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Effects of Project-based learning Professional Development on 21st-Century Skills

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EFFECTS OF PROJECT-BASED LEARNING PROFESSIONAL DEVELOPMENT ON 21ST-CENTURY SKILLS

by

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DEDICATION

I would like to dedicate this degree and research project to my life's earliest teachers, my grandmothers. Grandma Betty opened my world through reading and kept books in my hand. Grandma Evelyn sparked my imagination with stories, riddles and games one afternoon at a time as we held hands on the porch swing. They would be so proud that I have accomplished this goal.

ABSTRACT

by
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Title: Effects of Project-based learning Professional Development on 21st-Century Skills (Under the direction of Dr. Lynette Busceme)

This research project was designed to add to the limited available research concerning effects of project-based learning professional development on 21st-century skills within rural Arkansas settings. The researcher sought to determine if high school teachers, trained in project-based learning in the NTN model, perceived they taught and assessed their students' 21st-century skills differently than high school teachers not trained in project-based learning under the NTN model.

This casual comparative study was conducted in 20 school districts in Arkansas with a total student population of approximately 11,646 from 6th grade to 12th grade. The 21st-Century Teaching and Learning Survey was used to collect data on frequency of practice use and extensiveness of use measures for eight 21st-century skills.

The sample for this study examined teacher perceptions from ten schools participating in project-based learning professional development in the New Tech model. Two schools participated in the NTN professional development and began year one implementation of project-based learning in 2011-2012. Eight schools participated in the NTN professional development and began year one implementation of project-based

learning in 2012-2013. Ten additional schools were selected to form the group of non-participating schools. Schools were selected based on similar demographics of enrollment and poverty level as indicated by free and reduced lunch enrollment.

For each measure of 21st-century skills, the researcher focused on the difference between teachers who participated in extended project-based learning professional development and others who did not participate in extended project-based learning professional development on the frequency of use and extensiveness of use of 21st-century skills. The study compared mean scores and computed effect sizes based on overall standard deviation. Statistical significance was calculated using independent samples *t* tests for comparison of means. The results of this study showed significant differences between the group means for 6 of the 8 hypotheses.

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CHAPTER I

INTRODUCTION

College readiness and completion are not just aspirations for school and district leaders as well as governors and legislators; they are economic development imperatives. States strive to create high paying jobs and produce workers to fill them to avoid a phenomena referred to in the Decade Behind report as "low wage/low skill equilibrium" (Carnevale & Smith, 2012, p. 4). In the report, Carnevale and Smith suggested tax revenue could increase between 75 and 150% if southern states doubled the number of workers with bachelor's degrees.

By 2020, 51% of jobs in Arkansas are projected to require postsecondary education and training by 2020 (Carnevale & Smith, 2012). However, only 18.9% of Arkansans between 25 and 64 held a 2 or 4-year degree, ranking Arkansas 48th in the United States in education attainment according to the 2011 U.S. Census Bureau (American Community Survey, 2011). In his 2011 State of the State Address, Governor Mike Beebe (2011) established the state's college completion goals.

> We have a much bigger hill to climb when it comes to higher education. Our woefully low rates of degree completion must change if we truly claim educational success. We can and must double the number of college graduates in Arkansas by 2025 if we are to stay competitive. (para. 8)

Arkansas' education attainment rate indicates a gap that is important to close for economic growth in the state.

As a response to the need to increase educational attainment and produce workers to attract high paying jobs, Governor Beebe's Workforce Cabinet launched Science, Technology, Engineering, Mathematics (STEM) Works, an initiative to transform education by recognizing that future demands will be driven by the 21st-century economy (STEM Works Fact Sheet, 2012). STEM Works focuses on preparation of science, technology, engineering, and mathematics teachers skilled in problem-based learning; the creation of secondary schools designed around hands-on learning, student teams, and projects that integrate elements of the Common Core State Standards curriculum from multiple subjects; and fostering 21st-century student skills development that matches the needs of regional industry clusters.

One major component of the STEM Works initiative is the secondary education component, promoting the New Tech High model as a reform model for Arkansas schools. New Tech Network (NTN) works nationwide with schools, districts, and communities to develop innovative public high schools that enable students to gain the knowledge and skills needed to succeed in life, college, and tomorrow's careers. NTN achieves this goal by providing intensive professional development and on-going instructional coaching support to help schools with three elements of involving instruction, use of technology, and culture. NTN schools implement project-based learning instructional practices to authentically engage students and maximize deep under-standing of content standards in all courses. NTN schools provide ubiquitous access to technology for staff and students in order to enhance professional development

and differentiated learning, and to allow students to become more self-directed learners. Finally, NTN schools maintain a professional culture of "trust, respect, and responsibility" (NTN, 2012, para. 4).

In 2012, the Governor's Workforce Cabinet STEM Works initiative awarded $1.5 million dollars to 10 Arkansas schools to participate in the NTN model of school reform based on project-based learning and 21st-century skills (Arkansas STEM Works Facts, 2012). The long-term goal is that one-half of the state's high schools become New Tech schools within the next 10 years.

Statement of the Problem

The researcher sought to determine if high school teachers, trained in project-based learning in the NTN model, perceived they taught and assessed their students' 21st-century skills differently than high school teachers not trained in project-based learning under the NTN model. The purposes of this study were eight-fold.

1. The purpose of this study was to determine the differences of how teachers participating in project-based learning professional development in the New Tech model versus non-participating teachers perceive their ability to teach and assess critical thinking skills in 20 Arkansas high schools.
2. The purpose of this study was to determine the differences of how teachers participating in project-based learning professional development in the New Tech model versus non-participating teachers perceive their ability to teach and assess collaboration skills in 20 Arkansas high schools.
3. The purpose of this study was to determine the differences of how teachers participating in project-based learning professional development in the New

Tech model versus non-participating teachers perceive their ability to teach and assess communication skills in 20 Arkansas high schools.

4. The purpose of this study was to determine the differences of how teachers participating in project-based learning professional development in the New Tech model versus non-participating teachers perceive their ability to teach and assess creativity and innovation skills in 20 Arkansas high schools.
5. The purpose of this study was to determine the differences of how teachers participating in project-based learning professional development in the New Tech model versus non-participating teachers perceive their ability to teach and assess self-direction skills in 20 Arkansas high schools.
6. The purpose of this study was to determine the differences of how teachers participating in project-based learning professional development in the New Tech model versus non-participating teachers perceive their ability to teach and assess global connections in 20 Arkansas high schools.
7. The purpose of this study was to determine the differences of how teachers participating in project-based learning professional development in the New Tech model versus non-participating teachers perceive their ability to teach and assess local connections in 20 Arkansas high schools.
8. The purpose of this study was to determine the differences of how teachers participating in project-based learning professional development in the New Tech model versus non-participating teachers perceive their ability to teach and assess using technology as a tool for learning in 20 Arkansas high schools.

Background

History

NTN originated in Napa California in 1996 as a result of partnerships between the local school district and community businesses and partnerships in efforts to produce graduates with skills needed to meet demands of the new economy. The NTN spans across 120 schools in 18 states. The model is based on three elements; use of problem-based learning as the heart of instruction, use of technology as a tool with one-to one computing, and use of a professional culture of "trust, respect and responsibility where students have exceptional ownership of the learning experience and their school" (NTN, 2012, para. 4).

Since 2010, NTN has been a growing presence in Arkansas with two schools opening in 2010 and eight schools opening in 2011. Implementation models vary with three options. One option is to use the model across the entire school, in a whole school conversion process, where all students and teachers implement project-based learning. Another option is to create a stand-alone school, like a magnet school, that draws students from the district to a separate campus. The third option is to create a small learning community within the larger school.

Applications for school development planning in NTN are by invitation only. Questions in the application are used to both guide an applicant's planning for a New Tech school and to determine local capacity to implement the model with fidelity and success. After application review and acceptance, a NTN representative will conduct a Readiness Visit to the community. Successful applicants are invited to enter into a contracted agreement with NTN to support the development of a New Tech school and to

begin a more formal planning process to ensure a strong and sustainable implementation (NTN Agreement, 2010).

Schools electing to participate in the NTN agree to make every effort for teachers to participate in the training events. Schools are responsible for selecting teachers to serve in NTN teaching assignments. *Exhibit B Conditions for Success in the New Tech High School Agreement* (2010) stated that the school principal should have significant hiring autonomy from involuntary transfers from other schools to ensure hiring and assessment procedures will reflect the specific requirements of the model.

An additional staffing requirement is that NTN teachers and principals are full-time employees of the school and will not have their assignments shared with other schools. School staff will teach no more than three courses that require a unique prep in any one semester.

New School Training in the NTN model consists of principal residency training, a 2-day shadowing event for the principal and staff, and New Schools Training or New Teacher Track at the Annual NTN conference, both 5-day team trainings where teachers experience project-based learning and technology while learning how to create, teach, and assess curriculum standards and team learning outcomes using project-based learning. In addition, NTN provides on-site coaching and remote coaching for four years. NTN also offers regional conferences throughout the school year referred to as Meetings of the Mind. For the purpose of this study, teachers selected as NTN participants attended the New Schools Training or New Teacher Track at the Annual New Tech Conference, or participated in on-site coaching with NTN coaches.

Research

There is little literature on the NTN model, although NTN data suggests New Tech High schools have improved student achievement and attendance, increased graduation rates and post-secondary enrollment and narrowed achievement gaps (NTN, 2013). Rockman et al. (2006) consulting group reported findings that suggest the NTN model is meeting the academic and skills needs of its 21st-century students, with 89% of the responding alumni attending a 2-year or 4-year college/university or professional or technical institute, and 40% of the alumni respondents either majoring or working in STEM professions.

Linda Darling-Hammond described NTN as a model that "designed a rigorous, coherent instructional program that enables students to overcome barriers to access related to race, poverty, language, or initially low academic skill that exist in most schools" (Friedlaender, Darling-Hammond et al., 2007, p. 39). The *High Schools for Equity* study (Friedlaender, Darling-Hammond et al., 2007) described the project-based learning approach utilized for instruction as one that

> emphasizes trans-disciplinary skills not evaluated on standardized tests, but used extensively in the work-place. These include skills in oral presentation, personal presentation, collaboration, planning, and the development of a strong work ethic. As a result of regular engagement with these kinds of projects, New Tech students stand out in their self-confidence and their ability to articulate the purpose of their work and its relevance. (p. 28)

With project-based learning as the primary means of instruction, NTN students experience emphasis on 21st-century skills such as collaboration, and self-direction.

Alliance for Excellent Education, in the policy brief *A Time for Deeper Learning: Preparing Students for a Changing World* (2011), cites the New Tech High at Arsenal Tech in Indianapolis as an example of a project-based learning school demonstrating "power and promise of deeper learning". Deep learning is defined as the

> delivery of rich core content to students in innovative ways that allow them to learn and then apply what they have learned. Rigorous core content is the heart of the learning process; true deeper learning is developing competencies that enable graduating high school students to be college and career ready and then make maximum use of their knowledge in life and work. (p. 1)

The focus on professionalism and deeper learning allows NTN students to develop 21st-century skills such as critical thinking, and creativity and innovation skills.

