The study may create a general framework and provide insight to guide practitioners of the benefits, short-comings, and types of technology challenges encountered when considering implementing a flipped classroom instructional strategy in their school(s).

The variables within this study were student perceptions of their learning experiences in a flipped classroom, student performance based on pre-existing survey results from students, state assessment results from Minnesota Comprehensive Assessments (MCAs), and assessment results from ACT® tests.

This mixed method case study focused on one rural Minnesota school and was designed to seek answers to the following research questions:

1. What are high school student perceptions of the flipped classroom as a classroom instructional strategy?

2. What are high school student perceptions of their learning experiences using digital resources and digital technology in a flipped classroom?

3. What effect does the use of digital resources and digital technology within a flipped classroom environment have on student achievement based on common assessments such as the Minnesota Comprehensive Assessments (MCAs) and college entrance exams such as ACT® tests?

The researcher approached this problem as an administrator looking for new teaching strategies to help schools in his own district improve student outcomes.

The results of the data collected and analyzed indicated students had a favorable perception of the flipped classroom instructional strategy used by classroom teachers. Evidence within the study also indicated students had a favorable perception of the type of digital technologies used and available in a flipped classroom instructional strategy. Evidence of student achievement data based on Minnesota Comprehensive Assessments (MCAs) and the ACT® college entrance exam indicated the grade levels of students in the case study was above state of Minnesota average grade levels prior to implementation of a flipped classroom instruction strategy and continued at a higher level of achievement in the transition from a traditional lecture classroom instructional strategy to a flipped classroom instructional strategy. There was no evidence of regression of achievement with implementation of the flipped classroom instructional strategy.

Search Terms: Flipped Classroom, Blended Learning, Digital Learning, Case Study

CHAPTER I

INTRODUCTION

Technology is rapidly changing how we live and interact in our world. Smartphones, Internet, Facebook, Google, Twitter, iPads and laptop computers are just some of the types of digital technology changing the daily routines and habits of people, personally and professionally. According to Charles Schwahn and Beatrice McGarvey (2012), from a K-12 public education point of view it is inevitable these new technologies will transform education. One such transformation is a classroom teaching strategy called a “flipped classroom” which relies on utilizing digital, internet based resources accessed on computing devices such as a laptop, smartphone, or tablet.

At the beginning of this study, there were varying definitions of what flipped learning means. “So far, the flipped-learning movement has been primarily a grassroots phenomenon implemented by individual teachers” (LaFEE, 2013, p. 15). The Flipped Learning Network (2014a), a professional learning community, offered this definition of Flipped Learning:

> Flipped Learning is a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter. (para. 4 [green box])

Public education teachers Aaron Sams and Jonathan Bergman are regarded as the modern creators of a flipped classroom. They describe a flipped classroom as when the typical lecture or in-class material is delivered outside of class, typically with an online video and students do teacher guided work in the classroom (Sams & Bergmann, 2013). In its earliest form, teachers have applied flipped classroom instruction for decades. For example, English teachers assigned homework to their students to read a novel on their own outside a scheduled class. When class is in session, a teacher would dedicate instruction towards exploring themes and symbolism within the assigned reading (Berrett, 2012).

Another description of an inverted or flipped classroom is:

> Events that have traditionally taken place *inside* the classroom now take place *outside* the classroom and vice versa. The use of learning technologies, particularly multimedia, provide new opportunities for students to learn, opportunities that are not possible with other media. (Lage, Platt, & Treglia, 2000)

The two definitions are different. The Flipped Learning Network emphasizes interaction between the student and teacher while working on educational content; however, the flipped learning definition provided by Lage, Platt, and Treglia places emphasis on the use of learning technologies such as the computer or internet resources.

The flipped approach to teaching has become particularly attractive because of the availability of internet resources including audio and video on virtually any subject, frequently narrated by some of the world's outstanding authorities. And the approach seems to have singular appeal to students in this electronic age where videos in particular have found a special place in the heart of the "Awesome Generation" (Herreid & Schiller, 2013).

Public school districts across the country are currently in the process of developing and implementing efforts to launch and maintain 1:1 mobile computing programs. This is a daunting challenge because teachers and administrators must set goals for the program, determine which digital devices to use, train staff, get parent and community support, and evaluate the impact of the effort (Sanchioni & Newman, 2013). School districts across the country are at various stages of this effort, with many already providing mobile digital devices to their students to connect to the internet and the resources available on the internet network. Providing students with a digital learning device has created enthusiasm and excitement in students and parents that is often read about in local print media outlets.

In this research project, I approached the need to improve teaching strategies by attending conferences, seminars, etc. to find new ideas. At one of these meetings, I discovered the flipped learning instructional strategy that appeared to meet the needs of lifting or renovating 20th century teaching methods to a 21st century status. Flipped classrooms have great potential to take advantage of technology and resources available in the 21st century.

How do public classroom teachers transform their academic educational delivery in the classroom with unparalleled access to mobile digital devices and available resources on the internet? The emergence of new digital technologies and resources utilized in public education suggests the need for or an understanding of a new or emerging pedagogy in the K-12 classroom. A flipped classroom may be one of the instructional strategies at the forefront of this transformation.

Statement of the Research Problem

The purpose of this mixed-method case study was to analyze student perceptions of classroom teacher use of flipped classroom instruction strategies, and student perceptions of their learning experience using digital resources and digital technology in a flipped classroom. Although perceptions are important, student achievement or student performance data is a common tool used by policy-makers and judged by the general public as a means to strive for continued improvement in K-12 public education. The variables within this study will be student perceptions of their learning experiences in a flipped classroom and student performance skills based on pre-existing survey results from students and state assessment results from Minnesota Comprehensive Assessments (MCAs) and assessment results from ACT® tests.

Research Questions

This case study was designed to seek answers to the following research questions:

1. What are high school student perceptions of the flipped classroom as a classroom instructional strategy?
2. What are high school student perceptions of their learning experiences using digital resources and digital technology in a flipped classroom?
3. What effect does the use of digital resources and digital technology within a flipped classroom environment have on student achievement based on

common assessments such as the Minnesota Comprehensive Assessments (MCAs) and college entrance exams such as ACT® tests?

Scope of the Study

This study examined student use of digital technology and digital resources within 8-12 grade high school mathematics classrooms where the teacher(s) were using a flipped classroom instructional strategy. The knowledge gained from this study may assist school district administrators, school boards, and teachers to include flipped classrooms as effective transformational instructional strategies in future curricula because of the ubiquitous availability of digital technology and digital resources.

In February, 2014, a survey by SOPHIA® and the Flipped Learning Network indicated that the flipped classroom instructional delivery strategy has been expanding and changing in K-12 classrooms to the point of coming close to being mainstream (Smith, 2014). The survey indicated recognition of the term "flipped learning" has grown, reaching 96% of respondents, up from 73% in 2012. It's also received more acceptance among school administrators. Three out of four administrators support their teachers' flipped classroom efforts, according to the survey. And nine out of ten teachers indicated student engagement had improved with flipped learning (Flipped Learning Network, 2014b).

The popular use of the flipped classroom as an instructional delivery strategy is further indicated in a 2013 survey by *Project Tomorrow* titled "Speak Up 2013 National Research Project Findings: A Second Year Review of Flipped Learning." Results indicated interest in using flipped classrooms for Grades K-12 was surpassing other digital learning trends. Key findings from the Speak Up 2013 survey include:

- One in six math and science teachers surveyed said they use flipped learning;
- Forty-five percent of librarians and media specialists surveyed told researchers they regularly create videos and other rich media as part of their jobs;
- Forty-one percent of administrators indicated they believed pre-service teachers should learn how to set up a flipped classroom before they earn their teaching credentials;
- Sixty-six percent of principals said teacher preparation programs should teach pre-service teachers how to use and create videos and other digital media for use in the classroom; and
- Seventy-five percent of middle and high school students said they think flipped classrooms would help them learn.

"'From this research, it is evident that the flipped learning model is gaining the attention of educators who are interested in improving student achievement and teacher effectiveness by leveraging digital tools to enable innovation,' said Julie Evans, CEO of Project Tomorrow" (as cited in Meyer, 2014).

The need for transformation of instruction in public classrooms was made evident during a question and answer session with United States Department of Education

Secretary Arne Duncan after his key-note speech at the National Press Club in Washington, D.C. on October 2, 2012. Duncan said:

> Recent technological advancements were a "game-changer" because it gave students the opportunity to learn "anytime, anywhere, anyplace, rather than just having a chance to learn six hours a day, five days a week, nine months a year" in school.
>
> Furthermore, he said the United States has an opportunity to lead the world in education by "moving from print to digital as fast as we can."
>
> "In a couple years, textbooks should be obsolete." (as cited in Chambers, 2012, paras. 3-5)

This bold statement by the U.S. Department of Education Secretary carries significant implications for education reform relating to adoption of curriculum materials, instructional delivery methods, professional development, and investment in technology infrastructure in public education in the United States. This is especially important when the Secretary's comments are contradicted in a popular book, *Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns* (Christensen, Horn, & Johnson, 2008). Christensen et al. claimed, "Computers add cost while failing to revolutionize the classroom experience" (p. 82).

As early as 2001, Marc Prensky described the use of new technologies as a generational phenomenon by saying:

> Today's students – K through college – represent the first generations to grow up with this new technology. They have spent their entire lives

> surrounded by and using computers, videogames, digital music players, video cams, cell phones, and all the other toys and tools of the digital age. (Prensky, 2001, p. 1)

In his article, “Digital Natives, Digital Immigrants,” Prensky labeled students in classrooms at the time his article was written as being “digital natives” because they were “native speakers” of the digital language of computers, video games, and the internet (Prensky, 2001). Students would still have been considered digital natives at the time this report was written.

The generational label of “digital native” is elaborated on further in the book, *Born Digital: Understanding the First Generation of Digital Natives* by John Palfrey and Urs Gasser. Palfrey and Gasser (2008) contended, “the first generation of "Digital Natives"—children who were born into and raised in the digital world—is coming of age, and soon our world will be reshaped in their image” (Palfrey & Gasser, 2008, p. 393). Classroom instruction around the country is being redesigned to accommodate learners who have been surrounded by digital technology and digital resources all their life.

If today’s students are native to the use of digital technology, then what might we label teachers in the classroom who are working to teach these students or administrators of public schools where students attend school? Prensky termed the people who did not grow up with digital technology as “digital immigrants” (Prensky, 2001). The advancement and availability of mobile digital devices and the ease with which mobile devices are used to connect to the internet has resulted in educators seeing the potential of digital learning to achieve objectives, and the large-scale impact digital devices may have on learning (Roschelle, 2003) such as changing classroom teaching methods in public schools.

Not all educators subscribe to labels and comparisons of attractive phrases like *digital native* and *digital immigrants* as applied by Prensky (2001) and Palfrey and Gasser (2008). In-fact, Sylvia Martinez, president of Generation YES indicated labels and phrases capture the ease with which young people accept technology and their perceptions that teachers will never "get" technology the way kids do (Martinez & Prensky, 2011). The mere perception or belief that students are capable of a greater ease of use of technology than their adult teachers doesn't transform the learning process by simply having and being able to utilize digital technologies. This researcher believes a teacher still remains the single most important element in a classroom, and it is that person's job to teach, using research based pedagogies to expand the knowledge of students sometimes with and sometimes without the use of technology.

The pace of change occurring in our world, including change in education, is accelerating. If a person were to subscribe to Prensky's ideas and other proponents of the *digital natives* mind set, that person would agree educators are facing a challenge of responding quickly to guiding and improving classroom instruction for *digital natives* for purposes of improving student achievement as a response to prevalent trends which include:

- Improving student assessment results which provide local and state decision and policy makers (e.g.: decision and policy makers in the Minnesota Department of Education) with a comparison of student achievement between student sub-groups including students of color, students of poverty, English language learners, and special needs students;

- Improving student assessment results which provide national decision and policy makers (e.g.: decision and policy makers who administer the National Assessment of Educational Progress, and other administrators who rely on NAEP results) with a comparison of nation-wide student achievement data (National Assessment of Educational Progress [NAEP], 2014);
- Moving towards adoption and implementation of Federal Common Core State Standards in English and Mathematics as defined by the Common Core State Standards Initiative (Common Core State Standards Initiative, 2014);
- A need for students to develop essential 21st century skills (Appendix A) to be successful in a competitive and more global society (Kaufman, 2013);
- Changing instructional methods (e.g.: lecture [teacher]-centered to student–centered) as a means to improve student achievement;
- Changing student characteristics, specifically students of today growing up with access to digital technologies and being digital natives (being digitally savvy) as opposed to students from older generations being digital immigrants;
- Changing availability in access to information (e.g.: 24/7/365 internet access); and
- Changing digital technology (e.g.: types of mobile devices).

Multiple and complex demands within these current trends make it difficult for public education to establish and maintain focus. New or changing trends can come into being in a short time period. Rapid change and new and challenging trends may give the appearance public education is disorientated and without focus.

Significance of the Study

It is no secret public education in America has been experiencing an era of accountability where stakes are high for students, teachers, and administrators. This has been an era of strong support for public policies that use high-stakes tests to change the behavior of teachers and students in desirable ways (Amrein & Berliner, 2002). The achievement gap between students with disabilities and typical peers has continued to widen. Gaps in school achievement between different ethnic groups and between students from poor and non-poor families have been well documented. These gaps in achievement are wide, and they have been persistent; this is well known and widely accepted (Barton, 2003).

> The gap isn't because we don't identify enough students, allocate enough resources, employ enough teachers and paraprofessionals, or work hard enough. We need to be more effective. Everyone wants to know what works, and it becomes tempting to jump on the bandwagon of the "latest and greatest" educational initiatives. It is often reported that the one of the most critical problems our schools face is not resistance to innovation and improvement, rather, it is the fragmentation, overload, and incoherence

> resulting from the uncoordinated acceptance of too many different innovations. (Gibbons, 2013, p. 1)

A flipped classroom utilizing digital resources and digital technology may be considered one classroom instructional innovation which may trigger emerging broad acceptance.

Instructional methods utilized in public schools for decades tend to be termed "direct instruction," that is, teacher centered with classroom lecture(s) as the means to disseminate academic content to students. A lecture type of instructional delivery is additionally characterized by the use of printed textbooks. The lecture or direct instruction strategy is being challenged by educators because most educators today would assert instructional knowledge and information has expanded greatly beyond printed book covers and knowledge of a single teacher. Traditional teacher centered instructional strategies used in classrooms are being viewed as having knowledge content and student learning limitations.

There are a number of considerations for public school educators and administrators to address as they move towards changing their classroom instruction paradigm from a traditional teacher-centered method of teaching to a student-centered instructional delivery system to improve student achievement. Considerations include use of digital technologies and digital resources as well as a great amount of background information including planning, budgeting, training, and communicating to the public what is involved in transitioning to a flipped classroom (Berg-Beniak, Bauman, Smith, & Westphal, 2014).

There are various digital tools available for instructional use. "It seems almost certain that instructional videos, interactive simulations, and yet-to-be-dreamed-up online tools will continue to multiply. But who will control these tools and whether they will fulfill their potential remains to be seen" (Tucker, 2012, p. 83). The use of digital technology and digital resources and its impact on student achievement in a flipped classroom setting could be used as a means to transform classroom instructional methods and student learning.

A successful paradigm shift of instructional methods, particularly utilizing digital resources in the classroom, will require staff training for classroom teachers. The use of digital technology and digital resources and its impact on student achievement in a flipped classroom setting could be used as a means to focus on a particular set of staff development skills and training.

In June of 2010, the United States began an effort to adopt a national curriculum with the launching of the Common Core State Standards (Common Core) by the National Governor's Association and the Council of Chief State School Officers (Zhao, 2012). The common core standards, in part, are a response to United States students lagging behind international student test scores and global economic competition. Common core standards are intended to bring increased rigor and depth to our educational system and were developed to focus on development of skills in English language arts and mathematics to meet world-class standards and to ensure high school graduates are college and career ready (Rickabaugh, 2013). The use of digital technology and digital resources, and their impact on student achievement in a flipped classroom setting could be used as a means to deliver content for Common Core implementation and instruction.

The use of and benefits of digital technology and digital resources and their impact on student achievement in a flipped classroom setting could be used as a means to promote and gain support for a technology ballot question in a special referendum vote to local school district voters. There are many school districts in the state of Minnesota who have placed ballot questions on ballots seeking voter approval for funding technology improvements during a special school election (Appendix B). Gaining support from parents is important. But, parents are only a portion of a school district's eligible voting population. "If you can bring parents and community members into a classroom or show them online what it is you're doing and how effective it is for students and how engaged students are, a lot of them are going to be interested and want to know how they can help" (Schaffhauser, 2013, p. 1).

Schools across the state of Minnesota and the United States are positioning themselves to improve structural access to technology and professional development in an effort to combine technology integration and classroom instruction to improve student achievement (Roschelle, 2003). However, financial costs for planning, implementing, and acquiring technology is high. Despite growing interest in such efforts, little research has focused on teaching models and learning in these intensive computing environments (Drayton, Falk, Stroud, Hobbs, & Hammerman, 2010). Flipped classroom instructional strategies are gaining popularity among classroom teachers. A flipped classroom instructional strategy may be the bridge between use of technology and the delivery of classroom instruction to improve student achievement. Therefore, a dissertation on the impact a flipped classroom has on student achievement will provide literature and research to classroom teachers and school administrators to help determine if digital technology and a flipped classroom will improve teaching and student achievement.

Delimitations

There are different types of instructional strategies used by classroom teachers in K-12 public education. This study was limited to students and teachers utilizing a flipped classroom instructional strategy, a type of blended learning. In addition, the study was limited to ~ 188 high school math students in Grades 8 through 12 in a rural Minnesota public school district. A student survey was created and administered by mathematics teachers in a rural public school using *Google Forms* software prior to the start of this study. The survey was taken online by students participating in this study. Using the software capabilities of *Google Forms*, student survey responses were linked to a spreadsheet for analysis.

It was assumed survey data collected by teachers from the school participating in this case study were reported in a truthful manner and reflected actual student perceptions and attitudes of the student population. From the 2010-2011 school year to the 2013-2014 school year, the high school student population varied between 512 and 530 students in Grades 9-12. This equates to approximately 130 students per academic grade.

No demographic data was collected; as a result, this study does not provide data on sub-groups or minority populations. Public data available on the Minnesota Department of Education website described general characteristics of the student population of the high school in Minnesota that participated in this study compared to the state-wide student population (The high school participating in this study was given a pseudonym, and for the remainder of this paper, will be referred to as Central School).

Central School began planning and developing its flipped classroom instructional strategy utilizing digital resources and technology during the 2009-2010 school year. Classroom implementation actually became effective with the 2010-2011 school year. Since the online survey for this study was conducted during the 2011-2012 school year, the data available does not contain a great amount of historical data.

The case study data represents a snapshot at a certain point in time of one school's efforts and results by changing to a flipped classroom instructional strategy from a direct instruction teaching strategy. The results may be best suited for public school practitioners to gauge advantages, disadvantages, challenges of implementing a flipped classroom instructional strategy, and even serve as a guidepost to implement a flipped classroom teaching strategy in their school(s).

Definition of Terms

The following terms have been defined to assist the reader.

21st Century Skills: In his book, *The Global Achievement Gap*, Tony Wagner (2008) said students need seven survival skills including: (a) critical thinking and problem solving, (b) collaboration and leadership, (c) agility and adaptability, (d) initiative and entrepreneurialism, (e) effective oral and written communication, (f) ability to access and analyze information, and (g) curiosity and imagination (Wagner, 2008).

Another point of view describing 21st century skills is offered by Kaufman (2013) in Appendix A.

Common Core Standards: Common Core Standards are intended to bring increased rigor and depth to the United States' educational system and focuses on development of skills in English language arts and mathematics. Common Core Standards focus on what students need to learn and know, not on how teachers teach. The intent of Common Core Standards is to help Unites States students meet world-class standards and to ensure high school graduates are college and career ready (Rickabaugh, 2013). Common Core is a curriculum within the United States' national educational system.

Digital Immigrants: Those "who were not born into the digital world but have, at some later point in our lives, become fascinated by and adopted many or most aspects of the new technology" (Prensky, 2001, pp. 1-2).

Digital Natives: Today's students in K-12 through college represent the first of many generations to grow up with digital technology. They have spent their entire lives surrounded by technology – using computers, videogames, digital music players, video cams, cell phones, and all the other toys and tools of the digital age (Prensky, 2001).

Digital Resources: According to Harley et al. (2006), digital resources can be defined as:

(1) **General-purpose and reference materials** – Including portals, reference resources, materials from search engines [Google], exhibits, digital libraries, journals, and media sites.

(2) **Images and audiovisual materials** – Including images, digital film or video [YouTube], digital audio, simulations, and animations. Materials come from many sources, including commercial image databases, free image databases, and (occasionally) campus image databases.

(3) **Historical documents, maps, and primary sources** – Including maps, facsimiles of historical manuscripts, images, and (occasionally) other texts or documents. Less likely to use news and media resources, blogs, and curricular materials.

(4) **Data, news/media, and governmental resources** – Resources include datasets, governmental documents, and news resources (and occasionally maps).

(5) **Discussion and curricular materials** – Including blogs, class discussions, curricular materials, and digital readers/coursepacks. (pp. 4-17 – 4-18)

Digital Technology: Mobile digital devices such as a smartphone (iPhone), laptop computer or computer tablet (iPad) with internet access as a means to access digital resources.

Flipped Classroom:

In K-12 and higher educational circles, the "flipped classroom" instructional strategy (also known as the "inverted classroom") has been receiving a lot of attention. The idea is that rather than taking up limited

> class time for an instructor to introduce a concept (often via lecture), the instructor can create a video lecture, screencast, or vodcast [video podcast] that teaches students the concept, freeing up valuable class time for more engaging (and often collaborative) activities typically facilitated by the instructor. (Milman, 2012, p. 85)

Student Achievement: For the purpose of this study, student achievement will be defined as student progress measured by: Minnesota Comprehensive Assessment (MCA) scores and college entrance examinations (i.e.: American College Testing (ACT®) exams).

Student Centered Instruction: Student-centered learning is a strategy which puts the student at the center of a learning process.

> Student-centered learning is a model [strategy] in which students play an active role in their own learning styles and learning strategies. . . . Student-centered learning improves learning to learn and learning how to improve skills such as critical thinking, problem-solving and reflective thinking. Students apply and display different styles. Student-centered learning differs from teacher-centered learning in which it is characterized by the more active role of the learner when compared to the teacher.
>
> Student-centered learning helps students to get their own goals for learning, and determine resources and activities guiding them to meet those goals. . . . Because students pursue their own goals, all of their activities are meaningful to them. (ÇUBUKÇU, 2012, p. 50).

Teacher Centered Instruction: According to Carol A. Twigg, president of the National Center for Academic Transformation, "The traditional classroom typically consists of a lecture of some kind where students are listening or watching the professor" (as cited in Mangan, 2013, para. 13).

Acronyms & Abbreviations

The following acronyms and abbreviations are listed to support the reader.

ACT (American College Test): "The ACT® is a curriculum- and standards-based educational and career planning tool that assesses students' academic readiness for college" (The ACT®, 2015, para. 1).

CRB (College Readiness Benchmarks):

> The Benchmarks are scores on the ACT subject-area tests that represent the level of achievement required for students to have a 50% chance of obtaining a B or higher or about a 75% chance of obtaining a C or higher in corresponding credit-bearing first-year college courses. These college courses include English composition, college algebra, introductory social science courses, and biology. (ACT, Inc., 2015, para. 1)

ELO (Essential Learning Outcomes): According to Shirley Lesch (n.d.) from George Brown College:

> Learning outcomes are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course or program. In other words, learning outcomes identify

what the learner will know and be able to do by the end of a course or program. (para. 2)

ESEA (Elementary and Secondary Education Act): Here is what the U.S. Department of Education had to say about the definition and history of the ESEA.

> The Elementary and Secondary Education Act (ESEA) was signed into law in 1965 by President Lyndon Baines Johnson, who believed that 'full educational opportunity' should be 'our first national goal.'
>
> ESEA offered new grants to districts serving low-income students, federal grants for text and library books, it created special education centers, and created scholarships for low-income college students. Additionally, the law provided federal grants to state educational agencies to improve the quality of elementary and secondary education. (U.S. Department of Education, n.d.b, paras. 1-2)

LEA (Local Educational Agency): Local education agencies are defined by law. The U.S. Department of Education lists this definition for an LEA.

> As defined in ESEA, a public board of education or other public authority legally constituted within a State for either administrative control or direction of, or to perform a service function for, public elementary schools or secondary schools in a city, county, township, school district, or other political subdivision of a State, or for a combination of school districts or counties that is recognized in a State as an administrative

agency for its public elementary schools or secondary schools. (U.S. Department of Education, n.d.a., para. 12)

MCA (Minnesota Comprehensive Assessments): The following definition of the acronym MCA was found on the Minnesota Department of Education website.

> The Minnesota Comprehensive Assessments (MCAs) are state tests in mathematics, reading and science that meet the requirements of the federal Elementary and Secondary Education Act (ESEA). They are given every year to measure student performance against the Minnesota Academic Standards that specify what students in a particular grade should know and be able to do. (Minnesota Department of Education [MDE], 2014d, para. 1)

MDE (Minnesota Department of Education): The Minnesota Department of Education is the state education agency for the state of Minnesota.

MEPRI (Maine Education Policy Research Institute): This definition was obtained from the MEPRI website:

> The Maine Education Policy Research Institute provides policymakers with objective data, policy research and evaluation to define and evaluate educational needs, services and impact. It analyzes trends in K-12 data and performs targeted research. Established by the Legislature in 1995, the Maine Education Policy Research Institute is a cooperative effort of the University of Southern Maine and the University of Maine. (Maine Education Policy Research Institute, n.d., para. 1)

MLTI (Maine Learning Technology Initiative): A program initiated in the state of Maine was described by Silvernail, Pinkham, Wintle, Walker, & Bartlett (2011).

> Entitled the Maine Learning Technology Initiative (MLTI), this program funded by the State of Maine, provided all 7th and 8th grade students and their teachers with laptop computers, and provided schools and teachers with a wireless internet infrastructure, technical assistance, and professional development for integrating laptop technology into their curriculum and instruction.
>
> The first full implementation of MLTI began in the Fall of the 2002-03 academic year." (p. 1)

NAEP (National Assessment of Educational Progress): The NAEP "is the only nationally representative assessment of what America's students know and can do. It is the only assessment that can be compared across states. Assessments are conducted every 2 years in Math and Reading producing state results" (MDE, 2014c, Explore the Minnesota Report Card section, para. 10).

NCLB (No Child Left Behind):

> On December 13, 2001, the 107th Congress passed the No Child Left Behind Act of 2001 (NCLB), the latest reauthorization of the *Elementary and Secondary Education Act of 1965* (ESEA); President George W. Bush signed the legislation in January 2002. With this legislation, Congress and the President encourage the use of annual assessment of all students to promote high quality education. Both *Title I: Improving the Academic*

Achievement of the Disadvantaged and *Title III: Language Instruction for Limited English Proficient and Immigrant Students* include statements about measuring language proficiency and academic achievement using high quality assessments. These mandates represent an opportunity for states and districts to develop and maintain a full assessment system that meets their own needs as well as those of the federal Department of Education. (Wilde, 2004, p. 1)

NCLTI (North Carolina 1:1 Learning Technology Initiative): This description was taken from the North Carolina State University website:

> The NC 1:1 Learning Technology Initiative was a strategic initiative to support high schools throughout North Carolina in achieving the mission articulated by the NC State Board of Education: Every public school student will graduate from high school, globally competitive for work and postsecondary education and prepared for life in the 21st century.
>
> While the most visible component of NCLTI was providing a wireless computing device for every student and teacher, the Initiative also addressed pedagogy, technology infrastructure, policy, professional development, community engagement, funding, and organization as necessary components of a sustainable model for supporting future-ready students in North Carolina. (The Friday Institute for Educational Innovation, n.d., paras. 1-2)

NSF (National Science Foundation): "The National Science Foundation (NSF) is an independent federal agency created by Congress in 1950 'to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…'" (National Science Foundation, n.d., para. 1)

PLC (Professional Learning Community): This definition of a professional learning community was found online at the Glossary of Education Reform website published by Great Schools Partnership.

> A **professional learning community**, or *PLC*, is a group of educators that meets regularly, shares expertise, and works collaboratively to improve teaching skills and the academic performance of students. The term is also applied to schools or teaching faculties that use small-group collaboration as a form of professional development. (Professional Learning Community, 2014, para. 1)

SEA (State Educational Agency): "The term 'State educational agency' means the agency primarily responsible for the State supervision of public elementary schools and secondary schools" (Strengthening and Improvement of Elementary and Secondary Schools, 20 U.S.C. § 7801, para. 41). In Minnesota, the state educational agency is the Minnesota Department of Education.

STEM (Science, Technology, Engineering, and Mathematics):

> STEM education is an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering, and mathematics in

contexts that make connections between school, community, work, and the global enterprise enabling the development of STEM literacy and with it the ability to compete in the new economy. (as quoted in Lantz, 2009, p. 1; original authors were Tsupros, Kohler, & Hallinen, 2009, page not available)

WWW (World Wide Web): "The complete system of interlinked documents that use the HTTP protocol, residing on the Internet and accessible to users via a web browser" (WWW, 2011, para. 1).

Summary

Digital technologies have been changing the world in which we live, including public education. Today's youth have grown up with digital technologies and devices and expect to continue to use these digital resources in their daily lives. Support and efforts to adopt digital technology and digital devices in classrooms has been moving forward to varying degrees across the United States and even in foreign countries. The Alliance for Excellent Education and the Flipped Learning Network hosted a Flipped Classroom Open House on *Digital Learning Day* on March 13, 2015 (Thigpen, 2015). Twelve countries including Brazil, China, India, Italia, Kazakhstan, Mexico, Morocco, Serbia, Singapore, The Netherlands, UK, and the USA participated in the event (Flipped Learning Network, n.d.).

The search for a successful type of classroom instructional delivery strategy to be used by teachers that utilize digital devices and the internet's capabilities may be found within a flipped classroom instructional strategy. The intent of this dissertation has been to analyze student data of students studying within a flipped classroom instructional strategy to determine the extent to which use of digital technology and digital resources is perceived to improve (or not to improve) student learning and academic performance.

The case study data represents an illustration at certain point in time of one school's effort and results by changing to a flipped classroom instructional strategy from a direct instruction teaching strategy. The results may create a baseline of understanding or provide a starting point for public school practitioners should they seek to implement a flipped classroom in their schools.

Organization of the Study

This dissertation is organized into five chapters. Chapter I included an introduction and overview of the case study. Chapter II provides a review of the literature. Chapter III describes the methodology for this study. Chapter IV provides data results, based on research questions. Chapter V includes a discussion, summary, conclusions, limitations of the study, recommendations for education professionals, and suggestions for future research.

CHAPTER II

REVIEW OF LITERATURE

This chapter contains a review of literature which relates to a flipped classroom instructional strategy. The chapter is organized into seven areas of review. The first section provides a theoretical framework in which today's flipped classroom environment may be categorized. The second section discusses flipped classroom instructional delivery strategies. The third section explores the evolution and types of digital technology integrated into a flipped classroom instructional delivery strategy. The fourth section reviews the impact of using technology in a classroom on student achievement. The fifth section reviews the impact on student achievement of the use of digital technology at the time of this study integrated into classrooms using the flipped classroom instructional strategy. The sixth section reviews the positive aspects and short-comings of using digital technology using a flipped classroom instructional strategy. The final section in Chapter II provides an overview and describes the process of development and implementation of a flipped classroom instructional delivery strategy in Central School.

Defining or Categorizing the Flipped Classroom

Flipped classroom instructional strategies used by teachers and incorporating technology in and out of the classroom could be considered a type of "blended learning." "'Blended learning' (BL) is a 'buzz' word in language teaching. However, it has been in use for almost 20 years and its meaning ‘has been constantly changing during this period’” (Sharma, 2010, p. 456; see also Sharpe, Benfield, Roberts, & Francis, 2006).

For the purpose of this study, the researcher will apply implementation of the flipped classroom to three relevant definitions of blended learning:

1. “A combination of face-to-face and online teaching” (Sharma, 2010, p. 456). Sharma used the following explanation by Harrison to elaborate on Definition 1 of blended learning, “The integrated combination of traditional learning with web-based on-line approaches” (as cited in Whitelock & Jelfs, 2003, p. 99). This definition, put into practice, would have students meet with teachers face-to-face for classroom teaching and additional instruction would take place with the use of on-line resources outside of class.
2. “The combination of media and tools employed in an e-learning environment” (Whitelock & Jelfs, 2003, p. 99). This definition, put into practice, would have “a purely distance learning course, where no face-to-face lessons occur” (Sharma, 2010, p. 456). Communications between the student and instructor might take place through technology such as email. In its purist sense, K-12 instruction did not use this type of instruction as a teaching practice for a flipped classroom at the time of this report.
3. “A combination of a number of pedagogical approaches which is not necessarily dependent on the use of learning technologies” (Whitelock & Jelfs, 2003, p. 99). “A course that combines ‘transmission’ and ‘constructivist’ approaches would fit into this category, such as one

involving elements of a present-practice-produce methodology as well as task-based learning" (Sharma, 2010, p. 456).

Educational researchers Heather Staker and Michael B. Horn offered a similar definition as one of Sharma's blended learning definitions.

> Blended learning is a formal education program in which a student learns at least in part through online delivery of content and instruction with some element of student control or time, place, path, and/or pace and at least in part at a supervised brick-and-mortar location away from home. (Staker & Horn, 2012, p. 4)

The author of this dissertation used Staker and Horn's blended learning definition for this study because it provides the greatest flexibility for use of different types of instructional strategies using digital resources.

Another term that defines flipped classroom instructional strategies using technology in and out of the classroom is "cyberlearning." "The National Science Foundation (NSF) Taskforce on Cyberlearning published a report in 2008 that is often described as the origin of the term" (Montfort & Brown, 2013, p. 90). According to the NSF Taskforce, cyberlearning is "the use of networked computing and communications technologies to support learning" (NSF Task Force on Cyberlearning, 2008, p. 5). "The term 'cyberlearning' reflects a growing national interest in managing the interactions of technology and education, especially with respect to the use of networking and information technologies" (Montfort & Brown, 2013, p. 90). Advocates of the definition of cyberlearning intentionally did not attempt to name the newest technologically driven advances in education; instead "the Taskforce aimed to create a term that would encapsulate the way technology and education interact, without specific reference to a particular innovation or even era" (Montfort & Brown, 2013, p. 90). This definition clearly imbeds the use of computers or digital resources within its description.

Theories Behind Pedagogy

Instructional tools for use in flipped classrooms within "blended learning" or "cyberlearning" environments are constantly changing and will likely continue to do so. "Changes in education and learning due to technological/cultural shifts are unavoidable, . . ., but careful planning can ensure that those changes are positive" (Montfort & Brown, 2013, p. 90).

Pedagogy has been called the science or art of teaching (Pedagogy, 2015); specifically, of instructional theory. The challenge of classroom teachers today is to implement available technologies within different types and variations of teaching. Teacher training has educators implementing learning strategies based on pedagogical theory developed by John Dewey, Jean Piaget, Lev Vygotsky, and Jerome Bruner.

> These educators are largely from the twentieth century. Their contributions appear in educational journals, teacher education textbooks on the university level, as well as professional talks presented at international, national, and state educational conventions. They are quoted frequently in university classrooms in teacher education as well as in footnotes in professionals [*sic*] textbooks. (Ediger, 2012, p. 174)

Each of these theorists has contributed to public education, teacher training, and teaching strategies we knew at the time of this study. However, some educators have indicated with new technologies available to students, the old pedagogies are no longer relevant, and education needs a new pedagogy to enhance learning.

> Students today are digitally focused and require new skills that would meet up the needs of this new era. But the thing is teaching new skills is not the only solution and there is more to it than just that, in fact we need a new **pedagogy** with specific features that would cover every learning aspect. (Kharbach, 2011, para. 3)

The driving factors to authenticate a new pedagogy are yet to be determined. Is the emphasis to describe a new pedagogy because of the emergence of what some education reformers, such as Kaufman (Appendix A) or Tony Wagner, term “21^{st} century skills”? Wagner, in *The Global Achievement Gap* described 21^{st} century skills as: (a) critical thinking and problem solving, (b) collaboration and leadership, (c) agility and adaptability, (d) initiative and entrepreneurialism, (e) effective oral and written communication, (f) ability to access and analyze information, and (g) curiosity and imagination (Wagner, 2008).

Is the emphasis on describing a new pedagogy because of ubiquitous computer devices and digital resources available to students at the time of this study? Has availability of new digital resources required students to develop a new set of skills and fluencies in technology to use in their personal and educational environments? Technology fluencies include:

- "Technology fluency : know how to use technological tools"
- "Information fluency : know how to gather, process and validate information"
- "Media fluency : know how to view , select , and use media."

(Kharbach, 2011, para. 10)

For nearly 50 years prior to this report, teachers were trained to use Bloom's taxonomy (1956) when developing learning objectives. Educational psychologists such as Anderson and Krathwohl (2001) suggested a revision of Bloom's taxonomy was needed because of new digital technologies available to students and the emerging emphasis in public education for students to learn "21st century skills." A comparison of the two taxonomies is presented in Table 1.

Table 1. Bloom's Taxonomy.

Original (Bloom et al, 1956)	**Revised Taxonomy (Anderson et al. (2001)**
Knowledge	Remember
Comprehension	Understand
Application	Apply
Analysis	Analyze
Synthesis	Evaluate
Evaluation	Create

Reprinted from "Bloom's Digital Taxonomy and Word Clouds," by D. J. Skiba, 2013, *Nursing Education Perspectives*, *34*(4), p. 277. Copyright 2013 by the National League for Nursing, Inc.

> Recently, we have seen the development of a digital Bloom's taxonomy with associated web-based tools for K-12 and higher education. For example, Penney created the Bloom's Digital Taxonomy Pyramid (Figure 1) for the 2010 Illinois Education and Technology Conference to give teachers an idea of what Web 2.0 applications apply at each level of Bloom's revised taxonomy. (Skiba, 2013, p. 277)

It is likely there are other variations of this revised taxonomy being developed by educational researchers and psychologists. It is also likely this taxonomy is being developed and adapted for a specific type of digital device used by students (e.g. iPad) in the classroom.

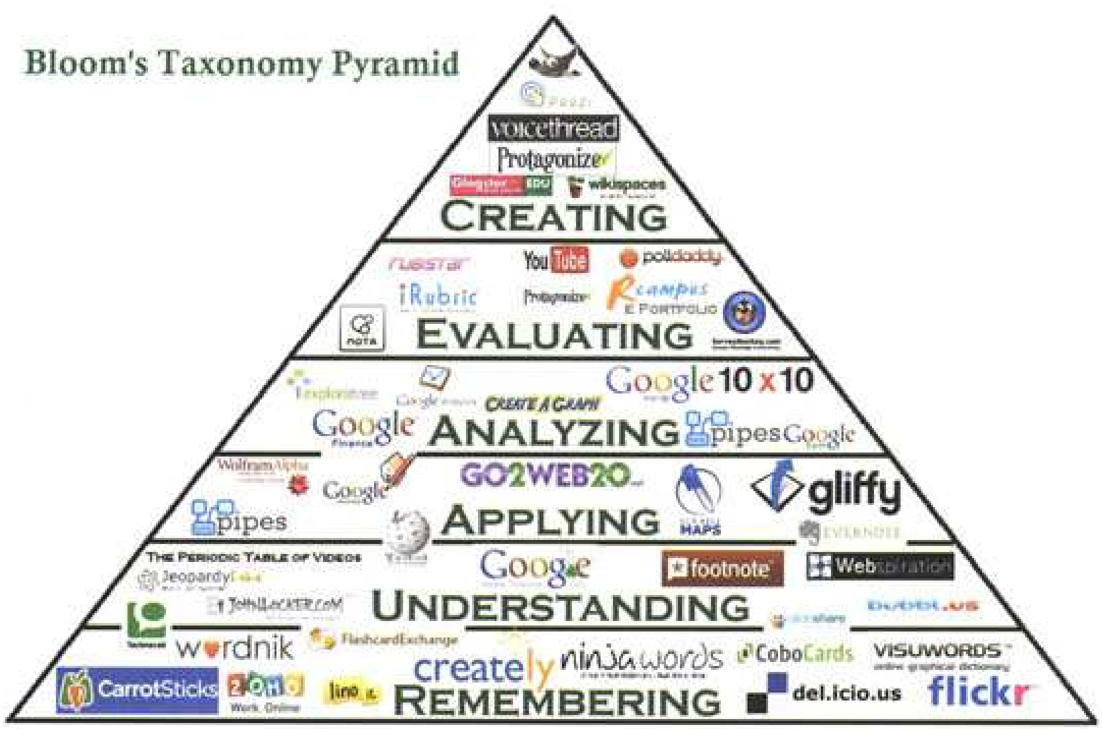

Figure 1. Bloom's Digital Taxonomy Pyramid. Reprinted from "Bloom's Digital Taxonomy and Word Clouds," by D. J. Skiba, 2013, *Nursing Education Perspectives*, *34*(4), p. 278. Copyright 2013 by the National League for Nursing, Inc.

The flipped classroom strategy offers a challenge for classroom teachers and public education in general where technology drives instruction. Or does an instruction strategy identify digital resources which work best within a pedagogic approach to be utilized? Does applying flipped classroom strategy fit within traditional theories of education such as John Dewey's experimentalism theory, Jean Piaget's developmental learning theory, Lev Vygotsky's social development theory, or Jerome Bruner's structure of knowledge theory (Ediger, 2012; Powell & Kalina, 2009); or is the flipped classroom a teaching strategy within what some educators term 21st century learning theory?

Flipped Classroom Instructional Delivery Strategies

There is a broad spectrum of classroom educational delivery methods applied by teachers in classrooms. "Direct instruction, which is typically used with a large group, is teacher-directed, structured, and focused on academic content" (McFaul, 1983, p. 67), and has been a prevalent classroom instruction delivery method for centuries. Teacher use of direct instruction has two components – "one managerial and the other pedagogical. The managerial dimension emphasizes effective discipline techniques, thorough organization, and steady pacing" (McFaul, 1983, p. 67). "Good classroom management requires a well-prepared, organized teacher who limits disruptions and distractions and thereby allows more time and opportunity for learning tasks" (McFaul, 1983, p. 68).

"The pedagogical dimension of DI [direct instruction] includes large-group teaching with highly teacher-directed comments, questions, and goals. While this approach may 'engage' some students, it may be dysfunctional for others" (McFaul, 1983, p. 68). Harvard physics professor, Eric Mazur, who himself relied on the traditional lecture method described the lecture method as “a process whereby the lecture notes of the instructor get transferred to the notebooks of the students without passing through the brains of either. That is essentially what is happening in classrooms around the globe” (Mazur, 2009, para. 4).

A flipped classroom instructional method is put into practice when the typical lecture or in-class material is delivered outside of class, typically with an online video, and students do guided work in class. In its earliest form, teachers have applied flipped classroom instruction for decades. For example, an English teacher may have assigned homework to students to read a novel on their own outside of scheduled classroom time. Then when class is in session, the teacher might dedicate instruction towards exploring themes and symbolism within the assigned reading (Berrett, 2012). “Flipped learning helps teachers move away from direct instruction as their primary teaching tool toward a more student-centered approach” (Sams & Bergmann, 2013, p. 16). A flipped classroom does not mean direct instruction is eliminated; there just may be less emphasis on lectures by the teacher to attain more interaction between student and teacher.

At the time of this report, Jonathon Bergmann and Aaron Sams were regarded as pioneers of the flipped classroom instructional strategy (Hamdan, McKnight, McKnight, & Arfstrom, 2013). Bergmann and Sams were high school chemistry teachers in a rural Colorado school district who, in 2006, like all other classroom teachers had to tolerate the interruptions within high school class schedules. Typical classroom interruptions included students who would be excused to participate in sporting or academic competition and students who would be out of school due to illness or family events. These circumstances resulted in students missing classroom instruction. Within a direct instruction classroom method, these disruptions would cause a host of classroom managerial problems which included the need for students to make up work missed due to being out of class and how to stay on an academic content schedule for students who are in the classroom versus those excused to be out of the classroom.