Although the NTN model is not heavily researched, the key instructional approach of project-based learning has over 40 years of accumulated evidence supporting that project-based learning can be effective in building deep content understanding, raising academic achievement and encouraging student motivation to learn. Research studies have demonstrated that project-based learning can be more effective than traditional instruction in increasing academic achievement on annual state-administered assessment tests (Geier et al., 2008). Studies show project-based learning to be superior over traditional instructional methods for important outcomes associated with 21st-century skills. Project-based learning has been shown to enable students to remember longer what they have learned and use that knowledge in new situations (Dochy, Segers, Van den Bossche, & Gijbels, 2003; Schwartz & Martin, 2004; Strobel & van Barneveld, 2009).

Project-based learning has been shown to enable students to learn how to work in groups, solve problems, and communicate what they have learned (Cognition and Technology Group at Vanderbilt, 1992; Gallagher, Stepien, & Rosenthal, 1992; Hmelo, 1998). Findings from research studies of the effectiveness of project-based learning on the performance of medical students found that students trained with a project-based learning approach performed better than non-project-based trained students on clinical components in which conceptual understanding and problem-solving abilities were assessed (Hmelo-Silver, 2004; Vernon & Blake, 1993). Project-based students and non-project-based students performed similarly on matters of factual knowledge. When assessed later, project-based students performed better than non-project-based students on clinical components and factual knowledge (Vernon & Blake, 1993).

The West Virginia Department of Education study on extended professional development in project-based learning found that extensively-trained project-based learning teachers taught 21st-century skills more often and more extensively than non-participants (Hixson, Ravitz, & Whisman, 2012). The West Virginia Department of Education undertook the 2-year project of sponsoring project-based learning professional development as a method of teaching 21st-century skills. This study was a summative evaluation conducted to investigate the effect of extended professional development in project-based learning on teacher's ability to teach and assess 21st-century skills and on student achievement. Although project-based learning students did not show standardized test score gains that exceeded a matched group of non-project-based learning students, their performance suggested that project-based learning did not impede standardized test preparation.

Hypotheses

The initial literature review suggested project-based learning can increase learning of 21st-century skills. Although there is a sizable body of research for project-based learning, little systemic research has been done examining the effect of professional development in project-based learning on teacher competencies focus on 21st-century skills.

1. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess critical thinking skills compared to non-participating teachers in 10 comparable high schools in Arkansas.
2. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess collaboration skills compared to non-participating teachers in 10 comparable high schools in Arkansas.
3. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess communication skills compared to non-participating teachers in 10 comparable high schools in Arkansas.
4. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning

professional development in the New Tech model on their ability to teach and assess creativity and innovation skills compared to non-participating teachers in 10 comparable high schools in Arkansas.

5. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess self-direction skills compared to non-participating teachers in 10 comparable high schools in Arkansas.
6. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess global connections compared to non-participating teachers in 10 comparable high schools in Arkansas.
7. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess local connections compared to non-participating teachers in 10 comparable high schools in Arkansas.
8. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess using technology as a tool for learning compared to non-participating teachers in 10 comparable high schools in Arkansas.

Description of Terms

21st-century skills. For the purpose of this study, the definition of 21st-century skills came from the West Virginia Department of Education Office of Research Study (Hixson et al., 2012). The defintions and instrucment code for each of the eight 21st-century skills are as follows:

Code	Skill name and definition
CT	CRITICAL THINKING SKILLS refers to students being able to analyze complex problems, investigate questions for which there are no clear-cut answers, evaluate different points of view or sources of information, and draw appropriate conclusions based on evidence and reasoning.
CO	COLLABORATION SKILLS refers to students being able to work together to solve problems or answer questions, to work effectively and respectfully in teams to accomplish a common goal and to assume shared responsibility for completing a task.
CM	COMMUNICATION SKILLS refers to students being able to organize their thoughts, data, and findings; and share these effectively through a variety of media, as well as orally and in writing.
CR	CREATIVITY AND INNOVATION SKILLS refers to students being able to generate and refine solutions to complex problems or tasks based on synthesis, analysis, and then combining or presenting what they have learned in new and original ways.
S	SELF-DIRECTION SKILLS refers to students being able to take responsibility for their learning by identifying topics to pursue and processes for their own learning, and being able to review their own work and respond to feedback.
G	GLOBAL CONNECTIONS refers to students being able to understand global, geopolitical issues including awareness of geography, culture, language, history, and literature from other countries.
L	LOCAL CONNECTIONS refers to students being able to apply what they have learned to local contexts and community issues.
U	USING TECHNOLOGY AS A TOOL FOR LEARNING refers to students being able to manage their learning and produce products using appropriate information and communication technologies.

(Hixson et al,. 2012, p.8)

This study considered the Innovative Teaching and Learning study (Shear, Novais, Means, Gallagher, & Langworthy, 2010) and The William and Flora Hewlett Foundation (2010) for conceptualization of skills associated with 21st-century skills. See Appendix A for comparison of the frameworks for these skills.

New Tech Network (NTN). NTN is a non-profit nationwide network that works with schools, districts and communities to develop innovative high school reform centered on professional culture of trust, respect, responsibility; implementation of project-based learning instructional practices; and ubiquitous access to technology. New Tech achieves this goal by providing modeling, training and coaching (NTN, 2012).

New Tech Network Professional Development. For purposes of this study, professional development in the New Tech Model was comprised of New Schools Training, New Teacher Track at the Annual New Tech Conference, or on-site coaching with NTN coaches (NTN, 2012).

Non-participating Group. For the purpose of this study, teachers from ten schools in Arkansas not participating in the project based professional development in the New Tech model were selected to form the group referred to as non-participating. Selection was based on demographics of enrollment and poverty level as indicated by free and reduced lunch enrollment.

Participating Group. For the purpose of this study, teachers from ten schools in Arkansas participating in professional development to implement project-based learning in the New Tech model formed the group of schools referred to in the study as participating schools. Two schools participated in the NTN professional development and began year one implementation of project-based learning in 2011-2012. Eight schools

participated in the NTN professional development and began year one implementation of project-based learning in 2012-2013.

Problem-based Learning. Project-based learning can vary by subject and grade level, and a wide variety of definitions exist. Buck Institute for Education is an institute dedicated to improving 21st-century teaching and learning by development of effective project-based learning. Buck Institute of Education (2013) defines project-based learning as an

> extended process of inquiry in response to a complex question, problem, or challenge. While allowing for some degree of student "voice and choice," rigorous projects are carefully planned, managed, and assessed to help students learn key academic content, practice 21st-century skills (such as collaboration, communication & critical thinking), and create high-quality, authentic products & presentations." (para.1)

This definition of project-based learning will be used for the purpose of this study.

STEM occupations. For this study, STEM occupations were defined as science, technology, engineering, and mathematics occupations by the Center for Education and Workforce STEM Report (Carneval, Smith, & Melton, 2011). STEM includes computer occupations (computer technicians, computer programmers, and computer scientists), mathematical science occupations, engineers and engineering technicians, life and physical Science occupations, and architects, surveyors, technicians, and sub-baccalaureate technical workers. Social scientists are not included (Carneval et al., 2011).

Significance

Research Gaps

In order to teach every child in the U.S. 21st-century knowledge and skills, teachers will need to teach in ways that are different from how most have been teaching. Research on the 21st-century skills revealed an emerging base of cognitive domain and base research but a need to clarify and define the 21st-century skills and associated terms. More research is needed to understand the relationship of these 21st-century skills to deep learning, and research is needed to understand more about how these skills can be learned, taught, and assessed.

A large amount of research supports project-based learning as an effective instructional strategy to build 21st-century skills including critical thinking, collaboration, communication, creativity and innovation, self-direction, making global connections, making local connections, and using technology as a tool. A review of the literature relating to project-based learning as a method of teaching 21st-century skills revealed a base of project-based learning research and a need for more research on the development of teacher knowledge, skill and efficacy needed for these skills to be learned, taught, and assessed effectively.

For teachers to address the learning needs of students using project-based learning, appropriate professional development must be in place to build knowledge and competencies, and develop teacher self-efficacy. A review of the literature on effective professional development and support for the development of teacher-efficacy identified components of quality professional development and identified the need for research

specific to professional development on project-based learning for the development of 21st-century skills.

Reform models, including NTN, leverage project-based learning as a means to increase 21st-century skills claiming increased student outcomes such as graduation, college retention, and career readiness (NTN, 2013). However, while NTN offers research finding positive student outcomes, there is little empirical research conducted on the impact of professional development on teacher execution of 21st-century skills within the classroom.

This study helps fill in the gap in these areas by building on the research presented in the West Virginia Department of Education study *Extended professional development in project-based learning: Impacts on 21st-century teaching and student achievement* (Hixson et al., 2012). It specifically examines how project-based learning professional development affects teacher use and perceived abilities to teach and assess 21st-century learning in Arkansas.

Possible Implications for Practice

The Arkansas Science, Technology, Engineering and Math (STEM) Works Initiative recognizes the importance of increasing graduates with 21st-century skills and seeks to support schools by funding school participation in the NTN. Findings from this study will provide useful information for policymakers to consider regarding STEM and 21st-century skills reform initiatives. In addition, these outcomes could influence teachers' interests in professional development in project-based learning as well as potential school district interest and commitment to the NTN model.

Process to Accomplish

Design

A quantitative, causal-comparative non-experimental study was conducted in school districts in Arkansas. This non-experimental, research study examined conditions that already existed in the schools; therefore, the independent variables in hypotheses one through eight were not manipulated. For the hypotheses, participation in project-based learning professional development served as the independent variable with teachers' perceived ability to teach and assess 21st-century skills serving as the dependent variables. The participants for the research questions were teachers in the state of Arkansas who had experienced or had not experienced the project-based learning professional development in the NTN model. The 21st-Century Teaching and Learning Survey (see appendix B) was used to measure how teachers involved in the project-based professional development perceived how effective they felt teaching and assessing 21st-century skills.

Sample

In the 2011-2012 school year, two Arkansas schools participated in the NTN professional development and began year one implementation of project-based learning. In the 2012-2013 school year, eight Arkansas schools participated in the NTN professional development and began year one implementation of project-based learning.

According to data retrieved from the National Office for Research on Measurement and Evaluation Systems (2013), enrollment in the 10 Arkansas high schools ranged from 322 to 1,263, with a total student enrollment of students in the New Tech High schools equaling 5,988. Grade spans taught in the participating schools

included one 7-12 high school, one 8-12 high school, six 9-12 high schools, and two 10-12 high schools. The percentage of free and reduced lunch students in four of the high schools was above the state average of 60%, and the percentage of free and reduced lunch students was below the state average of 60% in six of the high schools.