"Although it's hardly in mainstream use, the concept of 'flipped learning' has spread considerably during the past five years throughout K12 education. It's unknown how many schools or teachers use flipped learning now" (Finkel, 2012, para. 4). For flipped classroom instruction:

> The recent interest is driven by the convergence of several trends.
>
> The first is technological innovation, which has made it easier to distribute lectures by the world's leading instructors. Some faculty wonder whether it still makes sense to deliver a lecture when students can see the same material covered more authoritatively and engagingly—and at their own pace and on their own schedule. (Berrett, 2012, p. 37)

Students can access their classroom teacher's videos online for learning classroom topics or by searching free open online resources such as *YouTube* or *Khan Academy*. Online educational videos are described by Schwahn and McGarvey (2012). "Transformational technologies are disruptive. They have the power to make traditional tools and processes obsolete virtually overnight" (Schwahn & McGarvey, 2012, p. 18).

The combination of disrupting direct instruction along with the evolution and availability of new technology and educational resources has led to growth in use of the traditional flipped classroom. Over time, innovative classroom teachers have created variations of the traditional flipped classroom. One variation is called *flipped mastery*.

Flipped Mastery

In the flipped mastery-based strategy, . . .

> . . . students are not required to watch videos at home on a specific day. Instead, they are given an outline for each unit that includes all the resources they might need for each objective, including videos, worksheets, and textbook excerpts. They can then work through the material at their own pace, even taking tests and quizzes and performing labs when they are ready rather than as a whole class. (Ash, 2012, p. S7)

Mastery of educational content is attained by meeting a specified threshold determined by the teacher. For instance, if, through assessment, a student attains 80% mastery of content, they move on to the next learning concept. If mastery is not attained, remediation with additional resources would take place. "The goal should be to allow advanced students to move on after mastery of a concept, to give additional time to those who need it, but not to eliminate overall learning accountability" (Pulley, 2014, p. 111).

Peer Instruction

The *peer instruction* flipped learning model is another modification of flipped learning instruction. This instructional delivery strategy was developed by Eric Mazur, a Harvard University physics professor. Mazur contended, "The traditional approach to teaching reduces education to a transfer of information. Before the industrial revolution, when books were not yet mass commodities, the lecture method was the only way to transfer information from one generation to the next" (Mazur, 2009, para. 4).

The peer instruction flipped learning strategy requires students to gather classroom information prior to coming to class either by watching videos or reading selected content. In the classroom, the teacher poses conceptual questions from the video or written material and receives student responses. If students have mastered the content, the class shifts to another concept. If students have not mastered the content, students work with their fellow students and the instructor to discuss, clarify, and learn the concept. According to Mazur, "This approach has two benefits: It continuously actively engages the minds of the students, and it provides frequent and continuous feedback (to both the students and the instructor) about the level of understanding of the subject being discussed" (Mazur, 2009, para. 6).

Project-Based Learning

"*Project-based* [italics added] learning, or the *learning-by-doing* [italics added] method [was] advocated by John Dewey over a century ago" (Gress, 2013, p. 17). Dewey argued "the goal of schools ought to be developing an attitude — the love of learning" (Gibboney, 2006, p. 170), and what better way of learning than to give students projects or activities which are relevant to them and real life? Students are given a project, and working together, design a process and access resources to complete the project.

The project-based learning strategy requires students to become responsible for their own learning. The project-based learning teacher is a facilitator of student learning, and his/her interventions diminish as students progressively take on responsibility for their own learning processes. This method is characteristically carried out in small, facilitated groups and takes advantage of the social aspect of learning through discussion, problem solving, and study with peers (Hmelo-Silver & Barrows, 2006). Throughout the process, there are changing needs and resources which students can attain from each other, the teacher, or the flipped part of the process, by watching videos. The modern project-based learning, or the learning-by-doing strategy is an old instructional delivery system utilizing new digital resources available to students.

The Inquiry-Based Flipped Classroom

The same applies to what is termed an *inquiry* flipped classroom.

> Inquiry-based research—or learning—consists of a "process of learning that is driven by questioning, investigating, making sense of information, and developing new understandings, it is a process of active learning" . . . and is determined "by one's own curiosity, wonder, interest or passion to understand an observation or solve a problem" (Jansen, 2011, p. 11).

The flipped classroom use of inquiry learning at the time of this report utilized new digital resources available to students to investigate their interests. Jansen said:

> By turning the curriculum into engaging problems for students to solve, students can participate in inquiry while practicing many curriculum-mandated skills (i.e. reading, writing, listening, research) as they

> investigate subject-area content (social studies, science, health, math, etc.). Instead of teachers dictating the information students need to locate, allow them to determine what they know, want to know, and need to know to solve the information problem. (Jansen, 2011, p. 11)

An inquiry flipped classroom will "encourage students to use a variety of online and offline resources, and allow them to show their results by creating products that go beyond the traditional report and PowerPoint presentation" (Jansen, 2011, p. 11).

Evolution of and Types of Digital Technology Integrated Into Flipped Classrooms

Whatever flipped classroom instructional delivery method is used by teachers, growth in use and evolution of flipped classrooms is being stimulated by different types of digital technology and availability of that technology to classroom teachers. Over time, changes in availability of instructional technologies and digital resources have resulted in changes in educational or instructional delivery strategies available to classroom teachers. This is a natural relationship, because, from a historical perspective, most practices related to instructional media have occurred independent of developments associated with instructional design (Reiser, 2001).

Figure 2 is developed from the research of Anthony Betrus who also contended changes in availability of instructional technology has resulted in changes in educational or instructional delivery systems available to classroom teachers (Betrus, 2012). These changes, over time, are likely to continue to occur.

In most discussions of the history of instructional media, three primary factors were used for instruction prior to the 20th century (and still were the most common factors of instruction at the time of this report) — the teacher, the chalkboard, and the textbook (Reiser, 2001). The instructional method utilizing these three factors within the classroom was teacher centered with classroom lecture as the main means to disseminate academic content to students. In a flipped classroom, instruction is being stimulated by

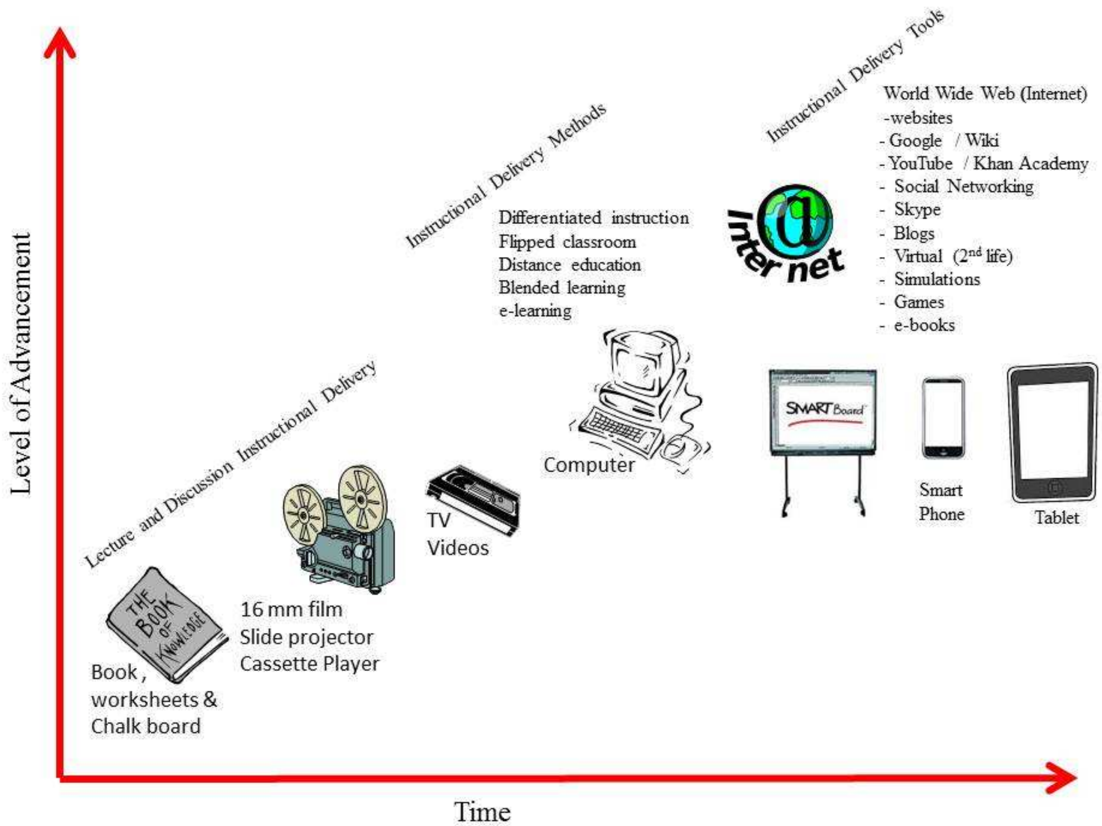

Figure 2. Historical Evolution of Instructional Technology. (Betrus, 2012)

different types of technology and the availability of digital technology to classroom teachers and students who use technology to access the world wide web (internet). The world wide web (WWW) provides an opportunity for teachers to present and disseminate instructional videos of academic content to students in addition to classroom lectures. The world wide web "appears to have the flexibility needed to let students order the material and choose the presentation format that best suit their preference" (Wallace & Mutooni, 1997, p. 211). So, teachers and students have a variety of instructional videos of academic content options available to them for use.

Khan Academy and *YouTube* are two prominent and free internet based video websites teachers can use to place their video lecture on to deliver academic content to students outside classes. Both *Khan Academy* and *YouTube* and other free internet based video websites would be considered by educational researchers as ideal sites for sharing microlectures. "A microlecture is a short recorded audio or video presentation on a single, tightly defined topic" (Educause, 2012, p. 1; Sweet, 2012).

> Khan Academy, which began in 2006, is a free Web site that currently features more than 1,600 short (10-20 minute) videos that teach a variety of subjects, especially in math and science. Users may browse by topic using the headings Math, Science, Humanities and Other. (Storm, 2011, para. 1)

Salman Khan, the founder of *Khan Academy*, . . .

> The videos are deliberately brief and concise. For example, the calculus module is divided into nearly 200 parts—very useful for students who want to review a concept or for those who need more repetition for mastery. . . . This site is excellent for supplementary instruction for science, technology, engineering, and math (STEM) students and educators at both the high school and college levels. (Storm, 2011, para. 1)

If a classroom teacher decides not to outsource a lecture to *Khan Academy,* they have the opportunity to create their own video lectures and make them available online on websites such as *YouTube*. *YouTub*e was founded in 2005 and became one of the most well-known and first genuinely mass-popular platforms for user-created videos posted online (Burgess & Green, 2009). As popular as *YouTub*e has become, there are other educational video libraries a teacher can store instructional videos, PowerPoint presentations, and other documents on. They include: *Voice Thread*, *author STREAM*, *SlideShare, TeacherTube*, *SchoolTube*, and *Vimeo.*

There are a number of software tools used by instructors to create their own instructional videos prior to posting them online. Teachers may use computer software such as SMART Recorder® which is associated with the popular Smart Board® inter-active whiteboards used in classrooms. Jing® Snagit®, and Screencast-o-matic® are free computer services that a teacher can use to capture basic videos, animation, and still images, and share them on the web. A powerful tool for creating and editing instructional video content is Camtasia Studio®.

Whatever video content a student accesses online, there are unprecedented opportunities to students including digital resources or educational content that learners have available online, which they can view at their own pace, on their own mobile device, and on their own time schedule. This provides the foundation for a flipped classroom instructional model in that students access the instructional videos outside their classrooms and time in the classroom is actually spent with the teacher on critical thinking, doing projects, problem-solving, or doing laboratory experiments.

Impact on Student Achievement of Technology Use in Classrooms

Educational reform efforts across the country in K-12 public education has included increased accountability on the part of local school districts. Motivation for greater public school accountability was heightened with re-authorization of the Elementary and Secondary Education Act (ESEA) in 2001. This federal legislative action became popularly known as the No Child Left Behind (NCLB) Act of 2001. "*No Child Left Behind* is the 21st-century iteration of this first major federal foray into education policy—a realm that is still mainly a state and local function, as envisioned by our Founding Fathers" (U.S. Department of Education, 2004, p. 13).

The hallmark of the federal government's education reform agenda was to hold schools accountable for improving the performance of all students in areas of math and reading. NCLB required student assessments to be developed by states and "be reported to the public disaggregated by race, gender, English language proficiency, disability, and socio-economic status" (Bush, 2001, p. 8). NCLB required states, school districts, and schools to be accountable for ensuring that all students, including disadvantaged students, would meet high academic standards.

Across the country, states began a vigorous effort to be in compliance with NCLB legislation. Under NCLB, the state of Minnesota's Department of Education (MDE) was required to generate academic content standards in core academic areas, measure those standards, and define student proficiency levels – minimum scores on a state assessment that students had to obtain in order to be considered academically proficient in core subjects. "According to NCLB, by 2005-2006, all students had to take annual reading and mathematics in Grades 3-8 and once during high school. By 2007-2008, students were to be tested in science and at least once in each of the following grade spans: Grades 3-5, 6-9, and 10-12. The overall goal of NCLB was to have all students proficient in reading and mathematics by 2014" (Technical Manual, MN Legislature 2007, p. 8).

In September of 2011, Arne Duncan, the U.S. Secretary of Education, wrote a letter representing views of the U.S. Department of Education regarding the No Child Left Behind Act of 2001. The letter indicated: many innovations and reforms . . .

> . . . were not anticipated when the No Child Left Behind Act of 2001 (NCLB) was enacted nearly a decade ago. While NCLB helped State and local educational agencies (SEAs and LEAs) shine a bright light on the achievement gap and increased accountability for groups of high-need students, it inadvertently encouraged some States to set low academic standards, failed to recognize or reward growth in student learning, and did little to elevate the teaching profession or recognize the most effective teachers. Instead of fostering progress and accelerating academic improvement, many NCLB requirements have unintentionally become barriers to State and local implementation of forward-looking reforms designed to raise academic achievement. Consequently, . . . [many states have been] petitioning . . . for relief from the requirements of the current law [NCLB]. One of . . . [the] highest priorities . . . [of the federal government at the time of this report has been] to help ensure that Federal laws and policies can support these reforms and not hinder State and local

innovation aimed at increasing quality of instruction and improving student academic achievement. (Duncan, 2011, para. 2)

The Minnesota Department of Education submitted a request to the U.S. Department of Education to waive aspects of NCLB and received notice of its waiver acceptance in February of 2012. The resulting new accountability system was based on multiple measures of reliable data to identify schools for recognition, accountability, and support. In addition, the new system provided a clearer focus on schools most in need of intensive intervention strategies and support, and moved the state forward in goals of closing achievement gaps and improving educational outcomes for all students (Minnesota Department of Education, 2012-2013).

Within the context of accountability for student achievement, "schools are working to improve achievement through the examination of instructional practice and the use of instructional technology" (Flumerfelt & Green, 2012, p. 356). A flipped classroom, with its tech-heavy emphasis, has been emerging as a favorable classroom instructional strategy.

In most cases, flipped classrooms require what is termed as a one to one (1:1) computing environment. For the purpose of describing a student's access to digital technology, this study used researcher William R. Penuel's definition of one-to-one computing, defined by three criteria: the machine referred to is a laptop, the computer is connected to the internet, and the school demands that students use it to complete academic tasks (Penuel, 2006).

> This research paper used a slightly modified “Penuel” definition of one-to-one projects, with an additional criterion: the computer must be used in a personal manner, meaning that one person must have access to the same computer at all times, with the same settings, programs, and folder structure. (Fleischer, 2012, p. 108)

Having all these digital resources available, what does the research indicate about student achievement where students use one-to-one computer projects?

Although overall results are mixed, recent studies have shown that carefully implemented 1:1 laptop initiative programs can increase students' general learning outcomes.

> Although there is evidence that 1:1 programs do not increase test scores in all situations, especially in the case of paper-and-pencil tests . . ., several studies have provided evidence that the use of laptops in the classroom can lead to increases in students' math and writing skills . . . and overall achievement. (Corn, Tagsold, & Argueta, 2012, p. 217)

Digital Technology Integrated Into a Flipped Classroom

> Despite massive investment in one-to-one projects across the country, few high-quality research studies have applied a strict research methodology to the subject of William R. Penuel’s research. On the other hand, there is an abundance of project evaluations, which tend to speak positively of the effects of one-to-one projects in schools. (Fleischer, 2012, pp. 109-110)

A study of a one-to-one computer project in the state of Maine may provide evidence of improved student achievement.

In the 2002-2003 academic year, the state of Maine implemented the Maine Learning Technology Initiative (MLTI) which met the criteria of a one-to-one computing initiative as defined by William R. Penuel. Eight years later, a MEPRI [Maine Education Policy Research Institute] research and evaluation team conducted an evaluation of the MLTI Initiative. The evidence presented in a report published in 2011 indicated, "The MLTI program has had a significant impact on curriculum, instruction, and learning in Maine's middle schools. . . . There also is some evidence of the direct impact of the laptops on student achievement" (Silvernail, Pinkham, Wintle, Walker, & Bartlett, 2011, p. 1).

The state-funded Maine Learning Technology Initiative (MLTI) provided computers to all 7th and 8th grade classroom teachers and students in nearly 110 school districts; however, how these computers were implemented in classroom settings was a local school district decision. It is not surprising a lack of a uniform technology utilization plan resulted in varying degrees of teacher interest and enthusiasm on computer use in classrooms. It was noted in the MEPRI's report that, "If a teacher actively participated in the . . . [staff development technology activities], increased their own content knowledge, and implemented classroom technology use practices, then student achievement improved." (Silvernail et al., 2011, p. 23). It would seem apparent, schools must have not only the capability to use laptops for instruction effectively, but also clear strategies and supports in place for ensuring effective student laptop use (Warschauer, 2006).

"In the spring of 2008, the North Carolina State Board of Education awarded a contract to the Friday Institute for Educational Innovation to conduct a 3-year evaluation of the North Carolina 1:1 Learning Technology Initiative (NCLTI) pilot schools" (Corn, Tagsold, & Argueta, 2012, p. 217). From 2007-2009, nearly 9,500 students and 650 teachers in 18 schools across North Carolina were provided laptop computers.

> The overall goal of the initiative is to use the technology to improve teaching practices, increase student achievement and better prepare students for work, citizenship and life in the 21st century. The intent of the evaluation was to provide information about whether the initiative enhanced student learning, as well as to identify challenges to successful implementation of 1:1 programs, strategies for meeting those challenges, and services and supports needed to enable successful programs throughout the state. (Corn, Tagsold, & Argueta, 2012, p. 217)

The evaluation also examined "the role of **students with special needs** in the successful implementation of a 1:1 program" (Corn, Tagsold, & Argueta, 2012, p. 217).

The results of the NCLTI pilot schools study indicated teachers who taught students with disabilities generally reported positive outcomes regarding the laptop initiative. Greater technology access resulted in improved communication and assessment methods, reading ability, enhanced organization, and increased confidence of students with special needs. "Teachers reported, to increase the success of the 1:1

initiative, teachers must continually pursue professional development opportunities involving new technologies and be willing to make mistakes when first utilizing digital content in the classroom" (Corn, Tagsold, & Argueta, 2012, p. 222).

Schools across the country have been working to improve student achievement through consideration of instructional practices such as flipped classrooms and the use of instructional technology. Testimonials, albeit generalized, abound about student success with implementation of a flipped classroom. For example, a principal of a 510-student Title I elementary school in Elgin, Illinois' District U-46, indicated, "We use technology to augment our traditional reading instruction in a flipped approach to student-teacher instructional interaction. This has resulted in improved academic outcomes" (Corcoran, 2013, p. 22).

Case studies have indicated the use of flipped classroom instruction improves student achievement. One such case study was in Clintondale High School (CHS) in Clintondale, Michigan. Clintondale had a student population that was 73% black where 74% of its 9-12 student body were eligible for free and reduced price meals. The high school implemented a flipped learning model at the start of the 2010-2011 school year. At the end of the school year, the school reported, in one high school social studies class that implemented the flipped learning model, all students passed the class. However, in another high school social studies class in which a traditional lecture instruction model was used, the pass rate was unchanged from the previous year (Pearson Education, Inc., 2013).

The principal at Clintondale High School further indicated, “test scores, graduation rates, and college attendance have increased” (Pearson Education, Inc., 2013, p. 2; see Figure 3). In addition, “student engagement has improved dramatically, and discipline problems have declined in both number and severity” (Pearson Education, Inc., 2013, p. 2).

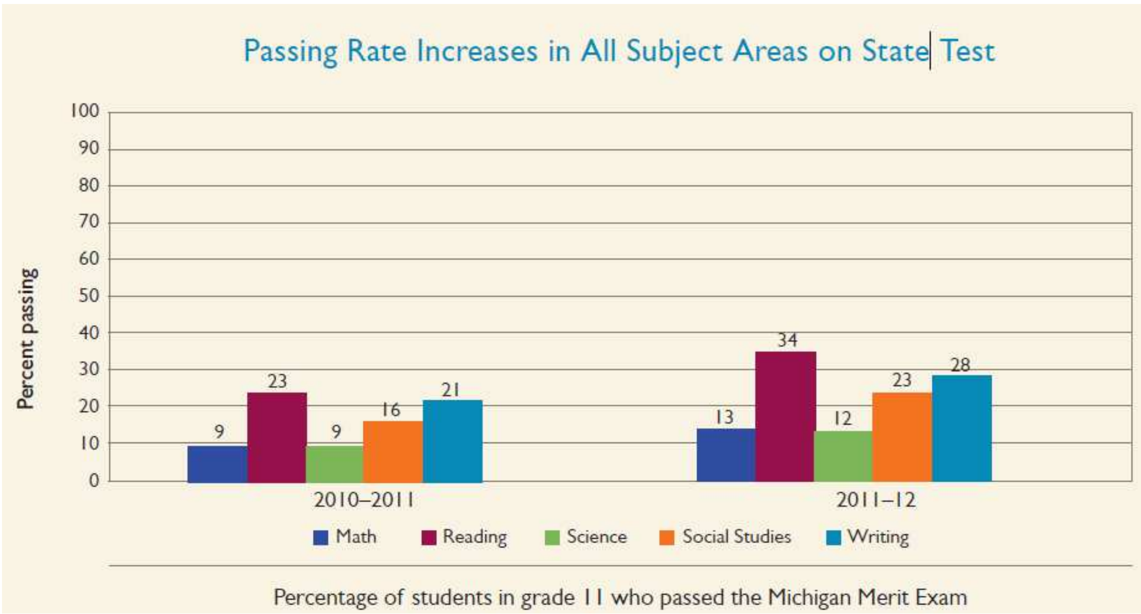

Figure 3. Passing Rate Increases in All Subject Areas on Michigan State Test. Reprinted from “Flipped Learning Model Dramatically Improves Course Pass Rate for At-Risk Students,” by Pearson Education, Inc., 2013, retrieved from http://assets.pearsonschool.com/asset_mgr/current/201317/Clintondale_casestudy.pdf, p. 2. Copyright 2013 by Pearson Education, Inc.

Figure 3 indicates:

> In the freshman class in the first flipped learning semester, the pass rate increased to 67 percent in English language arts, 69 percent in math, 78 percent in science, and 81 percent in social studies, representing an

> increase of 9 to 19 percentage points across the subjects" (Pearson Education, Inc., 2013, p. 2).

The Clintondale High School case study indicated a flipped classroom can have a positive impact on passing rates of students at risk. One researcher has been identifying positive impacts of the flipped classroom instructional model for college preparatory classes. In 2012, Ruddick, a graduate student at the University of Memphis, . . .

> Results showed that the RI students outperformed the standard lecture-based students. . . . Comments on the SALG survey suggested that the RI (flipped) students became more interested in and felt less intimidated by chemistry and found the online video and PowerPoint materials useful." (Herreid & Schiller, 2013, p. 63; see also Ruddick, 2012, for more information on Ruddick's study).

"Virtually unknown a few years ago, the Flipped Learning model of instruction is gaining attention . . . among instructors and professors at the college and university levels" (Aronson, Arfstrom, & Tam, 2013, para. 1). College instructors and professors are discovering a flipped classroom has a positive impact on students' attitudes toward their classes and instructors as well as on students' performance in classes. Wilson (2013), a member of the Department of Psychology at Capital University in Columbus, Ohio, implemented a flipped classroom in an undergraduate statistics course in the 2010-2011 academic year and again in the fall of 2011. The semester courses were evaluated by students in accordance with the university's faculty evaluation system. Results of student evaluations indicated the average rating increased on each survey question after a flipped classroom instructional model was implemented (Table 2). The data indicated students' attitudes toward their class and instructor had improved since changes described here were implemented.

Table 2. Student Evaluations of Course and Instructor.

	Traditional Class Structure[a]	"Flipped" Classroom[b]
Evaluation	*M (SD)*	*M (SD)*
Progress on relevant objectives	3.95 (0.07)	4.90 (0.14)
Excellent teacher	3.95 (0.21)	4.70 (0.00)
Excellent course	3.85 (0.35)	4.40 (0.42)

Note. IDEA Center results (5-point scale).
[a]n = 2 classes taught during the 2010-2011 academic year.
[b]n = 2 classes taught fall 2011 semester.

Reprinted from "The Flipped Class: A Method to Address the Challenges of an Undergraduate Statistics Course," by S. G. Wilson, 2013, Teaching of Psychology, 40(3), p. 197. Copyright 2013 by SAGE Publications.

Wilson (2013) said, "Although this improvement is gratifying, the primary motivation for implementing the changes was to enhance student learning of the course material" (p. 197). Student performance results indicated:

> There was no difference in pretest scores between students enrolled in . . . [classes] taught using the new [flipped classroom] method . . . and students enrolled in the two previous [traditional lecture method] sections. However, there was a significant difference in posttest scores between students enrolled in the first two sections taught using the new [flipped classroom] method . . . and students enrolled in the two previous [traditional lecture] sections. (Wilson, 2013, p. 197)

Positive Aspects and Shortcomings of a Flipped Classroom

Jonathon Bergmann and Aaron Sams have been regarded as creators of the flipped classroom instructional delivery method used at the time of this report. The flipped classroom has provided a means for students of Bergmann and Sams to continue with classroom instruction and content during periods when students have been absent from class for reasons which range from illness to attending student activities (Pappas, 2013). Over time, classroom instruction has evolved to the point where Bergmann and Sams "came to realize that Flipped Learning offered many advantages" (Cooney, 2014, para. 5) including:

- Efficiency
- Reproducible, scalable, and customizable content
- Student centered content
- Increased student to teacher interaction
- Increase student and student interaction
- Students assume the responsibility for learning" (Cooney, 2014, para. 6)

Additionally, in the flipped classroom, "The teacher's role changes. Instead of being the 'Sage on the Stage,' the teacher becomes a 'Guide on the Side.' The teacher's role within the flipped model is to provide:

- Accountability
- Expert feedback
- Concept Clarification
- Project/activity oversight" (Cooney, 2014, paras. 8-9)

So, as teachers change from a traditional lecture style of instruction to a flipped learning instruction strategy, their role changes from being the expert on a subject to providing guidance and steering students to learning on their own. The classroom lecture by the teacher is still a prominent part of the flipped classroom, however, "Instead of using class time to deliver the content using a passive delivery vehicle, they [teachers] utilize class time for active learning a more" (Cooney, 2014, para. 10).

In addition to the advantages of flipped classroom instructional strategies, there are practical disadvantages to the flipped classroom which a teacher may have no power to control or change. For instance, schools may not have the financial resources to purchase, maintain, support, and install needed technology, or the technology needed so every student can use and access the internet. Rural schools, schools with aging facilities, and schools with a high number of low income students are most likely to experience a shortage of funding to direct into technology (Pappas, 2013).

Within the actual classroom, "there is no guarantee students will watch the online lecture at home and come to class prepared. A Flipped Classroom's success is dependent on student participation" (Pappas, 2013, para. 8). An additional disadvantage for implementing a flipped classroom is parental "buy in" to a type of classroom experience they may not understand (Pappas, 2013).

Parents of today's students came from a different generation and had a different school experience void of many of the resources available today for their children. Resistance to flipped classrooms may also come from teaching colleagues and a school's administration. For the teacher actually implementing a flipped classroom, planning, creating, and providing relevant digital classroom resources on the classroom content storage space may, especially initially, lead to a large workload (Pappas, 2013).

The literature has demonstrated digital technology is pervasive and has been implemented to varying degrees in K-12 classrooms across the country.

> It is also important to note that ubiquitous computing access creates an environment that today's youth expect in their learning environments. They do not see technology as a mere tool for learning but a basic element of their day to day environments." (Mills, 2010, p. 60)

Since students are constantly plugged in, can the use of the technology they love so much be used as a part of an instructional model to improve school performance? The intent of this dissertation is to analyze student data within a flipped classroom instructional model to determine the extent to which the use of digital technology and digital resources is perceived to improve student learning and academic performance.

CHAPTER III

RESEARCH METHODS

Introduction

Chapter III describes study methods used for this research. The researcher used a mixed method case study research approach that combined collection and analysis of quantitative student achievement data and qualitative student survey data. Characteristics of participants of the study setting, and sample size are defined, along with descriptions of research methodology, survey instrument procedures, student assessments, and data analysis.

Research Methodology

The researcher used a case study approach with qualitative and quantitative research methodologies to guide this study. This mixed method research was used within a case study of a single high school mathematics department. The following research questions guided this study:

1. What are high school student perceptions of the flipped classroom as a classroom instructional strategy?
2. What are high school student perceptions of their learning experiences using digital resources and digital technology in a flipped classroom?
3. What effect does the use of digital resources and digital technology within a flipped classroom environment have on student achievement based on

common assessments such as the Minnesota Comprehensive Assessments (MCAs) and college entrance exams such as ACT® tests?

Design

A case study may be a beneficial tool for school administrator practitioners to consider prior to a change in or implementation of a new program, activity, or policy. "Case studies are typically carried out in close interaction with practitioners, and they deal with real management situations. Case studies therefore represent a methodology that is ideally suited to creating managerially relevant knowledge" (Gibbert, Ruigrok, & Wicki, 2008, p. 1465).

The flipped classroom with its emphasis on the use of computers and internet resources is gaining grassroots popularity, and in this form, is still a relatively new classroom instructional strategy. "Case studies are considered most appropriate as tools in the critical, early phases of a new management theory program, activity, or policy when key variables and their relationships are explored" (Gibbert, Ruigrok, & Wicki, 2008, p. 1465). From a practitioner point of view, rather than subscribing to the fascination of the latest and greatest fade in education, a practitioner may use a case study to provide valuable insights into how a new practice or technology affects student achievement before implementing that practice or technology.

This case study approach followed the description of a single case explanatory case study as defined by Baxter and Jack (2008) and Yin (2003) to describe a possible link between a flipped classroom instructional strategy and its effect on student achievement. Data sources within the case study included student surveys, direct observation, and interviews from a site visit by the researcher.

The researcher has attended professional association conferences as part of his professional development and in the normal course of his professional job duties. During those conferences, the researcher has attended informational sessions on flipped classrooms. In the recent past of this study, the researcher attended flipped classroom presentations by a Central School math teacher during both the Minnesota School Board's Association's and the Minnesota Association of School Administrators' state conferences. Exposure to the Central School math teacher and the content of this teacher's presentation(s) led to this research effort. It is the intent of this research to report findings of student perceptions on digital resources and digital technology in a flipped classroom, and impacts of those resources and flipped classroom setting on student achievement.

Qualitative data in the form of student perceptions, attained through two student survey instruments, was created and collected by teachers in Central School's math department, who, after collectively implementing a flipped classroom instructional strategy in math classes, sought to identify perceptions of high school math students in flipped classrooms during the 2011-2012 school year. Qualitative data was collected by classroom teachers through the use of a survey developed by the classroom teacher and completed by students using *Google Forms*. The survey included open-ended questions for students to respond to. *Google Forms* was the survey tool utilized because Central School is a *Google Apps for Education* school thereby enabling the survey to be e-mailed to students and responses collected and linked into an online *Google Apps* spreadsheet. Data collection was completed by classroom teachers in mid-November 2011 and in mid-January 2012. The researcher used this student survey data to guide the study on student perceptions.

The researcher, a practicing Superintendent of Schools, conducted a site visit of Central School in mid-May of 2014. The school district where the researcher was employed was seeking to review and gain an understanding of how schools have implemented computer technology in the classroom. The site visit was supported by and under the direction of the researcher's Board of Education as a part of the researcher's normal and typical superintendent duties associated with successful management and operation of the school district (Appendix F).

The researcher observed a teacher implementing flipped classroom instructional strategies in a high school math classroom. In addition, the researcher interacted with students in the flipped classroom environment. As a part of the site visit, the researcher, as a practicing school administrator, also interviewed three high school teachers implementing flipped classroom instructional strategies, the high school principal, and the superintendent of the school district.

Quantitative data to identify what effect the use of digital resources and digital technology within a flipped classroom environment has had on student achievement was collected by accessing the Minnesota Department of Education (MDE) website. The MDE website has provided MCA results and analysis for all Minnesota public schools including Central School's results for students in the 2011-2012 school year and beyond.

The MDE website provided users with the ability to download individual school results as well as the ability to provide comparisons and analysis to other schools and state of Minnesota results.

Additional quantitative data was collected from American College Testing (ACT®) which provides a high school profile report indicating results of Central School students taking the math portion of the ACT® test. The ACT® Profile Report for schools provides ACT® math results for Central School, math ACT® results for the state of Minnesota, and math ACT® results for the United States. The researcher used MCA and ACT® quantitative data sources to guide the part of this study on student achievement.

Characteristics of the Case Study Setting

Flipped Classrooms Utilizing Digital Technology at Central School

The location for this study was a rural Minnesota high school given the pseudonym of "Central School" by the researcher. Central School is a high school of nearly 550 students in 7th through 12th grade. The Central School math department began unintentionally and unknowingly laying the groundwork for a flipped classroom instructional delivery system utilizing digital resources and technology during the 2009-2010 school year. The school district's administration made its school district staff and residents aware that it was faced with a $1 million plus district-wide budget deficit effective in the 2010-2011 school year. Efforts to reduce the deficit ranged from reducing staff to delaying the purchase of costly textbooks. A solution proposed by the Central School math department to school administrators as math teachers' efforts to ease the budget deficit was to implement a textbook-free math curriculum. Budgetary savings would be recognized by not replacing old, dated text books.

In lieu of textbooks, the Central School math department would create its own textbook-free curriculum with free online digital resources. Teachers utilized their existing classroom technology tools such as inter-active white boards and laptops along with online resources such as YouTube®, C K12® and Kuta®, a worksheet generator to develop, teach, and assess math instruction and standards. In a short period of time, the math department created a math curriculum within each of its math courses that met state math standards. In addition, the curriculum was flexible enough to be able to change with the ability of students and even able to change if the state standards were to change.

Each course had its digital content accessible through Moodle®, a web-based open source software that allows teachers to post math content videos or links to other content videos which students can access for learning. Students were able to access these online resources within their own schedule 24 hours a day, 7 days a week.

The evolution and availability of new technology and educational resources online along with the concept of changing from a direct or teacher centered instructional model to a student centered instructional model led to growth in use of the traditional flipped classroom first used in the math department of Central School during the 2010-2011 school year. Over time, innovative Central School math teachers began to utilize variations of the traditional flipped classroom, namely the *peer instruction* model. Flipped classroom innovation originating in Central School's math department was developed within a culture of innovation as a part of Central School's continuous improvement model and fostered by its school district administration.

Central school was selected for this case study for two reasons. One, Central School received a national award for High School Mathematics prior to this study. The national award honored Central School for implementing innovative math and science programs and serving as models for other schools. An outcome of Central School receiving a national award for high school mathematics included recognition for the school in several publications.

The second reason Central School was selected was because the school's lead math teacher was recognized in his state as one of the top educators and proponents on the use of flipped classroom strategies. This teacher has provided presentations to professional education groups at the state and national levels including: the Minnesota School Board's Association, the Minnesota Association of School Administrators, the Minnesota Council of Teachers of Mathematics, the Minnesota Association of Secondary School Principals and FlipCon National Conferences in 2013 and 2014. This teacher has had two decades of high school math teaching experience and has been featured as a contributor to a book.

Central School was part of an independent school district located in southeastern Minnesota. Central School had a student population between 512 and 530 students or approximately 130 students per grade in its Grades 9-12 program at the time of this study. All high school students were housed in one school building with 34 licensed staff responsible for providing educational services to its students. All of Central School's core courses were taught by highly qualified licensed teachers.

The school was located in a community which was close in proximity to a regional center in southeast Minnesota. Although agriculture and agriculturally related economic activity was prevalent in this area at the time of this study, many Central School adult residents commuted to the nearby regional center for employment.

The demographics of Central School's district student population did not reflect state-wide K-12 student demographics as evidenced by Tables 3 and 4.

Table 3. Percentage Enrollment by Selected Demographic Category for Minnesota and Central School's District Student Population – 2014.

Enrollment by Ethnicity or Special Population	State of Minnesota	Central School District
White, not of Hispanic origin	71.5%	94.4%
English Language Learners	8.1%	0.1%
Special Education	14.9%	10.1%
Free/Reduced Price Lunch	38.5%	14.1%

Note. Adapted from "Demographics: What type of student is enrolled," by the Minnesota Department of Education, 2014a, *Minnesota Report Card*, Demographics [Click on Demographics button]. Retrieved January 1, 2014, from http://rc.education.state.mn.us/ . Copyright 2014 by the Minnesota Department of Education.

Note. The source for Central School District data has been omitted to maintain confidentiality.

Table 4. Graduation Rate Trends – Comparison Between State of Minnesota and Central School's School District.

Year of Graduation	State of Minnesota	Central School District
2009	74.3%	95.3%
2010	75.5%	94.6%
2011	77.2%	97.7%
2012	77.9%	92.2%
2013	79.8%	91.3%

Note. Adapted from "Graduation Rates: What is our graduation rate," by the Minnesota Department of Education, 2014b, *Minnesota Report Card*, Graduation Rates [Click on "Graduation Rates" button]. Retrieved January 1, 2014, from http://rc.education.state.mn.us/ . Copyright 2014 by the Minnesota Department of Education.
Note. The source for Central School District data has been omitted to maintain confidentiality.

A History of Flipped Classroom Development at Central School
(Any citation compromising confidentiality has been omitted)

During the 2009-2010 school year, the Central School math department recognized its mathematics textbooks were not up-to-date in terms of age and meeting current and changing state math standards. During this same time period, the district's financial position was such that it had to reduce financial expenditures by over $1 million for the subsequent school year. Because of these financial limitations, math teachers at Central School decided to change their classroom instructional delivery system.

Planning for this instructional paradigm shift was initiated by the high school math teachers and received the support of school administrators. Planning and development began in earnest in January of 2010 as part of the school's continuous improvement model and through Central School's professional learning community

(PLC). An outcome of this planning effort was extensive curriculum re-writing and development completed in the summer of 2010. Curriculum re-writing laid the foundation for implementation of a flipped classroom instructional delivery system to go into effect with the start of school in the Fall of 2010.

Math teachers already utilized SMART board® technology in classrooms and had access to the internet. Some teachers recorded lessons and placed them on YouTube®. Teachers decided to expand use of digital technologies available on the internet. Using Moodle, an online, open source software for collaborative learning, teachers created a website for each math course that listed essential learning outcomes (ELOs) by unit, and contained teacher created instructional videos, and links to other videos by other teachers. In addition, teachers created a Homework Solutions website for students in Central High School.

Central School administrators were supportive of math teachers' innovative efforts to change classroom instruction. Support was manifested by the district absorbing initial costs of set-up of technology. The district also provided support for on-going professional development for teachers to develop a textbook free curriculum. Technical support considerations included the district increasing its bandwidth to handle increased internet traffic as well as adding additional personnel to the technology support staff.

By combining teacher, administration, and technology departments' work efforts and vision, Central School created the capacity to change their classroom instructional model. The outcome of these planning efforts was implemented in the Fall of the 2010-

2011 school year, with a textbook free math curriculum that met state standards and was able to adjust as state standards changed or as student needs changed.

As part of the planning, developing, and implementing process, teachers realized digital resources available to students and teachers also challenged current and prevalent teacher centered methods of teaching or the lecture educational delivery system. With use and availability of digital resources and digital technology, dynamics of teacher instruction have been able to change or move towards a student-centered instruction model. For use in their own classrooms, the Central School math department began to investigate a flipped classroom instructional delivery strategy pioneered by Colorado science teachers Jonathan Bergmann and Aaron Sams (2012). In a flipped classroom, students watch engaging videos and learn educational material before class, then they have face-to-face peer and teacher class time to discuss and apply or remediate concepts.

Central School was using a traditional flipped classroom instructional strategy in 9-12 grade math classrooms in the Fall of 2010. Over the next 4 year period, the traditional flipped classroom instructional strategy was modified to the point where the *Peer Instruction* Flipped Learning model become the instruction strategy used in Central School math classrooms. A timeline for Central School's implementation of a flipped classroom instructional strategy in math classrooms is shown in Table 5.

Table 5. Timeline of Central School Math Department Implementing a Flipped Classroom Instructional Model.

Year of Implementation	School Year	Instructional Delivery Model Utilized
	2009-2010	Teacher centered - Lecture
1	2010-2011	Student centered - Flipped classroom
2	2011-2012	Student centered - Flipped classroom in Semester I and peer instruction in Semester II
3	2012-2013	Student centered - Flipped classroom (peer instruction model)
4	2013-2014	Student centered - Flipped classroom (peer instruction model)

Measuring Student Achievement

An end result of an instructional strategy is learning. That is what we strive for.

> Testing is used in schools to measure student achievement. State tests are given to students in a district once a year, based on their grade level and subject area. Classroom tests are given by individual teachers on a more regular basis and may include quizzes, mid-terms, chapter tests, and final exams, among others. Both types of tests give educators an idea of how well their students are learning the concepts presented to them in the classroom. (Minnesota Department of Education [MDE], 2014e, para. 1)

"The Minnesota Comprehensive Assessments (MCAs) are state tests in mathematics, reading, and science" (MDE, 2014d, para. 1) developed under the auspices of the Minnesota Department of Education (MDE) "that meet the requirements of the federal

Elementary and Secondary Education Act (ESEA)" (MDE, 2014d, para. 1). MCA math tests "are given every year" (MDE, 2014d, para. 1) to students in Grades 3-8 and in Grade 11 "to measure student performance against the Minnesota Academic Standards that specify what students in a particular grade should know and be able to do" (MDE, 2014d, para. 1).

Central School 11th grade students participated in the required state MCA math testing program from the 2009-2010 school year to 2013-2014 school year. State testing information (data) by school can be publicly viewed and retrieved on the Minnesota Department of Education website. MCA results inform curriculum decisions at the district level; inform instruction at the classroom level; and, in reading and mathematics, demonstrate student academic progress from year to year (MDE, 2014d).

Parents can utilize MCA results to determine their child's progress from year to year, to review and compare their child's school performance to other schools, and to use MCA data to make decisions about enrollment of their child in a particular school. Permission was granted by an authorized representative of the "Central School" School District to utilize existing student assessment and survey data to conduct this study (Appendix C).

"The ACT® is a curriculum- and standards-based educational and career planning tool that assesses students' academic readiness for college" (The ACT®, 2015, para. 1). "One component of the ACT is a battery of four multiple-choice tests of educational achievement—English, Mathematics, Reading, and Science" (The ACT®, 2014, p. 1, para. 2). "The ACT, typically taken in the eleventh or twelfth grade, measures students' academic readiness for college in key content areas" (The ACT®, 2014, p. 1, para. 5).

> ACT data are used for many purposes. High schools use ACT data in academic advising and counseling, evaluation studies, accreditation documentation, and public relations. Colleges use ACT results for admissions and course placement. . . . Many of the agencies that provide scholarships, loans, and other types of financial assistance to students tie such assistance to students' academic qualifications, as measured by ACT scores. (The ACT®, 2014, p. 1, para. 4)

Some states such as North Dakota use ACT® exams as a part of state-wide assessment programs. Other states use the ACT® is a voluntary assessment taken by students. At the time of this study, 11th or 12th grade students in the state of Minnesota took the ACT® on a voluntary basis.