For the purpose of this study, schools were classified into three sizes; small with an enrollment of 499 or less, medium with enrollment from 500-999, and large with enrollment of 1,000-1,500. Participating schools ranged in with five schools in the small category, three in the medium category, and two in the large category.

Teachers selected for the survey were those teaching in school in the first or second year of NTN implementation identified who participated in professional development on project-based learning including the New Schools Training, New Teacher Track at the Annual New Tech Conference, or on-site coaching with NTN coaches. The survey focused on instructional activities and perceptions of the trained teachers during the spring semester of 2013.

Schools of nonparticipants were selected to match the enrollment, and socio-economic demographics of schools of participants. Teachers were selected to match grade spans and subjects taught.

Instrumentation

The 21st-Century Teaching and Learning Survey was administered in the spring of 2013. The modified survey was based on the instrument used in the West Virginia Education Department Extended Professional Development in Project-Based Learning study (Hixson et al., 2012) with permission from the authors (see appendix C). Conceptualization of the skills in the original study survey came from the international

Innovative Teaching and Learning study (Shear et al., 2010), and The William and Flora Hewlett Foundation (2010). Survey items modified and used to indicate that the skills were taught based on reliability data reported by Shear et al. (2010).

Teachers were instructed to select a target course and a target class in which they felt their practices were most effective, and to answer the survey with this target class in mind. Background questions were asked about training and target classes were asked to allow close examination of the coding and results.

Teachers were asked whether their work had included a significant focus on technology integration, formative and benchmark assessments, or project-based learning. Teachers were asked whether most of the students in this class were behind, at, or ahead of the expected achievement level for their grade. Teachers were also asked about teachers' assessment of student learning of academic content, the hours per week an average student might be expected to continue working on their assignments outside of class, and how much time students spent preparing for standardized tests.

The 21st-century skill section of the survey consisted of a definition of the skill and the following prompt: "In your teaching of your target class, how often have you asked students to do the following?" A list of five to eight related practices or student tasks a teacher may have assigned as part of their teaching for each skill followed, and teachers responded using the following response choices for each practice. Response choices included *1, Almost never; 2, Few times a semester; 3, 1-3 times per month; 4, 1-3 times per week, or 5, Almost daily*. (Hixson et al., 2012).

After reading the definition of the skill and indicating the frequency of their practices, teachers indicated whether they had tried to teach these skills, whether students

had learned, and if they had been able to assess these skills. Teachers responded to the following prompts substituting the name of the skill (e.g., critical thinking):

a. I have tried to develop students' _____ skills.

b. Most students have learned _____ skills while in my class.

c. I have been able to effectively assess students' _____ skills.

Response choices included 1, *Not really*; 2, *To a minor extent*; 3, *To a moderate extent*; 4, *To a great extent*, or 5, *To a very great extent* (Hixson et al., 2012).

Data Analysis

For each measure of 21st-century skills, the researcher focused on the difference between teachers who participated in extended project-based learning professional development and others who did not participate in extended project-based learning professional development on the frequency of use and extensiveness of use of 21st-century skills. The study compared mean scores and computed effect sizes based on overall standard deviation. Statistical significance was calculated using independent samples *t* tests for comparison of means.

CHAPTER II

REVIEW OF RELATED LITERATURE

Every child in the United States needs 21st-century knowledge and skills to succeed as an effective citizen, worker, and leader. In order to prepare students to face rigorous post-secondary coursework successfully, career challenges and a globally competitive workforce, U.S. schools need to align classroom environments with real world environments. This is done by fusing content including English, reading or language arts, mathematics, science, foreign languages, civics, government, economic, arts, history, and geography, with critical thinking, problem solving, communication, collaboration, creativity and innovation (Partnership for 21st-Century Skills, 2009). While most business leaders, policy makers, and political leaders agree on the need to prepare students for success in a rapidly changing world and are asking schools to develop content knowledge and skills such as problem solving, communication, collaboration, critical thinking, and self-management, they use a variety of names for the lists of broad skills seen as valuable. A review of the literature relating to 21st-century skills revealed an emerging base of cognitive domain research, but a need to clarify and define the 21st-century skills and associated terms. More research is needed to understand the relationship of these 21st-century skills to deep learning, and how these skills can be learned, taught, and assessed.

Project-based learning is one instructional approach found to facilitate increased 21st-century skills in the classroom. It has an emphasis on instruction through inquiry, application, and problem solving. The Buck Institute for Education (2013) defined project-based learning as an extended process of inquiry in response to a complex question, problem, or challenge, allowing for student choice. Rigorous projects are carefully planned, managed, and assessed to help students learn key academic content, practice 21st-century skills and create high quality, authentic products and presentations.

With over four decades of research on project-based learning, it has been linked to increased understanding of concepts and the ability to apply knowledge as measured by standardized tests (Geier et al., 2008). In addition, this approach increased student motivation and improved attitudes (Boaler, 2002; English, 2013), as well as, demonstrated gains in content knowledge (Mergendoller, Maxwell, & Bellisimo, 2006). Therefore, project-based learning is becoming a key component in some school reform models, such as NTN, seeking to support teachers to teach 21st-century skills and prepare students to master these skills. A review of the literature related to project-based learning as a vehicle to teach 21st-century skills revealed a solid base of project-based learning research. However, there is a necessity for more research on the development of teacher knowledge, expertise and efficacy so that these skills may be effectively learned, taught, and assessed.

In order to meet big shifts such as teaching 21st-century skills associated with enhanced academic standards, implementing the next generation assessments, and meeting accountability measures there must be a comparable shift in educator professional development. Kane and Staiger (2012) reported that trained observers

watched 7,491 videos of instruction by 1,333 teachers from six socioeconomically and geographically diverse districts and found that while the classrooms were well-behaved and on task, the vast majority of teachers were not teaching for problem solving or critical thinking. Gulamhussein (2013) concluded that professional development needs to emphasize practices that turn students into critical thinkers and in order to do so "teacher learning is the linchpin between the present day and new academic goals" (p. 6). Classroom teachers need targeted preparation and support. "To meet the more rigorous expectations for new college and career ready standards, students will need teachers who teach in ways that are distinctly different than how most have been teaching" (Coggshall, 2012, p. 1). These finding suggest that professional development beyond traditional instructional methods is necessary in order for teachers to prepare students for increased demands to master 21st-century skills.

Implementation of project-based learning is a complex process. Many factors have been cited in literature as challenges to successful implementation of project-based learning including project time management, classroom management, control of the flow of information, allowing student independence balanced with support, and difficulty designing authentic assessments (Center of Excellence in Leadership of Learning, 2009). Teachers must be adequately prepared to meet these challenges. A review of the literature on effective professional development and support for the development of teacher-efficacy identified components of quality professional development and revealed the need for research specific to professional development on project-based learning for the development of 21st-century skills.

Arkansas, like many states, realizes the need to increase the number and quality of students graduating from college and being career ready. The Arkansas STEM Works Initiative recognizes the importance of increasing graduates with 21st-century skills that are transferable from school to work and careers. It seeks to encourage and support schools in efforts by funding school participation in the NTN, a high school reform model that uses project-based learning as its primary instructional approach to increase 21st-century teacher and student outcomes.

This literature review in this chapter provides a research-based foundation for this study and its findings. The chapter is organized into five parts. First, an overview of the research defining and clarifying 21st-century skills was presented. Second, a review of the literature relating to project-based learning as a means of instruction for 21st-century skills was discussed. Third, the researcher provided a look at the research on the development of teacher knowledge, skill and efficacy needed for 21st-century skills to be taught effectively is presented. Fourth, there was an examination of the professional development provided by the NTN, one school reform model that intends to promote project-based learning and subsequent acquisition of 21st-century skills for educators and students. Fifth, conclusions were drawn.

Defining and Clarifying 21st-century skills

Students need to develop a range of skills and content knowledge. In addition, business and political leaders are increasingly asking schools to develop cognitive and non-cognitive skills such as problem solving, critical thinking, communication, collaboration, and self-management often referred to as 21st-century skills. Investigation of key research revealed many initiatives involved with the 21st- century skill movement

including the Partnership for 21st-Century Skills, The Assessment and Teaching of 21st-Century Skills Project, the Center for Public Education, the Organization for Economic Co-operation and Development, the Metri Group in partnership with the North Central Regional Educational Laboratory, Teaching and Learning Innovations, the William and Flora Hewlitt Foundation, and the Knowledge Works Foundation. These initiatives use various theoretical models to conceptualize their lists of 21st-century skills into categories and domains.

In order to assist researchers and policy makers, the National Research Council (NRC, 2012) was commissioned by several foundations to define the set of key skills that are referenced by the labels 21st-century skills, college and career readiness, student centered learning, next generation learning, new basic skills, and higher-order thinking. These labels are typically used to include skills such as critical thinking, problem solving, collaboration, effective communication, motivation, persistence, and learning to learn. The committee drew on a large research base in cognitive, developmental, educational, organizational, social psychology and economics fields but did not provide precise, scientifically credible definitions of all the various terms, citing a lack of definitive research on the range of skills and behaviors that have come to fall under the headings of 21st-century skills. Rather than develop specific definitions of 21st-century skills, the committee viewed 21st-century skills as dimensions of expertise that are specific to and intertwined with knowledge within a particular domain of content and performance. Therefore, 21st-century skills are viewed as competencies rather than skills.

To clarify and organize the terms associated with 21st-century skills NCR (2012) identified three broad domains of competence. The first domain, the cognitive domain,

involves reasoning and memory. The second domain, the intrapersonal domain, involves the capacity to manage one's behavior and emotions to achieve one's goals, including learning goals. The third domain, the interpersonal domain, involves expressing ideas, and interpreting and responding to messages from others. NRC (2012) then aligned several lists of 21st-century skills proposed by various groups and assigned the 21st-century skills to clusters of competencies within each domain. The cognitive domain includes three clusters of competencies: cognitive processes and strategies, knowledge, and creativity. Competencies related to the cognitive domain include critical thinking, information literacy, reasoning and argumentation, and innovation. The intrapersonal domain includes clusters of intellectual openness, work ethic and conscientiousness, and positive core self-evaluation. These clusters include competencies such as flexibility, initiative, appreciation for diversity, and metacognition. The interpersonal domain includes two clusters of competencies: teamwork and collaboration, and leadership. Competencies include teamwork, collaboration and leadership, communication, collaboration, responsibility, and conflict resolution.

NRC (2012) reported limited research on the importance of these types of competencies for success in education, health and career contexts other than correlative studies. Cognitive competencies have been more extensively studied than the other competencies and showing consistent, positive correlations with desirable educational, career, and health outcomes. Among intrapersonal and interpersonal competencies, conscientiousness (with indicators such as staying organized, responsible, and hardworking) was most highly correlated with desirable educational, career, and health outcomes. Research on labor market impacts shows that the level of education attainment

strongly predicts adult earnings, health, and civic engagement. Although it is not known what mixture of cognitive, interpersonal and intrapersonal competencies contribute to the career benefits of additional schooling, "promoting educational attainment itself may constitute a useful complementary strategy for developing 21st-century competencies" (NCR, 2012, p. 5). Higher levels of education appear to indicate more knowledge and skill on the job.

Although NRC (2012) defined 21st-century skills as dimensions of expertise that are specific to and intertwined with knowledge within a particular domain, deeper learning was defined as the process through which an individual becomes capable of taking what was learned in one situation and applying it to a new situation. The product of deeper knowledge is transferable knowledge, including content knowledge in the domain and knowledge of how, why and when to apply this knowledge to answer questions and solve problems. This blend of both knowledge and skills was referred to as 21st-century competencies. NRC (2012) concluded that the process of deeper learning is

> essential for the development of transferable 21st-century competencies (including both knowledge and skills), and the application of 21st-century competencies in turn supports the process of deeper learning, in a recursive, mutually reinforcing cycle. (p. 8)

The 21st-century skills, dimensions of expertise intertwined within content knowledge, reinforce and support deeper knowledge.

Importance of 21st-Century Skills and Deeper Learning

The need to increase transfer knowledge is escalating, fueled by Freidman's (2005) "flat world" (p. 5) and statistics that say information equivalent to 37,000

Libraries of Congress is produced annually and is growing at a rate of 30% each year (Lyman & Varian, 2003). Content knowledge expands and updates at a rate too high to master it all as a pre-requisite before applying 21st-century skills. Developers of the enhanced curriculum standards in English, mathematics and science increased the emphasis on skills within each discipline. Comparison of the Common Core State Standards, the Next Generation Science frameworks, and the NRC definitions of deeper learning and the 21st-century competencies indicate areas of overlap mainly within the cognitive domain but also within the intrapersonal and interpersonal domains (NRC, 2012). This indicates that disciplinary goals have expanded beyond the traditional focus of basic content.

Understanding the cycle-like nature of the relationship between 21st-century competencies and deeper learning is important in order to better produce transfer of knowledge and skill within and across disciplines and across school to work and social settings. What is lacking is research on how to help learners transfer competencies learned across disciplines. Review of the literature indicated more research is needed to define and clarify 21st-century competencies, examine casual relationships between them and desirable adult outcomes, and determine whether and to what extent teaching 21st-century skills within a discipline can facilitate transfer across disciplines.

Project-Based Learning for 21st-Century Skills

Project-based learning has been heavily researched over the last forty years, with recent literature linking project-based learning to 21st-century skills (Bell, 2010; Hixon et al., 2012) Studies define project-based learning in a variety of ways, but hold some essential elements in common. Buck Institute for Education (2013) defined project-based

learning as an extended process of inquiry in response to a complex question, problem, or challenge, allowing for student choice. Rigorous projects are carefully planned, managed, and assessed to help students learn key academic content, practice 21st-century skills and create high-quality, authentic products and presentations. Buck Institute of Education (2013) added indicators to the development of their definition that rigorous, meaningful and effective project-based learning. First, project-based learning is intended to teach significant content. Second, it requires critical thinking, problem solving, collaboration, and various forms of communication. Third, it requires inquiry as part of the process of learning and creating something new. Fourth, it is organized around an open-ended driving question. Fifth, it creates a need to know essential content and skills. Sixth, it allows some degree of student voice and choice. Seventh, it includes processes for revision and reflection. Last, it involves a public audience.

Research studies have demonstrated that project-based learning can be more effective than traditional instruction in many areas. According to an analysis of project-based learning research completed by Thomas (2000), evidence can be found to support project-based learning as more popular with students and teachers than traditional methods and both students and teachers believe that project-based learning is beneficial and effective as an instructional method. Second, project-based learning enhances the quality of student learning in subject matters compared to other instructional models. Third, project-based learning seems to be equal or slightly better than other models of instruction for producing gains in academic achievement. Fourth, project-based learning can help increase student attendance, attitude, and self-reliance. Fifth, for teachers, project-based learning can increase professionalism and collaboration. Finally, project-

based learning is an effective strategy for teaching complex skills such as planning, communication, problem-solving, and decision making.

Geier et al. (2008) found that seventh and eighth grade science students in Detroit Public Schools taught through project-based learning instruction not only showed pre- and post-test gains on unit assessments, but that students also showed increasing academic achievement on annual state-administered assessment tests. These findings demonstrated that project-based learning "can lead to standardized achievement test gains in historically underserved urban students when the curriculum is highly specified, developed, and aligned with professional development and administrative support" (Geier et al., 2008, p. 922). Hixon et al. (2012) compared student achievement between students taught with high and little or no project-based learning and found no significant differences. These findings suggest that use of project-based learning does not interfere with standardized test performance.

Project-based learning has been found to be effective for gains in content knowledge. Mergendoller et al. (2006) found that project-based learning was more effective than traditional instructional approach for teaching macroeconomics than traditional lecture approach. Research also indicated project-based learning was effective for students with various levels of aptitudes. Project-based learning was more effective for students with average verbal ability and below; students who were more interested in the content; and students who were most and least confident in their ability to solve problems. These findings suggest that project-based learning may have positive impact in various contents and with students of various ability levels.

Research shows that engagement and enjoyment contribute to learning. Motivation is increased when students have choice and control (Deci & Ryan, 2006; Dweck, 2006; Pink, 2009). Project-based learning was shown to contribute to positive student outcomes such as personalized learning, increased engagement and increased motivation (Boaler, 2002). Yanez (2009) conducted a study at Manor High School in Austin, Texas to examine practices that supported students taking responsibility for their own learning and reported findings of the presence of a supportive school culture and of high levels of student engagement through project-based learning. Researchers noted students "taking responsibility for their own learning in multiple ways in their commitment to accomplishing tasks for a project, their self-direction in joining in-class workshops on specific topics, and their monitoring of group roles and responsibilities" (p. 11). Students experienced emphasis on project-based learning that lead to self-direction skills and a culture of professionalism.

Rockman et al. (2006), an educational evaluation and consulting agency, connected project-based learning with 21st-century skill acquisition. When interviewed, graduates from one New Tech High School using project-based learning and found that feedback from graduates strongly suggested that the educational experience was based on 21st-century principles. Respondents mentioned acquiring 21st-century skills such as collaboration skills, problem solving skills, and communication skills. They felt confidence in public speaking, which was perceived as resulting in positive leadership and career outcomes. Graduates reported themselves capable of working in 21st-century settings and of having the self-management skills needed to make decisions in study and work. Forty percent of the graduates reported working in STEM related fields.

Lee (2010) interviewed project-based learning graduates and reported that access to technology, collaborative work, taking college courses while in high school, critical thinking, written communication skills, and oral communication skills were deemed valuable or extremely valuable. Graduates described projects as "rigorous with high standards that pushed students to conduct research, think critically about multiple perspectives, connect learning across subject areas, and analyze different sources of information" (Lee, 2010, p. 14). These alumni findings suggest that use of project-based learning may have a positive impact on interpersonal and intrapersonal domain competencies, as well as cognitive domain competencies.

Meta-analysis and meta-synthesis combined the results of many studies over thirty years of research from 1976 to 2007 comparing project-based learning to traditional instruction. Walker and Leary (2009) conducted a meta-analysis across 82 studies and 201 outcomes that favored project-based learning primarily associated with medical education and allied health. However, the analysis included 47 outcomes outside these fields. Walker and Leary (2009) concluded that in studies limiting the scope to standardized tests of concepts, "project-based learning is able to hold its own in comparison to lecture-based approaches" (p. 27). Across almost all of the analyses run, project-based learning students either did as well as or better than their lecture-based counterparts.

Strobel and van Barneveld (2009) conducted a qualitative meta-synthesis of existing meta-analyses to compare and contrast findings of the meta-analytical research on effectiveness of project-based learning. Although project-based learning was not the only effective strategy to achieve learning, Strobel and van Barneveld (2009) concluded

that “project-based learning is significantly more effective than traditional instruction to train competent and skilled practitioners and to promote long-term retention of knowledge and skills acquired during the learning experience or training session” (p. 55). They concluded that project-based learning was superior for building long-term retention, skill development, and satisfaction of students and teachers, and traditional approaches were more effective for short-term retention as measured by standardized tests.

Hattie (2009) cited 8 meta-analyses and 285 studies on project-based learning in *Visible Learning: A synthesis of over 800 meta-analyses relating to achievement*. Project-based learning ranked 118 out of 138, with Hattie’s review noting the importance of distinguishing between effects on surface and deep knowledge and understanding. Project-based learning was found to have limited or negative effects on attainment of surface level knowledge and accumulation of facts. It held positive effects on deeper learning, self-direction, and attitude towards learning. “Application of knowledge, not the development of knowledge, is the heart of the success of project-based learning” (Hattie, 2009, p. 211). These findings support project-based learning as an effective instructional approach to develop 21st-century skills.

Bell (2010) explained that students develop 21st-century skills through project-based learning when assessments are authentic and when students are included in self-evaluation and reflection.

> In the future, children must enter a workforce in which they will be judged on their performance. They will be evaluated not only on their outcomes, but on their collaboration, negotiating, planning, and organizational skills. By implementing project-based learning, we are preparing our students to

> meet twenty-first century skills with preparedness and a repertoire of skills they can use successfully. (p. 43)

Bell (2010) stated that students learn best when they learn from processes, and reflect on how well they worked in collaborative groups, how they contributed, negotiated, and listened. During project-based learning students become critical friends giving constructive feedback, and become aware of their own strengths. Although research supports the use of project-based learning to teach 21st-century skills, there is limited research on the school support systems and professional development needed to support it.

Fullan (2012) cited Hattie's synthesis of over 800 meta-analyses on the effects of teaching practices on student achievement as support for his belief that preparing students for 21st-century learning skills will require radically different roles for teachers, students, and principals. With the majority of research literature finding project-based learning as or more effective as traditional instruction, focus for future research points to learning more about how to best support and deliver project-based learning. Strobel and van Barneveld (2009) concluded that

> Since the evidence suggests that project-based learning works in particular contexts, especially for workplace learning with a focus on skills and long-term retention, the focus should shift from researching effectiveness of project-based learning versus traditional learning, and should refocus on studying the differences in effectiveness of support structures to find optimal scaffolding, coaching, and modeling strategies for successful facilitation of project-based learning. (p. 55)

Ravitz (2009) also concluded that future studies in project-based learning are needed to inform practice, inform policy, and identify specific mechanisms that contribute into project-based learning effectiveness.