Study Population

The study group consisted of high school math students in grades 8 through 12 who were enrolled in mathematics classes in the Central School math department utilizing a flipped classroom instructional delivery model during the 2011-2012 school year. A survey developed by Central School math teachers was completed by students in Grades 8 through 12 enrolled in eight different math courses. Of the eight math courses offered, five had mixed grades of students taking the course (Table 6).

Table 6. Grade Levels Taking Math Courses Offered at Central School – October 2011.

Grade Enrolled in Course	Central School Math Course Title
8	8th Grade Accelerated Math
9 and 10	High School Algebra 1
9 and 10	Geometry
10 and 11	Accelerated Algebra 2
11	Algebra 2
11 and 12	Statistics
11 and 12	Pre-Calculus
12	Calculus

Survey Instrument

Two student surveys were developed by the Central School math department during the 2011-2012 school year so classroom teachers could determine student perceptions of the flipped classroom instructional strategy and determine how flipped classrooms could be improved. Teachers created the survey using *Google Forms.* This survey development tool was utilized because Central School is a *Google Apps for Education* school thereby enabling the survey to be e-mailed to students and responses collected and linked into an online *Google Apps* spreadsheet. Each of the student surveys were web-based and intended to take between 7 to 15 minutes to complete. The researcher did not influence or participate in the development of the student surveys.

The first student survey was administered to Central School students in October of 2011 (Appendix D). The survey was nine questions in length. The survey sought student opinions on flipped classroom instructional strategies and using digital technology with the use of two types of survey questions: (a) close-ended survey questions utilizing a five point Likert Scale; and (b) open-ended survey questions which, in order to elicit a response, required participants to type in their answer.

The second student survey was administered to Central School students in January of 2012 (Appendix E). This survey was eight questions in length. The survey sought student perceptions on flipped classroom instructional strategies and using digital technology with the use of two types of survey questions: (a) close-ended survey questions utilizing a five point Likert Scale; and (b) open-ended survey questions which, in order to elicit a response, required participants to type in their answer.

Student Achievement Instrument

The instruments to collect quantitative school achievement data were the Minnesota Comprehensive Assessments (MCAs) and ACT® data. MCA math tests have been required to be given every year to students in Grades 3-8 and in Grade 11 "to measure student performance against the Minnesota Academic Standards that specify what students in a particular grade should know and be able to do" (MDE, 2014d, para. 1).

Central School 11^{th} grade students participated in the required state MCA math testing program from the 2005-2006 school year to the 2013-2014 school year. A description of state testing information and data by school can be publicly viewed and retrieved on the Minnesota Department of Education website.

The ACT® is typically taken in the spring of the school year by students generally in 11th or 12th grade (Figure 4).

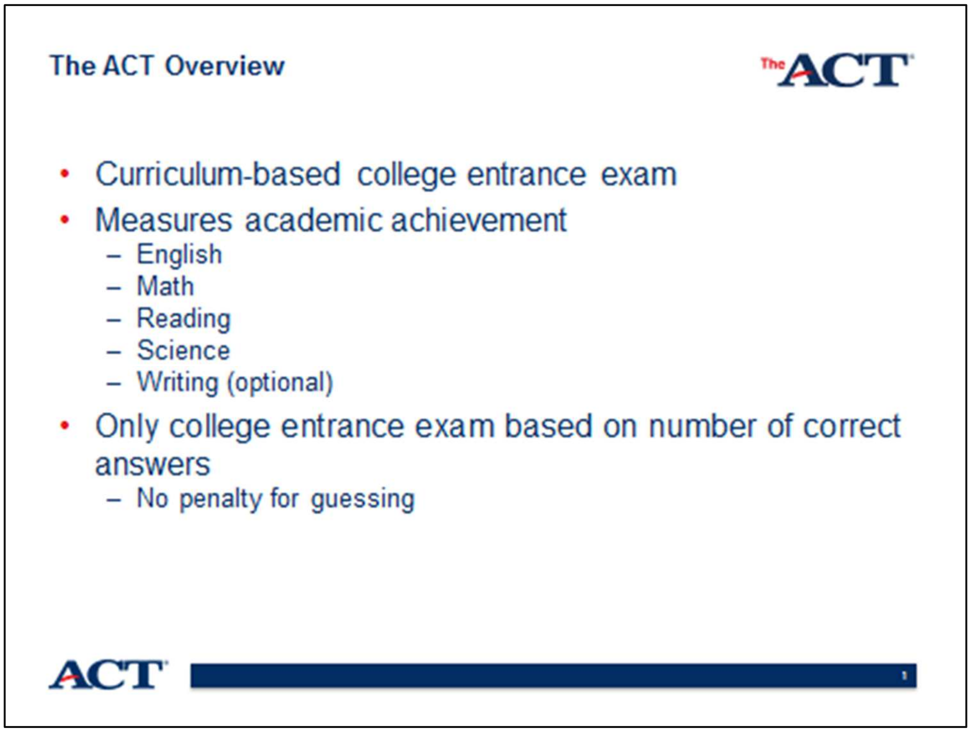

Figure 4. Brief Overview of ACT® Assessment Exam. Reprinted from "ACT Content," by A. Hansen, 2015, a PowerPoint presentation, p. 1. Copyright 2015 by ACT, Inc.

Mathematics is one of four academic content areas tested within the ACT® (Figure 5). Central School 11th grade students participated in the ACT® testing program from the 2009-2010 school year through 2013-2014 school year. ACT® testing information (data) by school can be publicly viewed and retrieved on the Minnesota Department of Education and ACT® website.

Procedures

Two surveys were completed by students in Grades 8 through 12 enrolled in eight different Central School math classes during the 2011-2012 school year. Teachers introduced the survey to students during class and explained its importance in helping teachers understand student perceptions of using a flipped classroom instructional strategy. Teachers explained to students the survey was voluntary.

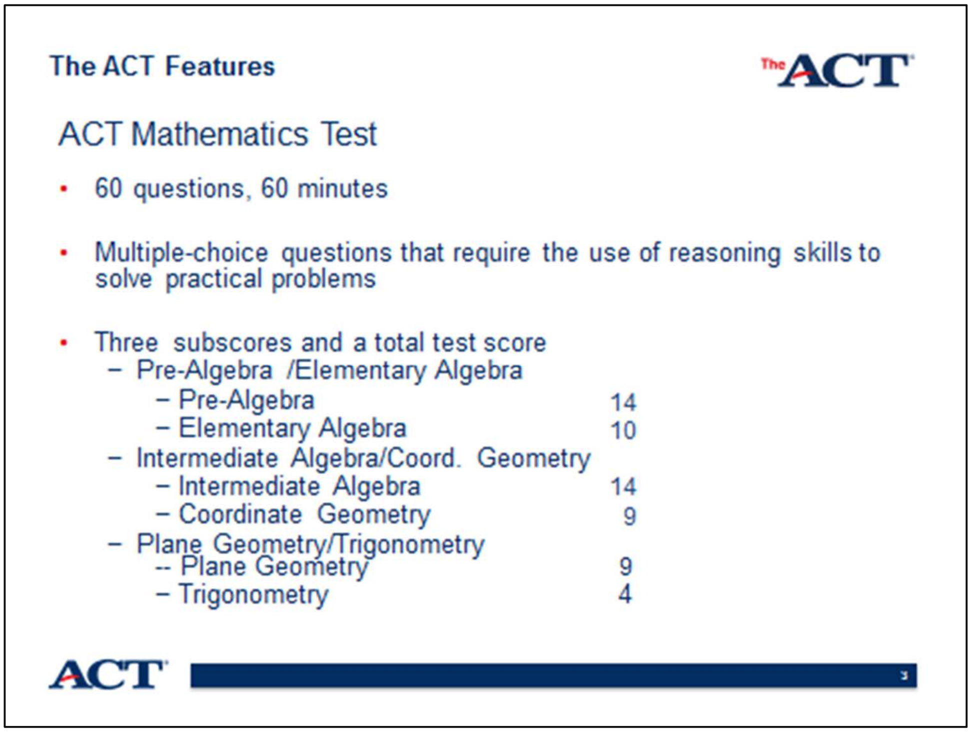

Figure 5. Overview of ACT® Mathematics Test. Reprinted from "ACT Content," by A. Hansen, 2015, a PowerPoint presentation, p. 3. Copyright 2015 by ACT, Inc.

The first survey was distributed as a web-based link within an e-mail sent to each student's school-issued g-mail account in mid-October of 2011. Students would open the *Google Form* survey link, complete the nine question survey and submit their survey responses. Students were given two weeks to complete the survey. During the assigned time frame, students would complete the survey at their own pace and time schedule using whatever computing device connected to the internet available to them. Classroom teachers sponsoring this survey were able to monitor the number of students responding to the *Google Form* survey. Classroom teachers provided classroom reminder(s) to students to complete the on-line survey within the two week survey time period.

The second survey was distributed as a web-based link within an e-mail sent to each student's school-issued g-mail account in mid-January of 2012. Students would open the *Google Form* survey link, complete the eight question survey and submit their survey responses. Students had two weeks to complete the second survey. During the assigned time frame, students would complete the survey at their own pace and time schedule using whatever computing device connected to the internet available to them. Classroom teachers sponsoring this survey were able to monitor the number of students responding to the *Google Form* survey. Classroom teachers provided classroom reminder(s) for students to complete the on-line survey within the two week survey time period.

This researcher visited Central School in mid-May of 2014 as a part of the researcher's normal and typical superintendent duties associated with successful management and operation of his school district (Appendix F). The researcher observed a teacher implementing flipped classroom instructional strategies in a high school math classroom. In addition, the researcher observed students working in small groups and interacted with students in their small groups in their classroom setting.

Data Collection

Upon students completing and submitting their on-line surveys, student responses were recorded within a *Google Apps* spreadsheet. All student responses were automatically collected and linked into a *Google Apps* spreadsheet which permitted sponsors of the survey to analyze student data using charts and other spreadsheet functions and capabilities. Survey sponsors were able to view each student's response within a *Google Apps* spreadsheet in a single row of the spreadsheet with each survey question shown in a column of the spreadsheet. Permission to use student survey data for this research was granted by the superintendent of the Central School District (Appendix C).

Quantitative MCA and ACT® student achievement data was obtained by accessing the MDE website. Additional ACT® student achievement data was obtained from ACT, Inc. and the math department at Central School also provided the researcher with existing student assessment results from the 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013 and 2013-2014 school years. Permission to use student achievement data was also granted by the superintendent of Central School's District (Appendix C).

Qualitative data was collected by the researcher from student responses during a mid-May 2014 site visit. The researcher (acting as a consultant) interacted with students while they were working in small groups in a flipped classroom environment. The researcher asked questions directed to the group. The researcher used pen and paper to record student responses.

Data Analysis

The variables within this study were student perceptions of digital resources available in a flipped mathematics classroom based on survey results from students and aggregate assessment results on the Minnesota Comprehensive Assessments (MCAs) and

ACT® tests. A frequency and percentage analysis was conducted to determine student perceptions of digital resources available in a flipped math classroom. The researcher worked with Dr. Jim Sheehan, an independent private developer, to create and present Minnesota Comprehensive Assessments and ACT® assessment metrics summary reports. Data collected from Minnesota Comprehensive Assessments and ACT® test results was analyzed and reported. Chapter IV will report the main findings pertaining to research questions and data collection from the study.

CHAPTER IV

DATA RESULTS AND ANALYSIS

The purpose of this study was to analyze student perceptions of their classroom teacher's use of flipped classroom instructional strategies, and student perceptions of their learning experiences using digital resources and digital technology in a flipped classroom. Although perceptions are important, student achievement or student performance data is a common tool used by policy-makers and judged by the general public as a means to strive for continued improvement in K-12 public education. The variables within this study are student perceptions of their learning experiences in a flipped classroom and student performance skills based on pre-existing survey results from students and state assessment results from Minnesota Comprehensive Assessments (MCAs) and assessment results from ACT® tests.

Analysis of Data

Research Question #1

What are high school student perceptions of the flipped classroom as a classroom instructional strategy?

Qualitative data in the form of student perceptions was obtained through two student survey instruments created and collected by teachers in Central School's math department (Appendices D and E). Student surveys were conducted after Central School's math department had collectively implemented flipped classroom instructional strategy in math classes. The intent of Central School's math teachers was to identify perceptions of high school math students in flipped classrooms during the 2011-2012 school year. Qualitative data collection was completed by Central School classroom teachers in mid-January of 2012. The researcher used student survey data from Appendix E (January 2012) to guide the study on student perceptions for Research Question #1.

Central School teachers used six questions in the survey to measure student perceptions of their flipped math classroom. Two of the survey questions were answered by students based on pre-populated choices. On two survey questions, students were asked to select their response on a Likert-type scale. The Likert-type scale was developed by Central School math teachers to measure student perceptions of the flipped classroom as a classroom instructional strategy. A frequency and percentage analysis of the survey data provided by Central School students was completed to determine student perceptions of the flipped classroom as a classroom instructional strategy. The final two questions within the survey were considered "open ended" where students stated their thoughts on the flipped classroom process. The researcher analyzed student responses to "open-ended" questions. A numeric code was created for each fact isolated from participant responses. Facts were grouped into categories. Categories were grouped into themes. Student responses were tallied and reported in table or graphic form.

Table 7 indicates the math courses students enrolled in Central School participated in during the student survey in mid-January, 2012.

Table 7. Frequency and Percentage of Students Enrolled in High School Math Classes in Central School – January, 2012.

Type of Math Class	Frequency	Percent	Cumulative Percent
Algebra 1	127	67.6	67.6
Accelerated Algebra 2	13	6.9	74.5
Algebra 2	8	4.3	78.7
Pre-Calculus	40	21.3	100.0
Total	188	100.0	100.0

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

Table 8 indicates how students answered the question: Do you like the “flipped classroom” approach, where you watched the videos at night [during the evening] and did homework in class? In this survey question, students were asked to select their response on a Likert-type scale that ranged from 5 = *Like a lot* to 1 = *Do not like*. Ninety-eight (98) respondents selected 4 or 5 on the Likert scale or 52.1% of students liked the "flipped classroom" approach, or liked it a lot.

Table 8. Student Responses Indicating How They Liked a Flipped Classroom Approach to Teaching and Learning – January 2012.

Likert Scale	Frequency	Percent	Cumulative Percent
1 = Do not like	29	15.4	15.4
2	26	13.8	29.3
3	35	18.6	47.9
4	49	26.1	73.9
5 = Like a lot	49	26.1	100.0
Total	188	100.0	100.0

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

Table 9 indicates student responses to the question: How often do you find the "flipped classroom" more beneficial compared to the traditional lecture classroom? Student perceptions were gauged by using a Likert-type scale that ranged from 10 = *All the Time* to 0 = *None of the Time*. Using a Likert scale, 113 (60.1%) of the students selected numbers above 5 indicating they ranked the flipped classroom more beneficial compared to the traditional lecture classroom.

Table 9. Student Responses Indicating How Often They Found Flipped Classrooms More Beneficial Than Traditional Lecture Classrooms – January 2012.

Likert Scale	Frequency	Percent	Cumulative Percent
0 = None of the Time	22	11.7	11.7
1	5	2.7	14.4
2	5	2.7	17.0
3	9	4.8	21.8
4	13	6.9	28.7
5	21	11.2	39.9
6	14	7.4	47.3
7	29	15.4	62.8
8	34	18.1	80.9
9	18	9.6	90.4
10 = All the Time	18	9.6	100.0
Total	188	100.0	100.0

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

Table 10 indicates student responses to the question: If given a choice, which method of instruction would you prefer? Two options were available for the student to respond: (1) Flipped classroom; or (2) Traditional classroom. With the two options available, 62.2% of the students preferred the flipped classroom over the traditional lecture instructional strategy.

Table 10. Student Preferred Method of Instruction – January 2012.

	Frequency	Percent	Cumulative Percent
Flipped	117	62.2	62.2
Traditional	71	37.8	100.0
Total	188	100.0	100.0

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

The final two questions within the survey were considered "open ended" where students wrote their thoughts on the flipped classroom process. The researcher analyzed student responses to "open-ended" questions. A numeric code was created for each fact isolated from participant responses. Facts were grouped into categories. Categories were grouped into themes. Student responses were tallied and reported in table or graphic form.

Table 11 indicates the frequency and percentage of students providing responses to the open-ended survey question: What did you like about the flipped classroom process?

Table 11. Frequency and Percentage of Responses to Survey Question: What Did You Like About the Flipped Classroom Process? – January 2012.

	Frequency	Percent	Cumulative Percent
Students who provided a response to the question.	163	87.7	87.7
Students who provided no response, a response not pertaining to the survey question, or a response with low frequency	25	13.3	100.0
Total (*N* = 188)	188	100.0	100.0

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

The researcher coded student survey responses. Based on the responses, the researcher identified four categories or themes of student perceptions to the open-ended survey question: What do you like about the flipped classroom process? Table 12 indicates the frequency and percentage of student responses to categories identified by the researcher. The categories identified were:

1. Student contact time with teachers and peers;
2. Getting homework done in the classroom;
3. Students working at their own pace; and
4. Students not liking the flipped classroom.

The highest number and percentage of representative statements made by students in Category #1 suggest students most liked contact time with the teacher and their peers. One student commented the flipped classroom results in "less time spent doing homework at night, easier to [do] homework in class with the help of teachers and students." Another student comment in this category was, "I like that we could ask questions on the homework directly to the teacher." A third student comment in this category was written by a student who said, "The ability to work with others to figure out problems, thus, learning the concept easier."

Table 12. Frequency and Percentage of Students Who Responded to: What Did You Like About the Flipped Classroom Process? – by Category, January 2012.

Category	Frequency (*N* = 163)	Percent	Cumulative Percent
1. Student contact time with teachers and peers	69	42.3	42.3
2. Getting homework done in the classroom	48	29.5	71.8
3. Students working at their own pace	28	17.2	88.9
4. Students not liking the flipped classroom	18	11.0	100.0
Total	188	100.0	100.0

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

The second highest number and percentage of representative statements made by students in Category #2 indicated students were positive towards getting homework done in the flipped classroom. One student commented, "I like being able to watch the videos at home and doing the homework at school because it allows me to ask more questions during class time and get more information." Student comments were brief including, "Time to do work in class" and "It does not take long to watch the videos at home" from one student, and, "a lot of time to do homework in class which meant I actually did it" from another student.

In Category #3, student representative comments towards working at their own pace in a flipped classroom included, "It gives students the chance to learn at their own pace and on their own time," "If I want to go ahead in class, all I have to do is to go on Moodle and watch the videos" and

> I like it because you are more solo with your work. You can do it at your own pace and rewind the video if you don't get it. Also, you can watch the video and then do the homework the next day during class so you have more time to ask questions.

Category #4 was the least commented on by students with 11.0% of students providing their comments of dissatisfaction of the flipped classroom instructional strategy. Student comments were brief. Comments by students such as "Nothing, I hate it. I don't learn anything and can't do my homework or tests," "I don't like anything about it"; and "absolutely nothing" were most prevalent.

The researcher conducted a site visit of Central School in mid-May of 2014. The researcher observed a teacher implementing flipped classroom instructional strategies in a high school math classroom. After the teacher presented a lesson, the class of approximately 20 students was placed into four groups consisting of approximately five students to work on a math assignment. This arrangement is consistent with a peer instruction flipped classroom. The groups were identified as Group 1 (G1), Group 2 (G2), Group 3 (G3), and Group 4 (G4). The researcher (acting as a consultant) interacted with students by group in the flipped classroom environment by asking the question, "What do you like about the flipped classroom?" The researcher recorded student responses with paper and pen. Student responses were later coded into categories or themes. Table 13 indicates student responses, by group, to the question.

Table 13. Student Responses to the Question: What Do You Like About the Flipped Classroom? – by Category and Group, May 2013.

Category	Frequency (*N* = 4)*	Percent of Groups Responding
1. Student contact time with teachers and peers	3 (G1, G2, G3)	75.0
2. Getting homework done in the classroom	4 (G1, G2, G3, G4)	100.0
3. Students working at their own pace	2 (G1, G2)	50.0
4. Students not liking the flipped classroom	0	0.0

* There were four groups of students with approximately five students per group. Groups answered collectively, so there was one answer per group.

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

Table 14 indicates frequency and percentage of students providing a response to the open-ended survey question: What would you change about the process [a flipped classroom] to improve it?

Table 14. Frequency and Percentage of Responses to Survey Question: What Would You Change About the [Flipped Classroom] Process to Improve it? – January 2012.

	Frequency	Percent	Cumulative Percent
Students who provided a response to the question.	137	72.9	72.9
Students who provided no response, a response not pertaining to the survey question, or a response with low frequency	51	26.1	100.0
Total (*N* = 188)	188	100.0	100.0

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

The researcher coded student survey responses. Based on the responses, the researcher identified five categories of student perceptions to the open-ended survey question: What would you change about the process to improve it? Table 15 indicates the frequency and percentage of student open-ended responses by categories identified by the researcher. The categories identified were:

1. Improve teacher contact time within flipped classroom;
2. Improve videos used in the flipped classroom;
3. Revert to traditional (teacher-centered classroom);
4. Change nothing about flipped classroom; and
5. Improve flipped classroom processes.

Table 15. Frequency and Percentage of Students Who Responded to: What Would You Change About the Process to Improve It? – by Category, January 2012.

Category	Frequency (N = 137)	Percent	Cumulative Percent
1. Improve teacher contact time within flipped classroom	47	34.3	34.3
2. Improve videos used in the flipped classroom	24	17.5	51.8
3. Revert to traditional (teacher-centered classroom)	21	15.3	67.1
4. Change nothing about flipped classroom	25	18.3	85.4
5. Improve flipped classroom processes	20	14.6	100.0
Total	137	100.0	100.0

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

The highest number and percentage of representative statements made by students in Category #1 suggested students were seeking changes to improve teacher contact time. One student commented, "I think it gets kind of confusing having to learn it by ourselves. I think we should have a review day like where the teacher lectures and goes over some problems as a class." Another representative comment came from a student who said,

> Sometimes, I feel as though the system is taken advantage of by the teachers when they have a quiz before giving a day of class time to ask questions and do homework. This then gives me extra homework to do at night, because I want to have practiced all the material before taking the quiz. Also, it is difficult if the videos have mistakes, and I cannot ask

> questions immediately to check my understanding. So, to change it, I would make sure adequate class time is given before all quizzes and lessons are updated to ensure accuracy.