Teacher Knowledge, Competencies and Efficacy Associated with 21st-Century Skills

Hixon et al. (2012) examined the impact of extended professional development on project-based learning on the frequency and extensiveness of use of 21st-century skills. The study compared teachers who participated in extended professional development using project-based learning to teachers who did not use project-based learning or who used it but had limited or no professional development. Responses indicated that teachers participating in professional development using project-based learning taught 21st-century skills more often and more extensively, and perceived themselves as having taught the skills to a greater extent that the non-project-based learning group. These findings suggest that with professional development on project-based learning teachers teach 21st-century skills with more frequent and extensive use.

Implementing project-based learning is a complex change. Fullan (2007) identified a sense of efficacy as one of the motivating factors in the decision to put effort into a particular change. According to the theory of self-efficacy, self-efficacy in a specific context affects focus, determination, and willingness to experiment (Bandura, 1997). Tschannen-Moran, Hoy and Hoy (1998) defined teacher self-efficacy as a teacher's belief in his or her ability to accomplish a particular teaching task in a given context.

Greater efficacy leads to greater effort and persistence, which leads to better performance, which in turn leads to greater efficacy. The reverse is

> also true. Lower efficacy leads to less effort and giving up easily, which leads to poor teaching outcomes, which then produce decreased efficacy. Thus, a teaching performance that was accomplished with a level of effort and persistence influenced by the performer's sense of efficacy, when completed, becomes the past and a source of future efficacy beliefs. Over time this process stabilizes into a relatively enduring set of efficacy beliefs. (p. 234)

As a motivation construct, the level of efficacy affects the amount of effort a teacher will expend in a teaching situation and the persistence a teacher will show in the face of obstacles.

Bandura (1997) proposed four influences on self-efficacy beliefs; verbal persuasion, vicarious experiences, mastery experiences, and physiological arousal. Tschannen-Moran and Johnson (2011) researched these influences in relation to professional development formats. Verbal persuasion related to professional development would be the act of telling or persuading the teacher that the instructional strategy would work and should be attempted. Vicarious experiences related to professional development would be sharing examples or models of the use of the instructional strategy in another school or classroom and inferring that the practices could work if attempted. Mastery experiences related to professional development would include practice with colleagues and coaching in the teacher's own classroom. Physiological arousal relates to the feelings of capability or incompetence, and depending on whether the teacher experiences excitement or anxiety about the performance of the strategy.

Recent studies have established the positive relation of teacher self-efficacy with important educational outcomes such as implementation of technology for instruction in agriculture (Bunch, Robinson, & Edwards, 2012), inquiry-guided instruction (Powell-Moman & Brown-Schild, 2011), and balanced reading instruction (Hastings, 2012). Studies show that self-efficacy is a reliable predictor of behavior change for technology integration (Pan & Franklin, 2011).

A recent study examined the role of teachers' motivational beliefs (self-efficacy, outcome expectancy, and task value), perceptions of school conditions, and project-based learning implementation (English, 2013). Of the three motivational beliefs examined, neither self-efficacy nor outcome expectancy played a significant role in the extent of implementation. Task value was found to be significant to implementation. "Learning how rewarding and motivating PBL can be for students can provide the spark that motivates initially reluctant teachers to give it a try" (English, 2013, p. 38). Teachers who saw more value in project-based learning for themselves and students implemented strategies to a greater extent.

Teachers in this study reported high measures of self-efficacy using project-based learning, yet low measures of outcome expectancy, which indicated that even when they believed they were capable of teaching, they had low expectations for student success. They reported a perceived lack of ability or lack of willingness of students to take responsibility for learning. English (2013) reported this as a critical finding since teachers are less likely to "sustain an extended process of learning and effort to implement an innovative pedagogy when they believe the success or failure is not dependent upon their

level of knowledge, skills, and effort" (p. 40). Poor outcomes could lead to lower efficacy and less effort to implement project-based learning.

Perception of school conditions and school structures were also important factors impacting implementation of project-based learning. Time to plan and implement project-based learning, and time to teach both content standards and 21st-century skills were indicated as challenges. Teachers in environments with professional development, opportunities for common planning time, collaboration, and administrators' support implemented project-based learning to a greater extent (English, 2103).

The influences of teacher self-efficacy seem to align with research about characteristics of effective professional development. Joyce and Showers (2002) indicated that four critical components, theory, demonstration, practice, and peer coaching, are necessary to transfer the objective of the training into the classroom. Additionally research on effective professional development indicates that professional development is job-embedded (Flores, 2005; Guskey & Huberman, 1995; Tate, 2009), has an instructional-focus (Lambert, Wallach, & Ramsey, 2007; Lieberman, Pointer Mace, 2008; Mundry, 2005; Porter, Garet, Desimone, & Birman, 2003), is collaborative (Guskey & Huberman, 1995), and is, according to the National Staff Development Council (NSCD, 2009) standards, on-going. Research showed that teacher learning and changes in teaching practices involve a recursive and continual process that takes place over time (Fullan, 1995). Lasting changes typically take a minimum of three to five years (Guskey & Huberman, 1995) because teachers often need several months or even years to transition from personal concerns about a new innovation to planning, implementation, and management concerns (Loucks-Horsely & Stiegelbauer, 1991). Although there is a

sizable and growing body of best practices literature for professional development, little systematic research has been done examining the effect of professional development on teacher practice or classroom achievement.

Research on effective professional development and the importance of teacher self-efficacy show the need to develop a supportive school climate, however research into the supportive school systems is limited. Schools using reform models to implement project-based learning were found to show increased implementation of project-based learning. Ravitz (2008) found in a national survey of teachers across several major reform networks that teachers believed project-based learning teaches skills beyond academic content, teaches content more effectively, and personalizes learning. Teachers who used project-based learning tended to be the most professionally engaged. Project-based learning was used most in schools that have restructured or undergone reform. Ravitz (2010) examined how teachers using project-based learning differed with respect to teacher culture, school culture, and instructional reforms. Comparisons were examined among comprehensive schools, reform schools, and other small schools. Reform model schools set the bar for project-based learning use and transformations of school culture. The reform models appeared to provide a means for changing both the approach to instruction and the student culture, by giving instructional change (specifically project-based learning) as much weight as structural and cultural changes. Cultural changes may have enabled use of project-based learning at the same time that project-based learning reinforced positive changes in school culture. These findings suggest that project-based learning is impacted by school culture and can have an impact on school culture.

Providing teachers with professional development in problem-based teaching is critical for achieving positive project-based learning results on a district-wide scale (Geier et al., 2008). The success of project-based learning also depends on motivating and supporting teachers in new roles of facilitating inquiry. Teachers learn project-based learning by collaborating with colleagues, introducing project-based learning in the classroom, and reflecting on their experiences (Krajcik, Blumfield, Marx, &Soloway, 1994).

An Examination of Professional Development Provided by New Tech Network

Though there are many forms of project-based professional development and models of school reform, NTN (2012) intends to combine project-based learning with the promotion of 21st-century skills along with a cultural shift that empowers teachers and students. NTN begun in 1996 in Napa, California as a result of one high school and business leader partnership to redesign the school to produce graduates ready for college and career. NTN defines the organization's role as one that works to provide students the skills and knowledge needed to thrive in post-secondary education, career and civic life. NTN is a non-profit learning organization of educators, instructional coaches, and teachers from across the country that works to develop innovative learning environments. The model features three key elements: (a) utilization of project-based learning as the main instructional strategy, with emphasis on technology, rigorous, relevant, projects that meet state standards, and built around professional community partnerships; (b) development of a culture of trust, respect and responsibility where students and teachers make meaningful contributions to learning and policy; and (c) emphasis on technology integration into classrooms through one-to-one device ratios, Internet access, and use of a

learning management system that allows students to be self-directed learners and teachers to be effective learning facilitators (NTN, 2012).

NTN works directly with administrators and teachers to implement design principles through comprehensive professional development including onsite and virtual coaching. New school leaders participate in leadership residency training which is focused on recognizing the need and developing the ability to facilitate school culture changes through adaptive leadership. Heifezt, Grashow and Linsky (2009) stated, "the most common cause of failure is produced by treating adaptive challenges as if they were technical problems" (p. 19). Technical problems often have solutions such as structure changes, while adaptive challenges require solutions such as shifts in culture, beliefs, or mindsets as well as structures.

Residency training is conducted through a weeklong series of whole group meetings, workshop sessions, and research time held at operating NTN schools that model the project-based learning process used in their schools. Administrators participate in a weeklong project. They work in collaborative teams to plan the product of the project. This product is a strategic action plan for facilitation and implementation of the opening of their own NTN school. Leaders determine what they currently know about the work, decide what they need to know more about, and then plan their next steps. They can choose from a menu of workshop offerings based on their own needs, and conduct classroom observations or conduct principal, teacher, and student interviews.

The leadership professional development experience models the process used in student instruction. It also simulates processes leaders should use to involve teachers, and eventually, students, in developing the school culture of trust, respect and responsibility

that engages and empowers teachers and learners to take ownership for their own learning. Focus on recognizing the differences between the adaptive challenges and technical challenges is intended to prevent school leaders from adopting reforms that merely changes the structure and organization and yet do little to change the instruction, culture and operation of the school.

Inexperienced school teams participate in a New School shadowing event in the spring, prior to implementation training. Shadowing is a 3-day long series of whole group meetings, workshop sessions, and research time held at operating NTN schools. The use of project-based learning is modeled there as well, with the team of teachers collaborating in a project. They work in collaborative teams to plan the product of the project, which is a presentation of how the team will conduct new student orientation for students and parents for facilitation and implementation of the opening of their own NTN school. Just as administrators did, teachers determine what they know about the work, decide what they need to know next, and plan their next steps. They can choose from a menu of workshop offerings based on their own needs, and conduct classroom observations or conduct principal, teacher, and student interviews. This teacher professional development experience models the process used in student instruction. It also models processes teachers should use to involve themselves, other teachers and eventually students in developing the school culture of trust, respect and responsibility that engages and empowers teachers and learners to take ownership for their own learning.

Just as leadership residency and the new schools shadowing experience immerse principals and teachers in the New Tech Model, New School Training does the same at the national level with a one week in-depth training. During this training teams learn how

to structure instructional delivery using project-based learning, and use the NTN resources and protocols for the review and development of team culture and class projects. During the week, school teams participate in a series of whole group meetings, workshop sessions, and research time. Outcomes include continued development of the school's strategic action plan for opening and implementation of the processes, consensus and development of school wide learning outcomes, and practice developing quality project-based learning projects.

In relation to Bandura's stages (1997) of self-efficacy, the professional development provides verbal experiences through direct sharing of information about the NTN model. Vicarious experiences are encountered as examples from other operational schools are reviewed, such as project-based learning, school culture issues, and use of technology. Mastery experiences include the practice of having each administrator share his or her strategic action plan with colleagues. Teachers share their project ideas with one another, and schools participate in coaching by New Tech facilitators. Physiological arousal relates to the feelings of capability or incompetence, and depending on whether the leaders or teachers experience excitement or anxiety about future work to implement the model. Leaders benefit by having a collaborative network of support and developing connections to other school leaders facing the same kinds of challenges.