A third student commented, “Change it from flipped to lecture and still have the Moodle as a secondary resource the way it was originally designed.”

The second highest number and percentage of responses made by students fell into Category #2 and indicated students were seeking changes to improve videos they were assigned to view in the flipped classroom. One student commented,

> Although the videos cover all the information, I personally find it easier to follow a written lesson that describes every step. Often, many times in the lesson, I'll be following the video, and I'll be confused or stuck on only a single step.

Students made comments about the length of the videos. One student commented, “Some of the videos can get lengthy, and the videos sometimes do not cover more difficult problems that are on the homework.” Additionally, students made statements about the availability of time they had to watch videos, a representative example from one student was, “Give time to watch videos at the end of class for the next day.”

Student comments in Category #3 indicated 17.5% satisfaction of the flipped classroom instructional strategy. Student comments were brief. Comments by students such as “Nothing, I think that it's great!” and “I really can't think of anything” were most prevalent.

Student comments in Category #4 towards seeking changes of the flipped classroom indicated forthright comments to revert back to the traditional or teacher-centered classroom instruction. One student stated, “I don't like the flipped classroom; I learn things a lot better with the traditional classroom.” Another student stated, “Not doing this flipped classroom thing. Most people are *whatever* about it, but I think they really don't like it.” Yet another student comment towards back to the traditional or teacher-centered classroom instruction was, “The traditional classroom was much simpler.”

Category #5 covered the least number of student comments with 14.6% of students providing their perception on how to change the flipped classroom process. One student commented, “Have an online chat thing so students can converse and discuss questions they may have with each other and/or the teacher.” Another student said, “Have all the answers online, if you [are] doing your homework and don't get it, you have to wait until the next morning to figure it out.” A third student said,

> Flipped classroom could be improved if there were some way to put a question drop box into Moodle so that students could submit questions they had while watching the videos that could be gone over the next day with the whole class. This way, students won't forget the problem they were having trouble with, and teachers would be able to see what section is most difficult for students. Plus, it could all be done quickly/easily online and in keeping with the reverse classroom process.

Research Question #2

What are high school student perceptions of their learning experiences using digital resources and digital technology in a flipped classroom?

Quantitative data in the form of student perceptions was obtained through a student survey instrument created and collected by teachers in Central School's math department (Appendix D). The student survey was conducted after Central School's math department had collectively implemented a flipped classroom instructional strategy in math classes. The intent of Central School's math teachers was to identify perceptions of high school math students experiencing class in flipped classrooms during the 2011-2012 school year. Qualitative data in the form of open-ended survey questions were collected by Central School classroom teachers in mid-October of 2011. The researcher used student survey data to guide the study on student perceptions for Research Question #2.

For quantitative data, a Likert-type scale was developed by Central School math teachers to measure student perceptions of their learning experiences using digital resources and digital technology in a flipped classroom. Central School teachers used nine questions in the survey to measure student learning experiences in their math classroom. Five of the survey questions were answered by students based on pre-populated choices. In two survey questions students were asked to select their response on a Likert-type scale that ranged from 5 = *Very helpful* to 1 = *Not helpful*. A frequency and percentage analysis of the survey data provided by Central School students was completed to determine student perceptions of their learning experiences using digital resources and digital technology in a flipped classroom. The final two questions within the survey were considered "open ended" where students wrote their thoughts on their flipped classroom experience. The researcher coded student survey responses to the two open-end questions. Based on the responses, the researcher identified categories of student perceptions to the open-ended survey questions.

Table 16 represents the number of students enrolled in Central School high school math classes who participated in the student survey in mid-October of 2011. Table 17 represents the grade level of students enrolled in Central School high school math classes who participated in the student survey in mid-October of 2011.

Table 16. Frequency and Percentage of Students Enrolled in High School Math Classes in Central School – October 2011.

Type of Math Class	Frequency	Percent	Cumulative Percent
8th Grade Accelerated Math	29	16.5	16.5
High School Algebra 1	22	12.5	29.0
Geometry	16	9.1	38.1
Accelerated Algebra 2	22	12.5	50.6
Algebra 2	12	6.8	57.4
Statistics	27	15.3	72.7
Pre-Calculus	47	26.7	99.4
Calculus	1	0.6	100.0
Total	176	100.0	100.0

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Table 17. Frequency and Percentage by Grade Level of Students Enrolled in High School Math Classes at Central School – October 2011.

Grade Level	Frequency	Percent	Cumulative Percent
8	29	16.5	16.5
9	25	14.2	30.7
10	34	19.3	50.0
11	52	29.5	79.5
12	36	20.5	100.0
Total	176	100.0	100.0

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

Central School's implementation of a flipped classroom requires students to access the internet for digital resources to complete school work. Table 18 represents the frequency and percentage of home internet access of students enrolled in high school math classes in Central School who participated in the student survey in mid-October of 2011. Nearly 99% of all students participating in the survey had internet access at home.

Table 18. Frequency and Percentage of Students Enrolled in High School Math Classes at Central School Who Have Home Internet Access – October 2011.

Type of Internet Access	Frequency	Percent	Cumulative Percent
High Speed	172	97.7	97.7
Dial Up	2	1.1	98.8
None	2	1.1	99.9
Total	176	100.0	100.0

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Central School's implementation of a flipped classroom requires students to access a classroom teacher's Moodle site and content (digital resources) within the Moodle site to complete school work. *Moodle* is a popular "course management system for online learning" (Brandl, 2005, p. 16), which uses a "software package designed to help educators create quality online instruction" (Brandl, 2005, p. 1). Central School students access their classroom Moodle website as a means for students to download course materials.

Table 19 represents the frequency and percentage of student responses to the usefulness of their math classroom Moodle site. Using a Likert-Type scale, 153 (or 86.9%) of the students ranked their math classroom Moodle site between 4 (*helpful*) and 5 (*very helpful*).

Table 19. Frequency and Percentage of Student Responses to How Helpful They Found Their Math Classroom Moodle Site – October 2011.

Likert Scale	Frequency	Percent	Cumulative Percent
1 = Not helpful	3	1.7	1.7
2	4	2.3	4.0
3	16	9.1	13.1
4	53	30.1	43.2
5 = Very helpful	100	56.8	100.0
Total	176	100.0	100.0

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

Central School high school students surveyed were given an opportunity to respond to their experience of using four different types of online resources made available to them on their math classroom Moodle site. Using a Likert-type scale, students ranked the helpfulness of resources as 1 = *Not applicable*, or as between 2 = *Not helpful* to 5 = *Very helpful*. Resources included: (a) Video Lessons, (b) Guided Notes (completed), (c) Homework Solutions, and (d) Additional Resources available on their math classroom Moodle site.

Table 20 indicates 80.1% of Central School high school math students ranked their experience of Video Lessons on their math classroom Moodle site between 4 (*Helpful*) and 5 (*Very helpful*).

Table 20. Frequency and Percentage of Student Responses Regarding Their Experience Using Video Lessons on Their Math Classroom Moodle Site – October 2011.

Likert Scale	Frequency	Percent	Cumulative Percent
1 = Not Applicable	3	1.7	1.7
2 = Not helpful	8	4.5	6.2
3	24	13.6	19.9
4	45	25.6	45.5
5 = Very helpful	96	54.5	100.0
Total	176	100.0	100.0

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

Table 21 indicates 62.5% of Central School high school math students ranked their experience of Guided Notes on their math classroom Moodle site between 4 (*Helpful*) and 5 (*Very helpful*). Guided Notes were an outline of the notes Central School students were expected to take while watching a video lesson. Guided Notes included all the problems that were to be covered in the classroom. Guided Notes often had definitions and other content to allow students to focus on math content rather than taking notes.

Table 21. Frequency and Percentage of Student Responses Regarding Their Experience Using Guided Notes on Their Math Classroom Moodle Site – October 2011.

Likert Scale	Frequency	Percent	Cumulative Percent
1 = Not Applicable	17	9.7	9.7
2 = Not helpful	11	6.3	15.9
3	38	21.6	37.5
4	39	22.2	59.7
5 = Very helpful	71	40.3	100.0
Total	176	100.0	100.0

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Table 22 indicates 84.6% of Central School high school math students ranked their experience of Homework Solutions on their math classroom Moodle site between 4 (*Helpful*) and 5 (*Very helpful*). Homework Solutions included all the answers to problems plus all the work needed to find an answer to a math problem.

Table 23 indicates 55.6% of Central School high school math students ranked their experience of Additional Resources on their math classroom Moodle site between 4 (*Helpful*) and 5 (*Very helpful*). Extra resources available on the classroom Moodle site included instructional videos, flash files, additional problems, and links to interactive web sites.

Table 22. Frequency and Percentage of Student Responses Regarding Their Experience Using Homework Solutions on Their Math Classroom Moodle Site – October 2011.

Likert Scale	Frequency	Percent	Cumulative Percent
1 = Not Applicable	0	0.0	0.0
2 = Not helpful	3	1.7	1.7
3	24	13.6	15.3
4	33	18.8	34.1
5 = Very helpful	116	65.9	100.0
Total	176	100.0	100.0

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Table 23. Frequency and Percentage of Student Responses Regarding Their Experience Using Additional Resources on Their Math Classroom Moodle Site – October 2011.

Likert Scale	Frequency	Percent	Cumulative Percent
1 = Not Applicable	16	9.1	9.1
2 = Not helpful	17	9.7	18.8
3	45	25.6	44.3
4	54	30.7	75.0
5 = Very helpful	44	25.0	100.0
Total	176	100.0	100.0

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

Central School's implementation of a flipped classroom requires students to access a classroom teacher's Moodle site and content digital resources within the Moodle site to complete school work. Table 24 indicates the time of day Central School high school math students accessed their class Moodle site most often. Students accessed their math class Moodle site before school the least.

Table 24. Frequency and Percentage of Student Responses to Time of Day Students Access Their Math Classroom Moodle Site Most Often – October 2011.

Likert Scale	Frequency	Percent	Cumulative Percent
Before school	1	0.6	0.6
During school	7	4.0	4.6
After school or evenings	46	26.1	30.7
Weekends	2	1.1	31.8
Don't use	3	1.7	33.5
Before school & Weekends	1	0.6	34.1
During school & After school or evenings	23	13.1	47.2
During school & Weekends	2	1.1	48.3
After school or evenings & Weekends	37	21.0	69.3
Before school, During school, & After school or evenings	2	1.1	70.4
Before school, After school or evenings, & Weekends	3	1.7	72.1
During school, After school or evenings, & Weekends	31	17.6	89.7
Before school, During school, After school or evenings, & Weekends	18	10.2	99.9
Total	176	100.0	100.0

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

Table 25 indicates the frequency and percentage of students providing optional open-ended responses to survey question: How can your class Moodle site be improved?

Table 25. Frequency and Percentage of Responses to Survey Question: How Can Your Class Moodle Site Be Improved? – October 2011.

	Frequency	Percent	Cumulative Percent
Students who provided a response to the question.	89	50.6	50.6
Students who provided no response, a response not pertaining to the survey question, or a response with low frequency	87	49.4	100.0
Total (*N* = 176)	176	100.0	100.0

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The researcher coded student survey responses. Based on responses, the researcher identified four categories of student perceptions to the open-ended survey question: How can your class Moodle site be improved? Table 26 indicates the frequency and percentage of student responses to the open-ended survey question, by categories identified by the researcher. The categories identified were:

1. Leave as is;
2. Improve available resources;
3. Teachers provide timely updates; and
4. Improve computer network access.

Table 26. Frequency and Percentage of Students Who Responded to: How Can Your Class Moodle Site Be Improved? – by Category, October 2011.

Category	Frequency ($N = 89$)	Percent	Cumulative Percent
1. Leave as is	50	56.2	56.2
2. Improve available resources	20	22.5	78.8
3. Teachers provide timely updates	13	14.6	93.3
4. Improve computer network access	6	6.7	100.0
Total	89	100.0	100.0

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

The highest number and percentage of representative statements made by students in Category #1 suggested students like the Moodle site and desire to have it remain as is. Student comments were brief. One student commented, “I do not think it needs to be improved. I love the Moodle site. It is very functional and helpful.” Another representative comment by a student was, “I think it is just fine the way it is.” A third representative comment was written by a student who said, “Moodle is perfect! I think that Moodle is very helpful. It is a great way to get help if you have any questions like on homework or lessons.”

The second highest number and percentage of representative statements made by students in Category #2 indicated students desired an improvement to the resources on the Moodle site. One student commented, “My class Moodle site can be improved with the addition of other websites that can help you practice the lesson you are learning.”

One student commented, “Adding more resources and helpful tips/tricks to some of the lessons”; and another student said, “For the solutions manual, I would like to see how the work was done along with words to help guide the answer.”

In Category #3, student representative comments were directed towards the teacher providing more timely updates and improving the organization of the Moodle site. Comments such as, “I would like for the notes and resources of previous chapters to be kept visible on the Moodle site for longer, so I can go back and review concepts and assignments,” and, “Have the teacher do the homework solutions so we know how the instructor would like us to do each problem,” and, “Have the videos at the top be the current lesson” were representative comments of students within Category #3.

Category #4 was the least commented on by students with 6.7% of students making comments about their dissatisfaction with computer network accessibility to get to the classroom Moodle site. Student comments were brief. Comments by students such as: “Make it so it doesn’t crash as much,” and, “Sometimes, I can’t get logged on to Moodle, so if that would be able to be fixed that would be great” were most prevalent.

Table 27 indicates the frequency and percentage of students providing an optional open-ended response to the survey question: What do you like best about your class Moodle site?

Table 27. Frequency and Percentage of Responses to Survey Question: What Do You Like Best About Your Class Moodle Site? – October 2011.

	Frequency	Percent	Cumulative Percent
Students who provided a response to the question.	123	69.9	69.9
Students who provided no response, a response not pertaining to the survey question, or a response with low frequency	53	30.1	100.0
Total (N = 176)	176	100.0	100.0

Adapted from table of raw data, by Randal D. Kolb for Larry Guggisberg, 2014, *Statistical Consulting and Research Center, University of St. Cloud*. Copyright 2014 by Randal D. Kolb and the University of St. Cloud.

The researcher coded student survey responses. Based on the responses, the researcher identified three categories of student perceptions to the open-ended survey question: What do you like best about your class Moodle site? Table 28 indicates the frequency and percentage of student open-ended responses to categories identified by the researcher. The categories identified were:

1. Homework Solutions on Moodle is a useful resource;
2. Moodle allows students to work at their own pace; and
3. Flipped classroom strategy that is made available as a result of the Moodle site.

Table 28. Frequency and Percentage of Students Who Responded to: What Do You Like Best About Your Class Moodle Site? – by Category, October 2011.

Category	Frequency (N = 123)	Percent	Cumulative Percent
1. Homework Solutions on Moodle is a useful resource	75	61.0	61.0
2. Moodle allows students to work at their own pace	27	22.0	83.0
3. Flipped classroom strategy that is made available as a result of the Moodle site	21	17.0	100.0
Total	123	100.0	100.0

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The highest number and percentage of representative statements made by students in Category #1 suggested students like the Homework Solutions module on the class Moodle site. One student commented, "I like the solution manuals. If I am having trouble, I look at the answer and try to figure out what I did wrong or how I can get there." Another representative comment by a student was, "I like the solutions manuals; because when I am at home and struggling, they are helpful." A third representative comment was written by a student who said, "The solutions manual helps a lot, and the videos do a good job at explaining the lesson."

The second highest number and percentage of representative statements made by students in Category #2 indicated the class Moodle site permits students to work at their own pace. One student commented, "I am able to move ahead in class if I would like. I am also able to complete a full 'class day' of homework right on the computer and by myself without being in class." Another student commented, "Everything is online, so you can access it whenever you need to." A third student commented, "You can use it any time of the day."

Category #3 was the least commented on by students with 17.0% of students making a comment of their satisfaction with the flipped classroom because the Moodle site allows them to have the teacher use the flipped classroom instructional strategy. Comments by students such as "I like that for the majority of the time you can do everything online, which leaves time for homework in class. This gives me time to ask questions," and, . . .

> I love the reverse classroom and being able to get help from classmates during the class. I also like the fact that if I don't get the material from the video one night or from the in class lecture that I can go on Moodle and re-watch the video

. . . were representative student comments.

The researcher conducted a site visit of Central School in mid-May of 2014. The researcher observed a teacher implementing flipped classroom instructional strategies in a high school math classroom. After the teacher presented a lesson, the class of approximately 20 students was placed into four groups consisting of approximately five students to work on a math assignment. The groups were identified as Group 1 (G1), Group 2 (G2), Group 3 (G3), and Group 4 (G4). The researcher interacted with students by group in the flipped classroom environment by asking the question "What would you like best about your class Moodle site?"

The researcher recorded and coded their answers. Table 29 indicates student response, by group, to the question: What would you like best about your class Moodle site?

Table 29. Student Responses to the Question: What Would You Like Best About Your Class Moodle Site? – by Category and Group, May 2013.

Category	Frequency ($N = 4$)*	Percent of Groups Responding
1. Homework Solutions on Moodle is a useful resource	4 (G1, G2, G3, G4)	100.0
2. Moodle allows students to work at their own pace	2 (G1, G2)	50.0
3. Flipped classroom strategy that is made available as a result of the Moodle site	2 (G2, G3)	50.0

* There were four groups of students with approximately five students per group. Groups answered collectively, so there was one answer per group.

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Research Question #3

What effect does the use of digital resources and digital technology within a flipped classroom environment have on student achievement based on common assessments such as the Minnesota Comprehensive Assessments (MCAs) and college entrance exams such as ACT® tests?

A comparison of Central School students versus state of Minnesota students on the MCAs and ACT® was conducted to assess levels of academic achievement. Central School adopted a flipped classroom instructional strategy in math classrooms in the Fall of 2010. Over the next 4 year period, the flipped classroom instructional strategy was modified in Central School math classrooms. The variations included a *Flipped Mastery* model, an *Explore Flip and Apply* model and a *Peer Instruction* Flipped Learning model.

A timeline for Central School's implementation of a flipped classroom instructional strategy in math classrooms is shown in Table 5 shown earlier in this paper.

Figure 6 represents student proficiency in MCA mathematics assessments of Central School students as being at Level 3 (meets the standards) and Level 4 (exceeds the standards) compared to students at Level 3 and Level 4 in the state of Minnesota. The graph in Figure 6 provides a longitudinal view of academic achievement in MCA mathematics of students at Level 3 and Level 4 and the gap between Central School students compared to students in the state of Minnesota. "Each student receives a score that falls in one of four achievement levels—Does Not Meet the Standards, Partially Meets the Standards, Meets the Standards and Exceeds the Standards" (Minnesota Department of Education, 2014d, p. 2, para. "What does it take to pass the tests?").

Level 1 is defined as: Does Not Meet the Standards

Level 2 is defined as: Partially Meets the Standards

Level 3 is defined as: Meets the Standards

Level 4 is defined as: Exceeds the Standards

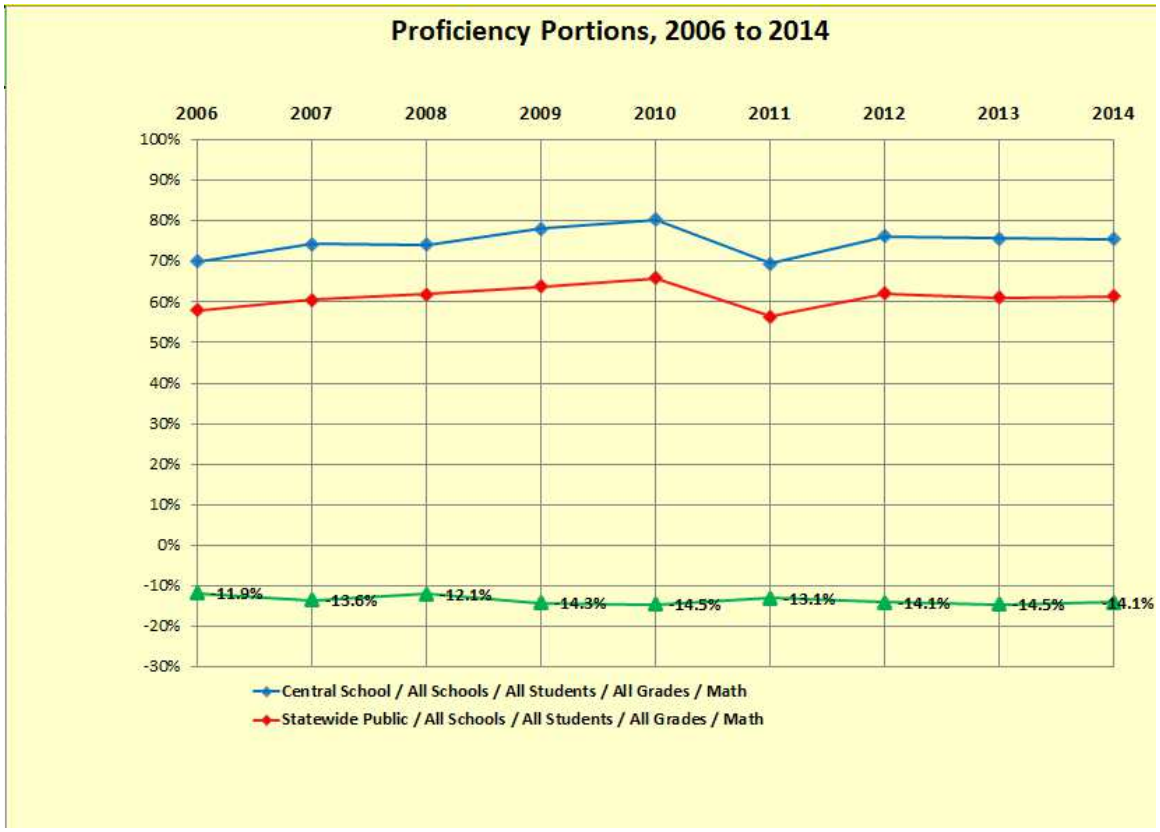

Figure 6. Level 3 and Level 4 MCA Math Proficiency and Proficiency Gaps Between 2006 and 2014 for Central School Students and Students in the State of Minnesota. Reprinted from a graph of raw data, by Jim Sheehan for Larry Guggisberg, 2014-2015, an independent consultant, Lakeville, Minnesota. Copyright 2014-2015 by Jim Sheehan.