Leadership development allows school leaders to develop capacity to implement NTN design principles, lead change, and build the district's ability to affect lasting change. There is an emphasis on building capacity to create a positive school culture and conditions for adults to experience deeper learning to create deeper learning for students. Teachers become skillful at creating learning experiences for their students that are

creative, contextual, shared, and aligned with state standards and the Common Core State Standards. The teaching role is shifted from traditional teacher centered classrooms to facilitators of student-centered learning, blending collaborative student work groups and technology as tools for learning.

Ongoing professional development, training and coaching places teachers at the core of quality instruction, and teachers are supported with NTN projects and resources. This model of professional development appears to address the stages of self-efficacy, which is related to the amount of energy, willingness and effort principals and teachers will expend to implement the initiative. The characteristic of effective professional development are also addressed by providing professional development that is job-embedded, instructionally focused, supportive and on-going.

Conclusion

In order to teach every child in the U.S. 21st-century knowledge and skills, teachers will need to teach in ways that are different from how most have been teaching. Research on the 21st-century skills revealed an emerging base of cognitive domain and base research, but a need to clarify and define the 21st-century skills and associated terms. More research is needed to understand the relationship of these 21st-century skills to deep learning, and research is needed to understand more about how these skills can be learned, taught, and assessed.

A large amount of research supports project-based learning as an effective instructional strategy to build 21st-century skills including critical thinking, collaboration, communication, creativity and innovation, self-direction, making global connections, making local connections, and using technology as a tool. A review of the

literature relating to project-based learning as a method of teaching 21st-century skills revealed a base of project-based learning research and the need for more research on the development of teacher knowledge, skill and efficacy needed for these skills to be learned, taught, and assessed effectively.

For teachers to address the learning needs of students using project-based learning, appropriate professional development must be in place to build knowledge and competencies, and develop teacher self-efficacy. Teacher self-efficacy, the teacher's belief in his or her ability to accomplish a particular teaching task in a given context, is a necessary factor in a teacher's decision on whether or not to implement change. The level of efficacy affects the amount of effort a teacher will expend in a teaching situation and the persistence a teacher will show in the face of obstacles. A review of the literature on effective professional development and support for the development of teacher-efficacy identified components of quality professional development and identified the need for research specific to professional development on project-based learning for the development of 21st-century skills.

Reform models, including NTN, leverage project-based learning as a means to increase 21st-century skills claiming increased student outcomes such as graduation, college retention, and career readiness (NTN, 2012). The professional development model provided by NTN appears to address the stages of self-efficacy, as well as the characteristics of effective professional development defined by current research. However, while NTN offers research finding positive student outcomes, there is little empirical research conducted on the impact of professional development on teacher execution of 21st-century skills within the classroom.

The Arkansas STEM Works Initiative recognizes the importance of increasing graduates with 21st-century skills and seeks to support schools by funding school participation in the NTN. Findings from this study will provide useful information for policymakers to consider regarding STEM and 21st-century skills reform initiatives. In addition, these outcomes could influence teachers' interests in professional development in project-based learning as well as potential school district interest and commitment to the NTN model. This study helps fill in the gap in these areas by building on the research presented in the West Virginia Department of Education study *Extended professional development in project-based learning: Impacts on 21st-century teaching and student achievement* (Hixson et al., 2012). It specifically examined how project-based learning professional development impacts teacher use and perceived abilities to teach and assess 21st-century learning in Arkansas.

CHAPTER III

METHODOLOGY

A review of the literature revealed that 21st-century skills play an important role in the development of deeper learning in content areas as well as on the learner's ability to transfer learning across disciplines. Additionally, research implies that these skills may be intertwined with complex problem-solving situations (NRC, 2012). A large amount of research supports project-based learning as an effective instructional strategy to build 21st-century skills. Currently, these skills are defined as critical thinking, collaboration, communication, creativity and innovation, self-direction, making global connections, making local connections, and using technology as a tool (Hixson et al., 2012). More research is needed to determine how 21st-century skills are acquired. More and more secondary classrooms are being designed to encourage 21st skills acquisition. Therefore, a connected area of needed research is how to support the development of teacher knowledge, skill and efficacy in order for 21st skills to be effectively learned, taught, and assessed.

The researcher sought to determine if high school teachers participating in professional development focused on project-based learning under the New Tech model, perceived they taught and assessed 21st-century skills differently than high school teachers not participating in professional development provided within the New Tech model. The research hypotheses are as follows:

1. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess critical thinking skills compared to non-participating teachers in 10 comparable high schools in Arkansas.
2. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess collaboration skills compared to non-participating teachers in 10 comparable high schools in Arkansas.
3. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess communication skills compared to non-participating teachers in 10 comparable high schools in Arkansas.
4. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess creativity and innovation skills compared to non-participating teachers in 10 comparable high schools in Arkansas.
5. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and

assess self-direction skills compared to non-participating teachers in 10 comparable high schools in Arkansas.

6. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess global connections compared to non-participating teachers in 10 comparable high schools in Arkansas.
7. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess local connections compared to non-participating teachers in 10 comparable high schools in Arkansas.
8. No significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess using technology as a tool for learning compared to non-participating teachers in 10 comparable high schools in Arkansas.

The six goals of this chapter are to (a) explain the research design of this study, (b) describe the subjects and explain the sample selection, (c) explain the instrumentation, (d) outline the data collection process, (e) provide details of the analytical methods utilized, and (f) identify the limitations of the study.

Research Design

Casual-comparative research attempts to determine the cause, or reason, for existing differences in the behaviors of groups of individuals (Gay, Mills, & Airasian, 2012). A quantitative, causal-comparative study was conducted in school districts in Arkansas. This non-experimental, research study examined conditions that already existed in the schools. Participation in project-based learning professional development, served as the independent variable in hypotheses one through eight. The teachers' perceived abilities to teach and assess the eight 21st-century skills served as the dependent variables. The 21st-century Teaching and Learning Survey was used to measure frequency of use and extensiveness of use of 21st-century skill practices. Two groups were formed involving teachers in ten high schools who participated in professional development in project-based learning under the NTN compared to teachers in ten high schools who did not participate. Statistical significance was calculated using independent samples *t* tests for comparisons of means between two different sets of teachers.

Sample

The study examined teacher perceptions from two groups referred to in the study as participating and non-participating. Ten Arkansas schools participating in project-based learning professional development in the New Tech model formed the group of schools referred to in the study as participating schools. Two schools participated in the NTN professional development and began year one implementation of project-based learning in 2011-2012. Eight schools participated in the NTN professional development and began year one implementation of project-based learning in 2012-2013. Ten

additional schools were selected to form the group of non-participating schools. Schools were selected based on similar demographics of enrollment and poverty level as indicated by free and reduced lunch enrollment.

For selecting schools of similar size, schools were classified into three sizes; small with an enrollment of 499 or less, medium with enrollment from 500-999, and large with enrollment of 1,000-1,500. New Tech schools included five schools in the small category, three in the medium category, and two in the large category. Non-participating schools included five schools in the small category, three schools in the medium category, and two in the large category.

The state average percentage of free and reduced lunches was 60% (NORMES, 2013) at the time of the study. The New Tech group of schools was comprised of six schools below the state average, and four above the state average. The non-participating group of schools was comprised of comparable schools

According to data retrieved from the National Office for Research on Measurement and Evaluation Systems (2013), enrollment in the 10 Arkansas high schools ranged from 298 to 1,354, with a total student enrollment of students in the New Tech High schools equaling 5,988. Enrollment in the 10 non-participating schools ranged from 234 to 1,194 with a total student enrollment of students in non-participating schools equaling 5,658. Grade spans taught in the study included grades 6-12.

Teachers selected for the survey from the participating group included teachers who participated in at least one of the following types of professional development focused on project-based learning: the New Schools Training, New Teacher Track at the Annual New Tech Conference, or on-site coaching with NTN coaches. NTN provided a

list of 189 email addresses assigned to teachers and administrator in Arkansas schools. Schools have the option of implementing the New Tech model as a whole school conversion or phasing in implementation with specific grade levels at a time. The email list contained administrators, counselors, and in some cases teachers in buildings whose grade levels or teams were not currently implementing project-based learning in their grade levels. The email list was reviewed by the NTN facilitators for Arkansas schools, and teachers in non-teaching positions or those not currently implementing project-based learning in their courses or grade levels were eliminated, reducing the list from 189 to a population of 129 possible participants.

Teachers selected for the survey from the non-participating group were included in email lists provided from each non-participating school. Schools were asked to exclude staff members with non-teaching assignments such as media specialists, counselors, and administrators. Bounced email addresses were excluded, leaving 311 valid email addresses for this group.

Gay et al. (2012) stated that there are no universally accepted minimum sample sizes, and that a minimum of 30 participants in each group is recommended for casual-comparative studies. Surveys were sent to 100% of both groups. The population of the participating group was 129. Sixty-six individuals completed the survey for a return rate of 51%. The population of teachers reported in the non-participating group was 311. One hundred persons completed the survey for a return rate of 32%. Seven non-participants reported that they had attended New Tech New School training or New Teacher Track Training. Their responses were deleted from the study leaving 93 responses.

Teachers were given the following prompt to "pick a target class in which you felt your teaching was most effective. If your teaching was equally effective in all your classes, pick the class that you think learned the most" (Hixson et al., 2012, p. 44). Respondents were instructed to refer to the target class when answering the rest of the survey. There were 66 completed responses from the participating group. Table 1 shows the breakdown of target course responses reported from both groups in the study.

Table 1

Target Courses Reported

Target Courses	Participating (n = 66)	Non-participating (n = 93)
English	12	24
Math	15	18
Social Studies	13	12
Science	10	12
Other*	16	27

*Includes fine arts, foreign language, career and technical education courses, health/physical education, EAST, and oral communications.

Respondents from each group were matched based on the selection of target class. A random selection process was used to select responses for matched pairs. Responses were coded into two groups, participating and non-participating. Responses within each group were then coded by the following target classes; English, math, social sciences, science, and other. Responses were then numbered. Random Sequence Generator

(http://www.random.org/) was used to generate a random sequence of the range of responses for the larger group by target class. The number of responses of the smaller group by target class determined the number of responses in the larger group that were retained. Starting at the beginning of the randomly generated sequence, the number of responses in the smaller group by target class was retained in the larger group by target class. Remaining responses were deleted. The process resulted in 65 matched pairs used for analysis.

Instrumentation

Cross-sectional survey research is designed to collect data from selected individuals at a single point in time (Gay et al., 2012). The researcher conducted a cross-sectional design survey utilizing a questionnaire used in the West Virginia Education Department Extended Professional Development in Project-Based Learning study (Hixson et al., 2012) with permission from the authors (see appendix C). Hixson et al. (2012) reported the measures of 21st-century skills were conceptualized based on the international Innovative Teaching and Learning study (Shear et al., 2010), and The William and Flora Hewlett Foundation (2010). Hixson et al. (2012) also reported survey items were modified and used to indicate that the skills were taught based on reliability data reported by Novais and Gallagher (2010).

J. Ravitz, a prominent project-based learning researcher, and S. Reed, researcher for NTN, offered expert opinions on the reliability and validity of the survey to measure project-based learning and 21st-century skills (personal communication, April 24, 2013). According to both researchers, the survey was both reliable and valid instrument to measure project-based learning based on previous reliability measures and the survey use

in two large studies, as well as alignment with the tenents of 21st-century skills practices and the tenents of NTN.

In the 21st-Century Teaching and Learning Survey, teachers were asked background questions about (a) indicators of professional development participation, (b) indicators of project-based learning use, such as frequency and duration of project-based learning, (c) indicators of estimated student achievement levels, (d) indicators of teachers' assessments of student learning of academic content, (e) indicators of general instructional practices such as the hours per week a typical student might be expected to continue working on their assignments outside of class, and how much time students spent preparing for standardized tests. These questions provided information to assist in coding as well as allow for further examination of data.

As previously discussed, teachers were instructed to determine a target course and, more specifically, a target class in which they felt their practices were most effective. They were directed to answer the survey with this target class in mind. The 21st-century skill section of the survey consisted of a definition of a particular skill and the following prompt: "In your teaching of your target class, how often have you asked students to do the following?" A list of practices or student tasks a teacher may have assigned as part of their teaching for each skill followed Teachers responded using the following response choices for each practice: *1, Almost never; 2, Few times a semester; 3, 1-3 times per month; 4, 1-3 times per week, or 5, Almost daily*. (Hixson et al., 2012).

After reading the definition of the skill and indicating the frequency of their practices, teachers were asked questions about their perceived extensiveness in use of 21st-century teaching practices. Teachers indicated to what extent they had tried to teach

the skills, to what extent students had learned, and to what extent they had been able to assess these skills. Teachers reacted to the following prompts substituting the name of the skill (e.g., critical thinking):

a. I have tried to develop students' _____ skills.

b. Most students have learned _____ skills while in my class.

c. I have been able to effectively assess students' _____ skills.

Response choices included 1, *Not really*; 2, *To a minor extent*; 3, *To a moderate extent*; 4, *To a great extent*, or 5, *To a very great extent*. (Hixson et al., 2012).

The researcher used a combination of teacher responses about frequency of practices used in assigning various project-based learning tasks, and more general teacher responses about perceptions about how extensively they taught and assessed each 21st-century skill to create indices to measure 21st-century skills practice. The resulting measures were utilized to determine if high school teachers participating in project-based learning professional development in the New Tech model perceived they taught and assessed their students' 21st-century skills differently than high school teachers not participating in professional development in New Tech model.

Prior to constructing the indices, the researcher analyzed the reliability for each measure. Both the practice and perception measures were highly correlated within each skill, allowing them to be combined into an overall index for each skill with strong reliability. The critical thinking subscale consisted of five practice measures and three extensiveness of use measures ($\alpha = 0.91$). The collaboration skills subscale consisted of five practice measures and three extensiveness of use measures ($\alpha = 0.92$). The communication skills subscale consisted of five practice measures and three

extensiveness of use measures (α = 0.90). The creativity and innovation skills subscale consisted of five practice measures and three extensiveness of use measures (α = 0.94). The self-direction skills subscale consisted of seven practice measures and three extensiveness of use measures (α = 0.94). The global connection skills subscale consisted of six practice measures and three extensiveness of use measures (α = 0.98). The local connection skills subscale consisted of five practice measures and three extensiveness of use measures (α = 0.95). The technology use skills subscale consisted of eight practice measures and three extensiveness of use measures (α = 0.94).

The researcher confirmed that teachers in the participating group more frequently reported indicators of project-based learning; the number of extended projects, the number of weeks conducting extended projects, and overall class time devoted to projects (see appendix D). The researcher then checked to make sure the measures of 21st-century skills teaching were correlated to indicators of project-based learning use. The overall measure of 21st-century skills teaching was positively correlated with the number of extended assignments, ($r = .56$, $p < .01$), weeks conducting extended projects ($r = .37$, $p < .01$), and overall class time devoted to projects ($r = .43$, $p < .01$).

Data Collection Procedures

Following IRB approval (see appendix E), the researcher conducted survey research in the Spring of 2013, following a process recommended by Gay et al. (2012), including an initial letter of explanation, multiple contacts, and an incentive of gift cards to be awarded randomly to respondents. Based on e-mail addresses provided by NTN and non-participating schools, the survey was disseminated using an electronic survey system

(SurveyMonkey) to distribute, follow up, and collect data from geographically dispersed teachers

Support for survey completion was provided by both NTN and administrators at schools employing non-participating teachers. A representative of the NTN sent a personal email to the participating teachers encouraging them to participate in the study. School principals were asked to send an initial communication to their teachers, authorizing the school's participation in the research and encouraging them to participate. The researcher followed with an email requesting participation and directing them to the on-line survey via a hyperlink in the message. Follow up emails were sent to individuals, along with follow up emails and phone calls to the schools.

Analytical Methods

IBM Statistical Packages for Social Sciences (SPSS) Version 21 was used for data analysis. First, data were coded and entered into SPSS. The following codes were used: participation (1 = participating, 2 = non-participating). Data coding schemes were used for different data sets for each of the eight 21st-century skills to calculate indices for frequency of use, extensiveness of use, and skills total (frequency of use plus extensiveness of use). Next, the researcher tested the assumptions of the independent samples *t* test using Levene's test for equal variance. Finally, Hypotheses 1 through 8 were analyzed using independent samples *t* tests for comparison of means. For each hypothesis the skill total (frequency of use plus extensiveness of use) was used to examine differences between participating and non-participating groups by comparing mean scores and computed effect sizes based on overall standard deviation. Differences in the mean scores for frequency of use and extensiveness of use were also analyzed for

further findings (see appendices E-L for comparison of group means on 21st-century skills subscale items). To test the null hypothesis, the research used a two-tailed test with a .05 level of significance.

Limitations

Limitations of the study should be noted to allow the reader to determine what, if any, effect these conditions might have had upon the interpretation of the results. The following were limitations associated with this study.

The first limitation of the study was the lack on measures of content learning. An important part of 21st-century teaching and learning is rigorous content learning. Although Hixson et al. (2012) compared student achievement on statewide assessments between participants of project-based learning and non-participants, the available Arkansas statewide assessment data would have limited the study to specific grade levels within literacy, math, and science. Teachers teaching non-core courses would be excluded from the study. Given the limited population size of teachers in the participating group, the study would likely not achieve a sample size of at least 30 participants in each group.

The second limitation in the study involved the risk of self-selection bias. Often the most motivated teachers self-select to participate in professional development and research. At times, self-selection for treatment increases the possibility of the Hawthorne effect because participants might perform better knowing they are being studied (Gay et al., 2012). Schools in the participating group made a school wide commitment to project-based learning and because of their interest in this program, the possibility of the

Hawthorne Effect was increased by the fact that they wanted the program to be successful.

The third limitation in the study was the early stage of implementation of the participating schools at the time of the study. Teacher learning and changes in teaching practices involve a recursive and continual process that takes place over time (Fullan, 1995). Lasting changes typically take a minimum of three to five years (Guskey & Huberman, 1995) because teachers often need several months or even years to transition from personal concerns about a new innovation to planning, implementation, and management concerns (Loucks-Horsely & Stiegelbauer, 1991). Two of the participating schools were in the second year of implementation, while eight were in year one.

A fourth limitation of the study was the lack of validity of the survey instrument as a measure of teacher self-efficacy. The study reports teacher perceptions about their ability to teach and assess 21st-century skills. The survey instrument was determined to be valid and reliable as a measure of frequency of use and extensiveness of use of 21st-century skill practices in previous studies. It was also determined to be aligned with the constructs of 21st-century skills as employed in the NTN model. However, M. Tschennan-Moran offered an opinion that the three questions designed to measure extensiveness of use lacked validity as measures of teacher self-efficacy (personal communication, October 31, 2013).

A fifth limitation of the study was the small sample size. Implementation of New Tech was relatively new in Arkansas at the time of the study. Schools have the option of implementing New Tech as a whole school conversion, as a school within a school, or in phase-in stages of implementation. A participating school might only have one or two

teams of teachers participating in the professional development and implementing project-based learning, creating a limited population. In order to show statistically significant differences between the participating and comparison group at the 95% confidence level, the researcher calculated the need to obtain 97 responses from each group (Krejcie & Morgan, 1970). However, this and the other limitations did not seem to exceed circumstances common in school related research.

CHAPTER IV

RESULTS

This research study took a quantitative approach to determine if high school teachers participating in professional development on project-based learning under the New Tech model perceived they taught and assessed 21st-century-skills differently than high school teachers not participating in professional development on project-based learning under the New Tech model. Participation in project-based learning professional development served as the independent variable in Hypotheses 1 through 8. The teachers' perceived abilities to teach and assess the eight 21st-century skills served as the dependent variables. Using SPSS, independent sample *t* tests were used to examine each of the eight hypotheses. Prior to running statistical analyses, assumptions of normality and homogeneity of variances were checked. In addition, descriptive statistics were used to examine the research questions. The results of this analysis are found in this chapter.

Hypothesis 1

Hypothesis 1 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess critical thinking skills compared to non-participating teachers in 10 comparable high schools in Arkansas. No outliers were found within the group sample, and the Levene's test of equality of variances indicated homogeneity of variance across the

groups. The dependent variables were not normally distributed within the participating group; however, the dependent variables within the non-participating group were normally distributed. Because the two-tailed *t* test is robust relative to violations of normality, no adjustments were made (Morgan, Leech, Gloeckner, & Barrett, 2011).

A statistically significant difference between the participating and the non-participating groups in critical thinking skills existed, $t(128) = 2.39$, $p = .018$, $d = 0.42$. The participating group ($M = 28.00$, $SD = 6.12$), on average, had a higher mean than the non-participating group ($M = 25.37$, $SD = 6.43$). The effect size was medium according to Cohen's (1988) guidelines. Sufficient evidence existed based on the difference of the means to reject the null hypothesis. Differences in the mean scores for the subscale items for critical thinking practices and extensiveness of use items were analyzed for further findings (see Table 2).