Table 30 provides a longitudinal view of MCA proficiency Levels 1 through 4. Table 30 also indicates a longitudinal view of academic achievement of students in Level 3 and Level 4 and the gap between Central School students compared to students in the state of Minnesota in MCA mathematics.

Table 30. MCA Math Proficiency Levels 1 Through 4 and Variances Between Levels 3 and 4 Between 2006 and 2014 for Central School Students and Students in the State of Minnesota.

	Central School / All Schools / All Students / All Grades / Math								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Count, level 1	110	80	76	55	45	96	78	70	68
Count, level 2	151	146	146	135	126	181	145	167	179
Count, level 3	395	390	367	385	374	370	362	423	420
Count, level 4	213	262	268	296	328	263	353	316	340
Count, total	869	878	857	871	873	910	938	976	1,007
Portion, level 1	12.7%	9.1%	8.9%	6.3%	5.2%	10.5%	8.3%	7.2%	6.8%
Portion, level 2	17.4%	16.6%	17.0%	15.5%	14.4%	19.9%	15.5%	17.1%	17.8%
Portion, level 3	45.5%	44.4%	42.8%	44.2%	42.8%	40.7%	38.6%	43.3%	41.7%
Portion, level 4	24.5%	29.8%	31.3%	34.0%	37.6%	28.9%	37.6%	32.4%	33.8%
Portion, levels 3-4	70.0%	74.3%	74.1%	78.2%	80.4%	69.6%	76.2%	75.7%	75.5%
Proficiency Single Score Weighted 4-3-2-1	2.82	2.95	2.96	3.06	3.13	2.88	3.06	3.01	3.02

	Statewide Public / All Schools / All Students / All Grades / Math								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Count, level 1	87,835	76,732	74,236	65,771	61,651	86,507	72,087	73,264	74,603
Count, level 2	89,079	79,406	77,737	79,142	76,452	94,732	86,103	89,335	88,400
Count, level 3	157,763	144,997	151,897	153,726	155,472	143,020	161,586	150,805	149,933
Count, level 4	87,013	95,402	96,423	102,371	111,311	91,860	97,682	105,319	109,071
Count, total	421,690	396,537	400,293	401,010	404,886	416,119	417,458	418,723	422,007
Portion, level 1	20.8%	19.4%	18.5%	16.4%	15.2%	20.8%	17.3%	17.5%	17.7%
Portion, level 2	21.1%	20.0%	19.4%	19.7%	18.9%	22.8%	20.6%	21.3%	20.9%
Portion, level 3	37.4%	36.6%	37.9%	38.3%	38.4%	34.4%	38.7%	36.0%	35.5%
Portion, level 4	20.6%	24.1%	24.1%	25.5%	27.5%	22.1%	23.4%	25.2%	25.8%
Portion, levels 3-4	58.0%	60.6%	62.0%	63.9%	65.9%	56.4%	62.1%	61.2%	61.4%
Variance in the (2) entities entered...	-11.9%	-13.6%	-12.1%	-14.3%	-14.5%	-13.1%	-14.1%	-14.5%	-14.1%
Proficiency Single Score Weighted 4-3-2-1	2.58	2.65	2.68	2.73	2.78	2.58	2.68	2.69	2.70

Note. Reprinted from a graph of raw data, by Jim Sheehan for Larry Guggisberg, 2014-2015, an independent consultant, Lakeville, Minnesota. Copyright 2014-2015 by Jim Sheehan.

Student Mathematics Achievement Data From ACT® Test

The ACT® is a curriculum- and standards-based educational and career planning tool that assesses students' academic readiness for college. "One component of the ACT is a battery of four multiple-choice tests of educational achievement—English, Mathematics, Reading, and Science" (The ACT®, 2014, p. 1, para. 2). "The ACT, typically taken in the eleventh or twelfth grade, measures students' academic readiness for college in key content areas" (The ACT®, 2014, p. 1, para. 5).

Table 31 indicates student participation in ACT® assessments from the 2007-2008 school year to the 2013-2014 school year.

Table 31. Student Participation Rates in ACT® Assessments of Central School Students From the 2007-2008 School Year to the 2013-2014 School Year.

Central School	ACT Participation			Reference	http://www.act.org/newsroom/data/2014/states.html
Grad Year	12th Grade Enrollment	School N	Est. of School% taking ACT	School % Minority	School Low Income
2008	116	95	81.9%	1.9%	28.8%
2009	111	73	65.8%	1.4%	23.9%
2010	110	80	72.7%	2.3%	27.5%
2011	128	102	79.7%	3.3%	35.2%
2012	123	99	80.5%	2.1%	31.7%
2013	144	112	77.8%	2.6%	30.9%
2014	122	91	74.6%	2.2%	27.0%

Note. Reprinted from a graph of raw data, by Jim Sheehan for Larry Guggisberg, 2014-2015, an independent consultant, Lakeville, Minnesota. Copyright 2014-2015 by Jim Sheehan.

Figure 7 shows average ACT® math scores of Central School students compared to average state ACT® scores from the 2007-2008 school year to the 2013-2014 school year. Each year, average student scores at Central School exceeded the average state student scores.

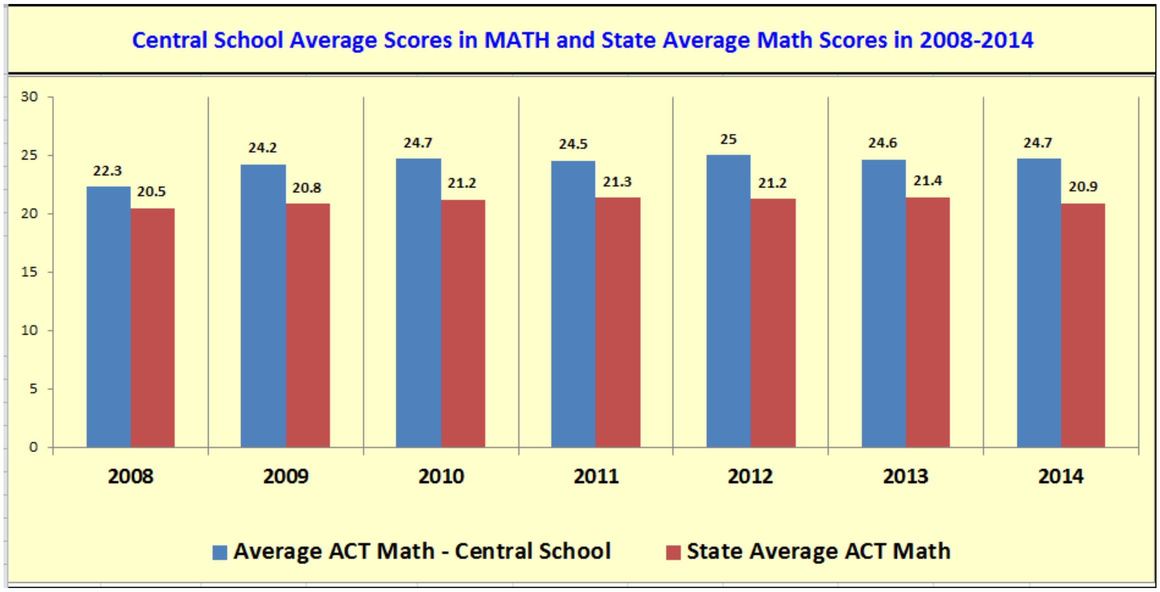

Figure 7. Comparison of Student Average ACT® Scores in Math at Central School to Average Student ACT® Math Scores at the State Level From 2008 to 2014. Reprinted from a graph of raw data, by Jim Sheehan for Larry Guggisberg, 2014-2015, an independent consultant, Lakeville, Minnesota. Copyright 2014-2015 by Jim Sheehan.

Table 32 compares average ACT® scores of Central School students to average ACT® scores of all students in the state and state ranking from the 2007-2008 school year to the 2013-2014 school year. Additionally, Table 32 indicates percent and state ranking of College Readiness Benchmarks (CRBs) for Central School students compared to College Readiness Benchmarks for all students in the state in math scores for the years 2008 through 2014. College Readiness Benchmarks . . .

> . . . are scores on the ACT subject-area tests that represent the level of achievement required for students to have a 50% chance of obtaining a B

or higher or about a 75% chance of obtaining a C or higher in corresponding credit-bearing first-year college courses." (ACT, Inc., 2015, para. 1)

Table 32. Comparison of Average ACT® Scores of Central School Students to Average ACT® Scores of Students at the State Level and State Ranking From the 2007-2008 School Year to the 2013-2014 School Year.

Central School					Average ACT scores in Subject and Year indicated					
			Avg Math	*State Rank*	MN District Avg Math		CRB % Math	*State Rank*		
2008			22.3	*(136)*	20.5		56	*(129)*		
2009			24.2	*(23)*	20.8		73	*(11)*		
2010			24.7	*(18)*	21.2		78	*(16)*		
2011			24.5	*(20)*	21.3		78	*(18)*		
2012			25	*(19)*	21.2		82	*(8)*		
2013			24.6	*(19)*	21.4		78	*(15)*		
2014			24.7	*(23)*	20.9		75	*(29)*		

Note. Reprinted from a graph of raw data, by Jim Sheehan for Larry Guggisberg, 2014-2015, an independent consultant, Lakeville, Minnesota. Copyright 2014-2015 by Jim Sheehan.

CHAPTER V

DISCUSSION – SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The organization of this chapter begins with a summary, continues with discussion of the findings, and is followed by conclusions. Finally, the recommendations section includes implications, limitations, recommendations for educators, and recommendations for further study.

Summary of the Study

The purpose of the current mixed-method case study was to analyze student perceptions of classroom teacher use of flipped classroom instructional strategies, and student perceptions of their learning experiences using digital resources and digital technology in a flipped classroom. Although perceptions are important, student achievement or student performance data is a common tool used by policy-makers and judged by the general public as a means to strive for continued improvement of students in K-12 public education. Variables within this study were student perceptions of their learning experiences in a flipped classroom, student performance skills based on pre-existing survey results from students, state assessment results from Minnesota Comprehensive Assessments (MCAs), and assessment results from ACT® tests.

The following questions were addressed in this case study:

1. What are high school student perceptions of the flipped classroom as a classroom instructional strategy?

2. What are high school student perceptions of their learning experiences using digital resources and digital technology in a flipped classroom?

3. What effect does the use of digital resources and digital technology within a flipped classroom environment have on student achievement based on common assessments such as the Minnesota Comprehensive Assessments (MCAs) and college entrance exams such as ACT® tests?

Summary of Findings and Conclusions

Findings and conclusions will be reported in sequential order by the three research questions presented in this study based on the analysis of data in Chapter IV.

Research Question #1

What are high school student perceptions of the flipped classroom as a classroom instructional strategy?

Data consisted of six questions in a survey to measure student perceptions of their flipped math classroom. The survey sought perceptions of how students liked the flipped classroom compared to traditional lecture instruction, which instructional strategy was believed to be more beneficial, what the students preferred method of instructional strategy was, what students liked about the flipped classroom process, and what students would change about the flipped classroom to improve it.

The largest percentage of students (52.1%) indicated they liked the flipped classroom approach where they watched the videos at night (during the evening) and did homework such as problem worksheets in class. The second largest percentage (29.3%) indicated they did not like the flipped classroom approach. Taking into account 18.6% indicated a neutral perception of the flipped classroom approach, the results of this survey question do not appear to indicate an overwhelming “like” of the flipped classroom approach. Depending on a person’s point of view, it may be concluded the greatest majority (70.7%) of students were neutral or liked the flipped classroom approach to instruction. School officials would be pleased with such a percentage and to know that students liked this flipped classroom instructional strategy. However, it may also be concluded 47.9% of the students in class were neutral or didn’t like the classroom approach to instruction.

When asked, which classroom instructional strategy was more beneficial, 60.1% of the students, if given a choice between the flipped classroom and the traditional lecture classroom, indicated the flipped classroom was more beneficial compared to the traditional lecture classroom. Survey data indicated a similar response with 62.2% of students indicating, if given a choice, they preferred the flipped classroom over the traditional lecture instructional strategy.

Four categories were identified based on student responses to the open-ended survey question: What do you like about the flipped classroom process? The category, “Student Contact Time with Teachers and Peers” had the highest percentage (42.3%) of common responses. In an effort to triangulate student survey responses to the open-ended survey question: What do you like about the flipped classroom process (Table 12) student interviews were completed during a classroom site visit by the researcher. The interview results (Table 13) indicated 75.0% of students liked “Student Contact Time with Teachers and Peers.” This finding appears to be consistent with Vygotsky’s social development theory which placed emphasis on children learning within social groups or with social contact rather than individualist learning.

The second most (29.5%) common response was made by students to the open-ended survey question "Getting Homework Done in the Classroom." During actual student interviews in the flipped classroom, 100% of the students indicated they liked "Getting Homework Done in the Classroom." The researcher would contend this is not a surprising interview outcome. Teenagers in school allocate and adjust their personal time management on a daily basis. Family, peer groups, school, community activities, and employment are just some of the goings-on in the lives of students. Not having school homework frees up time in a student's day.

The third category, "Students Working at their Own Pace," received comments from 17.2% of the students providing a survey response. Student interviews during the site visit indicated 50.0% of students liked "Working at their Own Pace." Students liked the convenience of working on school work according to their schedule.

There were 11.0% of students who openly indicated their dislike of the flipped classroom process on the anonymous student survey administered by the classroom teacher; however, 0.0% of students indicated a dislike of the flipped classroom during on-site interviews by the researcher. The researcher suspected the discrepancy between the two student responses was based on the method in which the question was asked. Students may be more comfortable providing an anonymous response compared to answering a question face to face, especially a question from a person who is not known by the student.

Five categories were identified based on student responses to the open-ended survey question: What would you change about the process [a flipped classroom] to improve it? The highest percentage (34.3%) of representative statements suggested students were seeking changes to improve teacher contact time. Here again, this finding appears to be consistent with Vygotsky's social development theory which placed emphasis on children learning within social groups or with social contact rather than individualistic learning. The category with the second highest (18.3%) number of responses indicated no changes to the flipped classroom process were necessary. A similar percentage (17.5%) indicated videos used in the flipped classroom process could be improved. Again, it was interesting to note, on the student survey administered by the classroom teacher, 15.3% of students openly indicated their desire to revert back to the traditional lecture classroom. The fifth and final category had 14.6% of students indicating a range of changes to the actual mechanics of using additional resources available on the classroom Moodle website.

Research Question #2

What are high school student perceptions of their learning experiences using digital resources and digital technology in a flipped classroom?

Data was derived from nine questions on a survey to measure student learning experiences using digital resources and digital technology in a flipped classroom. The survey sought student perceptions on accessing internet based content, usefulness of their class Moodle website, experiences with video lessons, guided notes, homework solutions, and other digital resources on their classroom Moodle website; and also, what would students change on their classroom Moodle website to improve it?

Survey results indicated 98.9% of students had home internet access. This is important because a flipped classroom relies on educational content on the internet. The data suggested home internet access for Central School students was not a barrier for students to access and do schoolwork. With substantial use of the internet required in a flipped classroom, 86.9% of students indicated their classroom Moodle site was "helpful" to "very helpful." If we were to add the percentage of students surveyed as being "neutral" to results, 96% of students indicated their classroom Moodle site experience was "neutral" to "very helpful."

Central School students indicated overall a high satisfaction with their experiences using their math classroom Moodle site. Survey results (80.1% of responses) indicated student satisfaction with their experience of using video lessons on their math classroom Moodle site. If we were to add the percentage of students surveyed as being "neutral" to results, 93.7% of students indicated satisfaction with their experience of using video lessons was "neutral" to "very helpful." Student satisfaction with their experience of using Guided Notes on their math classroom Moodle site was 62.5%. If we add students surveyed who were "neutral" towards using Guided Notes on their Moodle site, then 84% of students indicated their experience with Guided Notes was "neutral" to "very helpful." Student satisfaction with their experience with Homework Solutions on their math classroom Moodle site was 84.6%. If we include students surveyed that were "neutral" towards using Homework Solutions, then 98.2% of students indicated their experience with Homework Solutions was "neutral" to "very helpful." Student satisfaction of their experience with Additional Resources on their math classroom

Moodle site was 55.6%. Eighty-one and one-fifth percent (81.2%) of students indicated their experience with Additional Resources was “neutral” to “very helpful.”

Students have access to their classroom Moodle internet resources 24 hours a day, 7 days a week. Survey results indicated students accessed their Moodle website the least before school. During school and after school were the prominent times of day when students accessed their Moodle website.

Four categories were identified based on student responses to the open-ended survey question: How can your class Moodle site be improved? The highest percentage (56.2%) of representative statements suggested students were satisfied with their Moodle site and no changes to the flipped classroom process were necessary. Previous survey questions indicated overall student satisfaction with their experiences using their math classroom Moodle site; however, 22.5% of students responded to an open-ended survey question indicating the Moodle website could be enhanced by improving available resources. An additional 14.6% indicated the Moodle website could be enhanced by improving the general organization of the Moodle site.

A flipped classroom requires internet access to retrieve web-based educational content; therefore, reliable internet connectivity is important. Only 6% of students expressed dissatisfaction with connectivity to their classroom Moodle website. Insufficient data were collected to determine if connectivity issues were related to network problems within the school’s network system, an individual student’s computer network system at home, or perhaps the network provider itself.

Three categories were identified based on student responses to the open-ended survey question: What do you like best about your class Moodle site? The highest percentage (61.0%) of representative statements indicated students were most satisfied with "Homework Solutions" on their class Moodle site. In an effort to triangulate student survey responses to the open-ended survey question: What do you like best about your class Moodle site (Table 28), student interviews were completed during a classroom site visit by the researcher. Site visit interview results indicated 100.0% (Table 29) of students liked "Homework Solutions" on their class Moodle site. The second highest (22.0%) common response made by students to the open-ended survey question indicated "Moodle allows students to work at their own pace." During student interviews in the flipped classroom, 50.0% of students indicated Moodle allows students to work at their own pace. Although it was least (17.0%) commented on in the student survey, 50.0% of students commented in an actual interview that their Moodle site allows the teacher to use the flipped classroom instructional strategy.

Research Question #3

What effect does the use of digital resources and digital technology within a flipped classroom environment have on student achievement based on common assessments such as the Minnesota Comprehensive Assessments (MCAs) and college entrance exams such as ACT® tests?

Student academic performance results based on state assessments such as the Minnesota Comprehensive Assessments (MCAs) indicated Central School has been above the state-wide average prior to implementation of the flipped classroom instructional strategy. Performance of Central School students on the MCAs has continued to excel through the time of this study. If a school official's point of view were to compare a school's highest student achievement on the MCAs, Central School's student proficiency at Level 3 and Level 4 compared to the state student proficiency at Level 3 and Level 4 was above the state average at the time of this report. The variance between Central School average scores and state average student scores at Level 3 and Level 4 is consistently the same over the time reviewed in this study.

If a school official's purpose was to compare a school's lowest student achievement on the MCAs, Central School's student proficiency at Level 1 compared to the state student proficiency at Level 1 shows a lower percentage of students performing at Level 1 at Central School than at the state. In fact, in some years, the state average Level 1 student performance is two times higher than Central School's. From 2011 through 2014, Central School has been successful at reducing the number of students performing at Level 1; comparatively, the state average of students performing at Level 1 is effectively unchanged. Advancing students out of Level 1 proficiency into a higher level of proficiency is an effort teachers and school officials strive to attain.

Student proficiency at Level 2 in Central School is lower than the state average. Starting in 2014, Central School and the state average proficiency at Level 2 have remained constant for the previous four consecutive years.

Student academic performance results based on common assessments such as the math component of the ACT® test indicate Central School's math composite score has been above the state-wide average prior to implementation of the flipped classroom instructional strategy. This type of performance in math on the ACT® has continued through to the time of this study. Central School's average ACT math composite score above the state average from the 2008-09 school year to the 2013-14 school year is 3.48. School officials, including curriculum directors place importance on College Readiness Benchmarks (CRB) within the ACT® as predictors of college success. There are 699 public high schools in the state of Minnesota (EducationBug.org, 2015, Minnesota Public School Statistics section, para. 4). From 2009 to 2014, the percent of Central School students achieving ACT® College Readiness Benchmarks ranked as low as 29th or as high as 8th in the state. The CRB rankings achieved by Central School students at the time of this study indicated they would likely be successful in post-secondary education. Central School math teachers were successful in not compromising student performance while they changed their instructional strategy from a traditional lecture classroom to a flipped classroom.

Implications

The data in Chapter IV suggest students at the time of this report liked and used the digital resources available to them. Computer devices and internet connectivity have been ubiquitous in a person's daily life, including the K-12 classroom, if educators subscribe to the premise – old pedagogies are no longer relevant and education needs a new pedagogy to enhance learning.

> Students today are digitally focused and require new skills that would meet up the needs of this new era. But the thing is teaching new skills is not the only solution and there is more to it than just that, in fact we need a new pedagogy with specific features that would cover every learning aspect." (Kharbach, 2011, para. 3)

This statement may suggest emphasis towards using Bloom's Digital Taxonomy to educate 21st century learners in K-12 public education. At the present time, the flipped classroom with its heavy reliance on web-based digital resources and digital computing devices may be gaining popularity as the instructional strategy to address transition from traditional lecture classrooms to a more student centered instructional strategy.

At the time of this study, students liked digital technology. They were accustomed to the use of various technologies. They were continuing to use technology in and out of the school environment. At the time of this report, students were heavy users of digital social media such as Facebook, Twitter, and Instagram as a means to stay "connected" to friends and peers. However, data within this study indicated students liked social interaction in the classroom with their peers and teachers. Perhaps the means to get the most out of these synchronous phenomena would be for public education to adapt instructional strategies which combine social interaction with peer to peer, student to teacher, and teacher to student classroom relationships. The flipped classroom may not be the panacea for educating students to learn and develop 21st century skills, but for most, but not all students, it combines dynamics of what students like – technology and social relationships.

The physical classroom of today doesn't look much different than the classroom of 40 years ago. During that time, classroom technologies such as mimeographs, filmstrip projectors, overhead projectors, videotape players, and cassette players were introduced and advocated for by educators as destined to change teaching and learning. These technologies have come and gone and are only left in the memories of the oldest practicing classroom teachers at the time of this study. These classroom tools, exciting during their time, did not result in significant changes in instructional strategies.

Today's computers and other digital devices coupled with internet access are providing perhaps the most exciting and powerful tools for use in the K-12 classroom that we have seen to date. The digital technologies and resources of today are relatively new; time will tell if they have better staying power than other technologies that have entered our education systems and then disappeared from the classroom. In the short term, it is likely use of digital technologies and resources will continue to expand in K-12 education considering that a group of forward thinking educators are adjusting their classroom teaching strategies to the form of flipped classrooms to utilize new technologies in their instructional design and delivery. Simply stated, the flipped classroom appears to be evolving as an instructional strategy and gaining acceptance with K-12 classroom teachers as the instructional means to use technologies of today, technologies which school children use, are accustomed to, and to a great degree have control of. Over the years, students have been taught in groups by a single teacher. The flipped classroom uses this same arrangement, but uses a different means for teaching and engaging students for learning.

According to Bill Gates as cited on Create Hub (2014), "Technology is just a tool. In terms of getting the kids working together and motivating them, the teacher is the most important" (Technology Quotes by Bill Gates section, para. 1)

In a flipped classroom, a teacher guides the process of learning by using technology with the intent to inspire, challenge, excite, and engage students to learn.

This is the type of intrinsic desire and excitement for learning advocated by educational theorist John Dewey over one hundred years ago. Additionally, in a flipped classroom, a teacher, along with classmates, provides the social and emotional interaction and environment to advise, coach, nurture, and even coax student learning. This is the type learning can be categorized within Vygotsky's social development theory developed nearly a hundred years ago.

Clearly, classic theories and associated education pedagogies by Dewey and Vygotsky still apply in today's classrooms; however, new theories by educational psychologists are "under construction" to develop pedagogies to properly implement new digital technologies available to education. Time will tell what type of new theory(ies) and associated pedagogies have the staying power of the classic educational theories of Dewey, Vygotsky, and Benjamin Bloom and if the role of the teacher in the classroom changes from being teacher – centered to facilitators for student learning.

This researcher contends, the teacher still remains the single most important element in a classroom. Efforts to replace the teacher with technology will not result in the type of achievement children richly deserve and parents have demanded, and what is very much needed in society.

From a school practitioner's point of view, schools throughout the state of Minnesota are often susceptible to closing during severe winter weather conditions. Employee agreements and school policies are such that when school is missed due to an emergency closing, the day(s) are made up by the teacher and students. With new technologies available to students, there are teachers, parents, and administrators advocating, in lieu of students and teachers making up the missed day(s), student learning could take place off site and on-line. This may be viewed as an acceptable one-time effort because technology allows learning to take place 24 hours a day, 7 days a week, and 365 days of the year. However, justification to avoid make up days by using online learning strategies may simply be a guise to avoid the inconvenience and interruption of student, teacher, and support staff schedules that need to be changed to accommodate a school make-up day. If a digital school make-up day gains acceptance and is implemented, it is likely there will be an element of teachers, parents, and administrators advocating to add additional digital make-up days. Apply this scenario to closing schools due to hurricanes in the south, snowstorms and tornados in the mid-west, earthquakes in the west, and storms off the Northeast coast or for a local tragedy or even a loss of utilities supplied to the school building, justification is in place nation-wide to reduce student contact time with the teacher. Essentially, teachers, parents, and administrators advocating for this will whittle away at student and teacher contact time for the sake of convenience at the cost of student achievement. Teachers, parents, and administrators need to use caution in understanding the broad ramifications of placing emphasis, whether intentional or unintentional, on shifting learning from the teacher to reliance on today's digital technology and resources.

Limitations

The limitations of this case study include the following:

1. This case study does not have a control and experimental group for implementation of the flipped classroom. Central School first implemented

a flipped classroom instructional strategy in the 2011-2012 school year. The data in the current study represents survey data collected in the 2011-2012 school year, one year after flipped learning was implemented in Central School. Site visit interview data represented data that was two school years after the first year of implementation and one year out from the student survey data collected by classroom teachers.

2. Technology, in general, is changing at a rapid pace. The types of technology available in classroom settings when this case study began changed as time passed. During and continuing after completion of the case study, computer devices have improved and more software applications and internet resources have become available for educational use. Technology in education is advancing rapidly and is disruptive for school administrators and teachers who may sense being in a constant state of transformation with the use of computer devices and software applications.

3. Change in the types of and availability of computer devices and software provide an opportunity to transform teaching strategies; in addition, there are different types of flipped classroom instructional strategies. As a classroom teacher becomes more familiar with flipped classroom instruction, the use of flipped classroom instructional strategies may evolve into another type or more refined strategy. When this study began, Central School math instructors were using a traditional flipped classroom instructional strategy, when this researcher performed a site visit, the

instructors were using a peer instruction flipped classroom instructional strategy. Rapid advances in instructional strategies are disruptive for school administrators and teachers and perhaps even students and parents who may have an uneasy sense of being in a constant state of transformation.

4. Chapter II of this study indicates there are a variety of flipped classroom learning strategies. The year the student survey in this study was completed, a more traditional flipped classroom learning strategy was implemented. The year the site visit took place, a "Peer Instruction" flipped classroom strategy was phased-in for implementation. As a result, there is a lack of consistency across data sets.

5. At the beginning of this study, the case study school selected had been pioneering in the implementation of a flipped classroom instructional strategy in the state of Minnesota. Additionally, the classroom teacher implementing the flipped classroom has attained notoriety as an advocate and practitioner for the flipped classroom that few, if any, in the state of Minnesota have attained. The data from this study became out-dated from the time the study began until its completion.

6. Because of its economic affluence and lack of demographic diversity, the case study school does not necessarily represent a typical school district sample.

7. Data available do not provide a distinct causal relationship between implementation of flipped learning and student performance indicators as

measured by common assessments such as the Minnesota Comprehensive Assessments (MCAs) and college entrance exams such as ACT®.

Recommendations for Educators

1. This study may create a general framework and provide insight to guide practitioners of the benefits, short-comings, and types of technology challenges encountered when considering implementing a flipped classroom instructional strategy.
2. Teachers must adapt and accept change by recognizing their role as a classroom teacher using the traditional lecture instructional strategy will change with implementation of a flipped classroom. A teacher centered classroom where the teacher is the center of attention and the sole purveyor of distributing knowledge will, at least partially, make way to students who are engaged in learning with the use of digital resources.
3. School administrators and staff development committees must support, plan, and develop professional development activities for teachers in a manner which guide best pedagogy practices combined with best practices for the use of digital resources and devices within teaching.
4. Teachers must be trained to be proficient in the use of technology and web-based software applications on computer networks.
5. Prior to the implementation of flipped classroom instructional strategies, school officials need to recognize, commit, and provide short-term and on-

going financial support for computer devices and networks as well as software and technical support for students and teachers.

6. Students must adapt to change in a flipped classroom by recognizing they themselves are more accountable for their learning in a flipped classroom. With access to internet connectivity, the ability to work anytime, anyplace, 24 hours a day, 7 days a week should result in parents and teachers holding students accountable to “few” to “no” excuses for completing school work.
7. School administrators and teachers need to be aware of the availability of high quality resources and know how to access high quality instructional resources for teachers and students.
8. School administrators may attempt to create and develop a local or regional network of instructors to share expertise. There may be interest and opportunity among professional educators to create resources, including videos to share between schools. For example, perhaps a school has a science teacher with state-of-the-art science laboratory equipment (e.g. digital microscope) who can create an on line collection of digital photos a teacher and students in another area school enrolled in a similar and like science class would not have access to and could implement in their classroom.

Recommendations for Future Study

1. The researcher recommends future research in regard to academic achievement of students that are in classrooms using a flipped classroom instructional strategy.
2. The researcher recommends additional research is needed because the modern flipped classroom concept is relatively new and evolving. As the flipped classroom grows in popularity, the use of digital resources will likely expand. Additional research would be beneficial to guide best practices of mastering the art of teaching with available and emerging digital resources and technology.
3. The researcher recommends future research in regard to the impact of the flipped classroom instructional strategy on student achievement with student sub-groups such as students of color, special education students, English Language Learners, and students from economically disadvantaged families. The researcher recommends future study on student assessments when a flipped classroom is implemented. Students in a peer instruction flipped classroom learn and problem-solve from each other; however, the social learning connection is eliminated with current assessments tool.

APPENDICES

Appendix A
Twenty-First Century Skills

21st Century Skill	Exercise	Resources
1. Global awareness	• Students conduct cross-state/country projects communicating with peers outside of their classroom using Skype and ePals. • Students give "guided tours" via the Internet to locations worldwide or participate in an activity-station-filled classroom field trip.	Google Earth earth.google.com ePals (to connect globally) www.epals.com Schoolswaps.net
2. Creativity	• Students draw, paint, collage, perform, or edit a self-made product (e.g., video). • Students engage in sociodrama and role-play scenarios to express ideas and concepts. • Students explore topics of interest, hobbies, and hands-on experiences in after-school groups headed by volunteers and faculty (e.g., philosophy slam, robot creation, art for the community).	National Gallery of Art www.nga.gov Pixton (comic strip maker) www.pixton.com *Out of Our Minds: Learning to Be Creative* by Ken Robinson
3. Environmental and civic literacy	• Students create a documentary slideshow/video about an environmental or civic issue of interest in their community and provide potential solutions.	Worldometers (real-time stats) www.worldometers.info
4. Health and wellness awareness	• Students design healthy eating and lifestyle plans indicating knowledge of nutritional information, exercise, rest, and food choices based on individual needs.	U.S. Department of Agriculture www.choosemyplate.gov Centers for Disease Control and Prevention www.cdc.gov/physicalactivity
5. Leadership skills	• Peer-to-peer mentoring is developed among students in grades or between grades to provide academic and social supports. • Students have rotating classroom responsibilities including communication about assignment deadlines, teaching content to the class, or organizing and maintaining a portion of the room.	Scholastic (younger students) www.scholastic.com/teachers/article/classroom-jobs-all-your-student-helpers ProTeacher blog (all grades) www.proteacher.org/c/55_classroom_jobs.html
6. Social responsibility	• Students create a school-wide energy conservation program exploring how their school could be more energy efficient and how the ideal building is structured, and then design and recommend a plan of action.	Energyville (simulation) www.energyville.com/energyville BBC podcasts for schools www.bbc.co.uk/podcasts/series/wnc
7. Critical thinking	• Students engage in virtual environments, such as River City, where they are presented with a problem, develop a hypothesis to test, analyze and describe findings, and make recommendations (Silva, 2008). • Students become teachers for part of the day like those in a 21st Century Scholars Program (Clark, 2009) to demonstrate, e.g., DNA extraction, dance, podcasting, digital music composition, and photography.	River City Project muve.gse.harvard.edu/rivercityproject
8. Financial and economic literacy and awareness	• Students analyze primary sources to study components to various countries' financial systems. • Students make standards of living comparisons across countries, interpreting exchange rates, labor costs, major occupations, and educational opportunities.	Practical Money Skills (financial literacy and football) www.practicalmoneyskills.com Kids.gov (grades K–8) www.kids.gov
9. Contextual learning skills	• Students analyze a product or an issue from multiple perspectives. For example, students investigate a good, such as corn, for its economic and biological impacts. Students learn from farmers about the product life cycle from seed to harvest of corn, from the Environmental Protection Agency about the impacts of corn growth on the environment (e.g., pesticides, transportation), and from manufacturing plants that use corn to make ethanol.	Interdisciplinary Curriculum www.casenex.com/casenet/pages/virtualLibrary/Readings/interdisc.htm ASCD (integrating cross-connection curriculum) www.ascd.org/publications/books/103011/chapters/What-Is-Integrated-Curriculum%C2%A2.aspx

(continued)

10. Ethics	• Students lead debates through research and discussion of ethical issues related to, e.g., the environment, politics, science, citing sources in research or topics in specific course content. • Students examine readings about people who have acted both ethically and unethically in history to explore perspectives on ethical behavior. • Students create a class-wide code of ethics.	National Resources Defense Council www.nrdc.org/about
11. Adaptability	• Students work in alternating places within the room; bulletin boards are updated frequently; classroom instruction, assessment, and tools are varied.	*Pedagogy* journal www.yale.edu/eglab/pdf/RandiReprint.pdf
12. Business and entrepreneurial literacy	• Schools create teacher task forces to explore how local companies can contribute to class through guest speakers, field trips, and donated or lent resources for classroom use. Participants share experiences and lessons about their fields of work and volunteer to share expertise in after-school programs that match students' hobbies and interests. • In pairs, students work to "create a business." Students write a business plan and mission statement, design business cards and letterhead, create a 30-second commercial, complete spreadsheets of income and expenses, and design a company website. Students use presentation software to share with the class. The business or product may relate to specific time periods, locations, or content areas.	Google Sketch Up sketchup.google.com Software: Microsoft Movie Maker, iMovie, Excel
13. Problem-solving skills	• Students analyze contemporary issues facing the United States and abroad to research and discuss potential solutions and barriers to success (e.g., global warming, national debt). • Students are given scenarios to analyze. For example, based on roles of the American Revolution, students evaluate events from the time period and generate possible alternative plans of action or deduce reasoning for history.	*Teaching for Tomorrow: Teaching Content and Problem-Solving Skills* by Ted McCain Centre for Teaching Excellence cte.uwaterloo.ca/teaching_resources/tips/teaching_problem_solving_skills.html
14. Communicative skills	• Students research, write, film, and perform roles as members of a newscast on selected content topics. • Classes Skype authors, scientists, and others to discuss student questions and interests related to a unit of study.	Skype www.skype.com Twiducate (social networking) www.twiducate.com
15. Media literacy skills	• Students identify, research, and present a new technology or software to the class. • Students capture, edit, and compose their own video and audio projects reflecting course content.	Strategies for integrating digital technologies www.techlearning.com Jing www.techsmith.com/jing
16. Collaboration skills and people skills	• Students identify ebooks of interest, discuss their reading, produce reflections on wikis or the classroom website, and write critical responses to their readings and discussion with peers. • Students use Web 2.0 tools to collaborate on projects for feedback, discussions, and displaying work.	Free ebooks www.gutenberg.org Webspiration www.mywebspiration.com
17. Information and communication technology skills	• Students consult an online textbook platform to view content information, essential questions, maps, visuals, graphic organizers, relevant articles, videos, presentations, educational games, course assignments, and external links. Teachers adopt an online storage system such as Curriculum Loft to tailor curriculum to teacher wants and student needs.	Curriculum Loft curriculumloft.com
18. Accountability	• Students create, design, update, and organize an individual portfolio of work for various audiences.	MyEport (eportfolio) www.myeport.com
19. Personal productivity	• Students chart their progress and reflect often on their work through numerical representation, graphs, written and verbal reflections.	Software: Excel

20. Personal responsibility and self-direction	• Students monitor their own learning through portfolios of work and assessment. • A class website is used any time of day to receive course information, submit assignments, or communicate with the teacher and classmates.	Metycoon (decision making and career-minded thinking) metycoon.org
21. Innovative capability	• Engage students in skills of building innovative mind-sets (Dyer, Gregersen, & Christensen, 2011): o Associating—Students make connections across disciplines and concepts. o Questioning—Teachers embark on continual questioning; students generate questions and explore their inquiries. o Observing—Students watch peers, the teacher, guest speakers, and others in practice and observe examples of work and concepts (e.g., videos, artifacts). o Networking—Students are encouraged to seek information, especially from experts and leaders in fields, work with other students, and collaborate with those outside of their class. o Experimenting—Students experiment with ideas, try things out, take apart, and rebuild. • Students build games through which they will teach concepts to the class.	Prezi prezi.com VoiceThread voicethread.com *Creating Innovators: The Making of Young People Who Will Change the World* by Tony Wagner

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Appendix B
Minnesota Public School Bond and Levy Election Results (July 1, 2007 – 2013)

Count	School District	Date of Election	Stated Purpose On Ballot	Amount	Pass / Fail
1	Anoka	Nov. 6, 2007	Technology improvements	$14,000,000	Failed
2	Bloomington	Nov. 6, 2007	Technology	$30,000,000	Passed
3	Fairmont	Nov. 6, 2007	Technology, etc.	$9,415,000	Failed
4	Farmington	Nov. 6, 2007	Technology	$7,500,000	Passed
5	Inver Grove	Nov. 6, 2007	Technology improvements	$4,000,000	Failed
6	Lakeville	Nov. 6, 2007	Technology improvements	$10,000,000	Failed
7	Minnetonka	Nov. 6, 2007	Fund Technology Plan	$49,760,000	Passed
8	Osseo	Nov. 6, 2007	Technology improvements	$29,000,000	Failed
9	Osseo	Nov. 4, 2008	Technology Levy	5,000,000	Failed
10	Wayzata	Nov. 3, 2009	Capital Project Levy renewal for technology $3.1 million per year for 10 years		Passed
11	South St. Paul	Nov. 3, 2009	Capital Project Levy renewal for technology $650,000 per year for 10 years		Passed
12	Becker	Nov. 3, 2009	Capital Project Levy for technology	$420,000	Passed
13	LeCenter	Nov. 2, 2010	Capital Project Levy for Roofing, lockers, flooring, technology	$1,000,000	Failed
14	Hopkins	Nov. 2, 2010	Capital Project Levy 10 years technology and curriculum	$65,000,000	Passed
15	Lakeville	Nov. 2, 2010	Capital Project Levy for technology	$940,000	Failed
16	Anoka	Nov. 8, 2011	Capital Project Levy for technology	$30,000,000	Passed
17	Eastern Carver County	Nov. 8, 2011	Technology and curriculum project for 10 years	$19,838,000	Failed
18	Edina	Nov. 8, 2011	Capital Project Levy for 10 years technology from $1 million to $4.5 million per year	$4,500,000	Passed
19	New London-Spicer	Nov. 8, 2011	Capital Project Levy for technology	$1,600,000	Passed
20	Northfield	Nov. 8, 2011	Technology and maintenance project for 10 years	$7,500,000	Passed

Count	School District	Date of Election	Stated Purpose On Ballot	Amount	Pass / Fail
21	Orono	Nov. 8, 2011	Technology capital project levy for 10 years	$8,960,000	Pass
22	Stillwater	Nov. 8, 2011	Technology capital project levy for 10 years	$10,000,000	Failed
23	Inver Grove	Mar. 27, 2012	Capital project levy for Technology	?	Failed
24	Perham-Dent	April 3, 2012	Capital project levy for facility improvements, technology	$2,200,000	Passed
25	Deer River	Nov. 6, 2012	Capital project levy for technology, 7 years at $125,000 per year	$875,000	Failed
26	Blackduck	Nov. 6, 2012	Capital project levy for Technology	$105,000	Passed
27	Lake Crystal	Nov. 6, 2012	Capital project levy for Technology	$1,750,000	Passed
28	Northland Community School	Nov. 6, 2012	Capital project levy for Technology, buses 5 years at $310,000 per year	$1,550,000	Failed
30	Eastern Carver County	Nov. 5, 2013	Technology Levy	?	Passed
31	Eden Prairie	Nov. 5, 2013	Technology/capital projects Levy	$60,000,000	Passed
32	Richfield	Nov. 5, 2013	Capital projects Technology renewal	$22,000,000	Passed

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Appendix C
Letter of Permission from Participating School District

[redacted] Independent School District No. [redacted]

[redacted] Independent School District

November 13, 2013

To Whom It May Concern:

I am writing to grant permission to Larry S. Guggisberg to access student data and information gathered by the [redacted] School District in regards to the [redacted] Public Schools' technology and flipped learning initiatives. As an authorized representative of the [redacted] School District, I give permission for Mr. Guggisberg to use [redacted] School District data for his research project.

Mr. Guggisberg is allowed to use this information for the purposes of his doctoral research and will use the pseudonym, "Central School" to protect the anonymity of the school district..

Thank you,

Jeffrey S. Elstad
Superintendent

[redacted] Public Schools

JSE/db

Appendix D
Student Survey Given to Central School Math Students in October of 2011

Check the courses are you are enrolled in?

O……. 8th Grade Accelerated Math

O……. High School Algebra 1

O……. Geometry

O……. Accelerated Algebra 2

O……. Algebra 2

O……. Statistics

O……. Pre-Calculus

O……. Calculus

Check your current grade in school?

O……. 8th Grade

O……. 9th Grade

O……. 10th Grade

O……. 11th Grade

O……. 12th Grade

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How can your class Moodle site be improved?

What do you like best about your class Moodle site?

APPENDIX E
Student Survey Given to Central School Math Students in January of 2012

Class

O……. 8th Grade Accelerated Math

O……. High School Algebra 1

O……. Geometry

O……. Accelerated Algebra 2

O……. Algebra 2

O……. Statistics

O……. Pre-Calculus

O……. Calculus

This image cannot currently be displayed.

APPENDIX F

ROSEAU COMMUNITY SCHOOLS

Home of the Rams

Roseau Public Schools
ISD #682
509 Third Street NE
Roseau, Minnesota 56751

(218) 463 – 1471
(218) 463 – 3243

www.roseau.k12.mn.us

DATE: July 11, 2014

TO: Institutional Review Board - UND
c/o: Ms. Michelle Bowels

FROM: Mr. Stuart McFarlane
Chairman of the Roseau School Board

SUBJECT: Extension of IRB Project #2011312-223

I am aware and have provided school district approval for Mr. Larry Guggisberg, Superintendent of the Roseau School District to participate in a University of North Dakota Educational Leadership co-hort program in an effort to attain an Ed. D. degree.

The Roseau School District intends to purchase nearly $350,000 in computer equipment for use in Roseau School District K-12 classrooms during the 2014-2015 school year. Prior to School Board approval to purchase the computer equipment, the Roseau School District conducted site visits to at least three (3) Minnesota School Districts during the 2013-2014 school year. The purpose was of each site visit was to review and gain an understanding of how schools implement(ed) computer technology in K-12 public education classrooms.

Mr. Guggisberg and a group teachers made a site visit in May 2014 as the Superintendent of the Roseau School District, although we were aware the site visit location is also the subject of his dissertation. The site visit was done as a part of Mr. Guggisberg's normal or typical superintendent duties associated with successful management and operation of the Roseau School District.

PAUL J LaPLANTE
Notary Public–Minnesota
My Comm. Expires Jan. 31 2016

Subscribed and sworn to before me this 11th day of July, 2014

(Notary Public)

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