Table 2

Descriptive Statistics and t Test Results for Critical Thinking Skills Subscale Items with Participation in Project-Based Learning as the Independent Variable

	Participation						
	Participants (n = 65)		Non-Participants (n = 65)				
Critical Thinking Skills	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Compare information from different sources before completing a task or assignment?	4.12	0.98	3.71	0.95	2.46	.015	0.34
Draw their own conclusions based in analysis of numbers, facts, or relevant information?	3.42	1.12	3.26	1.09	0.79	.429	0.26
Summarize or create their own interpretation of what they have read or been taught?	3.57	1.03	3.22	1.07	1.92	.057	0.30
Analyze competing arguments, perspectives, or solutions to a problem?	3.14	1.14	2.68	1.17	2.27	.025	0.36
Try to solve complex problems or answer questions that have no single correct solution or answer?	3.38	1.13	2.71	1.31	3.16	.002	0.28
I have tried to develop students' critical thinking skills	3.88	0.82	2.97	0.92	1.34	.184	0.39
Most students have learned critical thinking skills while in my class	3.34	0.85	3.15	0.83	1.28	.204	0.31
I have been able to effectively assess students' critical thinking skills	3.15	0.85	2.97	0.92	1.19	.237	0.30

Hypothesis 2

Hypothesis 2 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess collaboration skills compared to non-participating teachers in 10 comparable high schools in Arkansas. One outlier was found within the participating group sample. Levene's test of equality of variances indicated homogeneity of variance across the groups. The dependent variables were normally distributed within both groups.

A statistically significant difference between the participating and the non-participating group in collaboration skills existed, $t(128) = 4.18$, $p = .000$, $d = 0.74$. Participating groups ($M = 28.51$, $SD = 5.72$), on average, had a higher mean than non-participating groups ($M = 23.75$, $SD = 7.18$). The effect size was large according to Cohen's (1988) guidelines. Sufficient evidence existed based on the difference of the means to reject the null hypothesis. Differences in the mean scores for the subscale items for collaboration practices and extensiveness of use items were analyzed for further findings (see Table 3).

Table 3

Descriptive Statistics and t Test Results for Collaboration Skills Subscale Items with Participation in Project-Based Learning as the Independent Variable

	Participation						
	Participants (n = 65)		Non-Participants (n = 65)				
Collaboration Skills	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Work in pairs or small groups to complete a task together?	4.29	1.01	3.63	1.02	3.71	.000	0.35
Work with other students to set goals and create a plan for their team?	3.68	1.05	2.63	1.18	5.35	.000	0.35
Create joint products using contributions from each student?	3.72	1.13	2.66	0.99	5.71	.000	0.35
Present their group work to the class, teacher, or others?	3.09	0.93	2.71	1.13	2.12	.036	0.28
Give feedback to peers or assess other students' work?	3.09	0.98	2.77	1.14	1.73	.086	0.27
I have tried to develop students' collaboration skills	3.88	0.83	3.35	1.04	3.19	.002	0.35
Most students have learned collaboration skills while in my class	3.46	0.83	3.08	0.99	2.40	.018	0.32
I have been able to effectively assess students' communication skills	3.29	0.89	2.92	1.05	2.16	.033	0.30

Hypothesis 3

Hypothesis 3 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess communication skills compared to non-participating teachers in 10 comparable high schools in Arkansas. One outlier was found within each group sample, and the Levene's test of equality of variances indicated homogeneity of variance across the groups. The dependent variables were normally distributed within the groups.

A statistically significant difference between the participating and the non-participating group in communication skills existed, $t(128) = 3.32$, $p = .001$, $d = 0.58$. The participating group ($M = 25.25$, $SD = 6.28$), on average, had a higher mean than the non-participating group ($M = 21.43$, $SD = 6.83$). The effect size was medium according to Cohen's (1988) guidelines. Sufficient evidence existed based on the difference of the means to reject the null hypothesis. Differences in the mean scores for the subscale items for communication practices and extensiveness of use items were analyzed for further findings (see Table 4).

Table 4

Descriptive Statistics and t Test Results for Communication Skills Subscale Items with Participation in Project-Based Learning as the Independent Variable

	Participation						
	Participants (n = 65)		Non-Participants (n = 65)				
Communication Skills	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Structure data for use in written products or oral presentations (e.g., creating charts, tables or graphs)?	3.11	1.40	2.54	1.05	2.62	.010	0.24
Convey their ideas using media other than a written paper (e.g. posters, video, blogs, etc.)?	3.55	1.35	2.52	1.02	4.92	.000	0.31
Prepare and deliver an oral presentation to the teacher or others?	2.88	1.02	2.17	1.01	3.97	.000	0.29
Answer questions in front of an audience?	2.74	1.05	2.78	1.23	0.23	.818	0.21
Decide how they will present their work or demonstrate their learning?	2.71	0.91	2.35	1.01	2.10	.038	0.27
I have tried to develop students' communication skills	3.66	0.85	3.29	1.11	2.12	.036	0.32
Most students have learned communication skills while in my class	3.34	0.82	2.91	1.04	2.63	.010	0.32
I have been able to effectively assess students' communication skills	3.26	0.92	2.86	1.14	2.19	.030	0.29

Hypothesis 4

Hypothesis 4 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess creativity and innovation skills compared to non-participating teachers in 10 comparable high schools in Arkansas. No outliers were found within the participating group sample, and the Levene's test of equality of variances indicated homogeneity of variance across the groups. The dependent variables were normally distributed within the groups.

A statistically significant difference between the participating and the non-participating group in creativity and innovation skills existed, $t(128) = 2.75$, $p = .007$, $d = 0.48$. The participating group ($M = 24.00$, $SD = 6.54$), on average, had a higher mean than the non-participating group ($M = 20.97$, $SD = 7.66$). The effect size was medium according to Cohen's (1988) guidelines. Sufficient evidence existed based on the difference of the means to reject the null hypothesis. Differences in the mean scores for the subscale items for creativity and innovation practices and extensiveness of use items were analyzed for further findings (see Table 5).

Table 5

Descriptive Statistics and t Test Results for Creativity and Innovation Subscale Items with Participation in Project-Based Learning as the Independent Variable

	Participation						
	Participants (n = 65)		Non-Participants (n = 65)				
Creativity and Innovation	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Use idea creation techniques such as brainstorming or concept mapping?	2.78	1.08	2.77	1.13	0.08	.937	0.22
Generate their own ideas about how to control a problem or question?	3.05	1.14	2.72	1.08	1.66	.100	0.25
Test out different ideas and work to improve them?	2.95	1.04	2.51	1.20	2.27	.025	0.26
Invent a solution to a complex, open-ended question or problem?	2.78	1.05	2.32	1.17	2.36	.020	0.25
Create an original product or performance to express their ideas?	3.05	0.93	2.38	1.14	3.63	.000	0.30
I have tried to develop students' creativity and innovation	3.62	0.95	2.95	1.17	3.56	.001	0.32
Most students have learned creativity and innovation while in my class	3.22	0.89	2.65	1.08	3.27	.001	0.31
I have been able to effectively assess students' creativity and innovation	2.95	0.96	2.66	1.12	1.60	.113	0.26

Hypothesis 5

Hypothesis 5 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess self-direction skills compared to non-participating teachers in 10 comparable high schools in Arkansas. One outlier was found within the non-participating group sample and the Levene's test of equality of variances indicated homogeneity of variance across the groups. The dependent variables were normally distributed within the participating group, however, the dependent variables within the non-participating group were not normally distributed. Because the two-tailed *t* test is quite robust to violations of normality, no adjustments were made (Morgan et al., 2011).

A statistically significant difference between the participating and the non-participating group in self-direction skills existed, $t(128) = 2.94$, $p = .004$, $d = 0.52$. Participating groups ($M = 33.01$, $SD = 8.54$), on average, had a higher mean than non-participating groups ($M = 28.542$, $SD = 8.76$). The effect size was medium according to Cohen's (1988) guidelines. Sufficient evidence existed based on the difference of the means to reject the null hypothesis. Differences in the mean scores for the subscale items for self-direction practices and extensiveness of use items were analyzed for further findings (see Table 6).

Table 6

Descriptive Statistics and t Test Results for Self-Direction Skills Subscale Items with Participation in Project-Based Learning as the Independent Variable

	Participation						
	Participants (n = 64)		Non-Participants (n = 65)				
Self-Direction Skills	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Take initiative when confronted with a difficult problem or question?	3.63	1.19	3.40	1.20	1.07	.286	0.27
Choose their own topics of learning or questions to pursue?	2.72	1.24	2.54	1.10	0.87	.385	0.20
Plan steps they will take to accomplish a complex task?	3.41	1.05	2.89	1.15	2.65	.009	0.29
Choose for themselves what examples to study or resources to use?	3.28	1.22	2.69	1.16	2.82	.006	0.27
Monitor their own progress towards completion of a complex task and modify their work before it is completed?	3.33	1.26	2.80	1.23	2.41	.017	0.26
Use specific criteria to assess the quality of their work before it is complete?	3.45	1.11	2.86	1.14	2.98	.003	0.29
Use peer, teacher or expert feedback to revise their work?	3.39	1.15	3.00	1.12	1.96	.053	0.27
I have tried to develop students' self-direction skills	3.66	0.91	3.00	0.94	4.30	.000	0.35
Most students have learned self-direction skills while in my class	3.25	0.94	2.72	0.91	3.23	.002	0.32
I have been able to effectively assess students' self-direction skills	2.91	0.92	2.68	0.97	1.37	.171	0.27

Hypothesis 6

Hypothesis 6 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess global connections skills compared to non-participating teachers in 10 comparable high schools in Arkansas. No outliers were found within the non-participating group sample, and the Levene's test of equality of variances indicated homogeneity of variance across the groups. The dependent variables were not normally distributed within the participating group or the non-participating group. Because the two-tailed *t* test is robust to violations of normality, no adjustments were made (Morgan et al., 2011).

No statistically significant difference between the participating and the non-participating group in global connection skills existed, $t(127) = 1.10$, $p = .272$, $d = 0.19$. The participating group ($M = 22.23$, $SD = 10.73$), on average, had a higher mean than the non-participating group ($M = 19.25$, $SD = 9.71$). The effect size was small according to Cohen's (1988) guidelines. Sufficient evidence existed based on the difference of the means to fail to reject the null hypothesis. Differences in the mean scores for the subscale items for global connection practices and extensiveness of use items were analyzed for further findings (see Table 7).

Table 7

Descriptive Statistics and t Test Results for Global Connections Skills Subscale Items with Participation in Project-Based Learning as the Independent Variable

	Participation						
	Participants (n = 64)		Non-Participants (n = 65)				
Global Connections Skills	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Study information about other countries or cultures?	2.55	1.39	2.14	1.18	1.80	.075	0.17
Use information about other countries or culture?	2.50	1.37	2.18	1.17	1.41	.162	0.17
Discuss issues related to global interdependency (for example, global environment trends, global market economy)?	2.42	1.34	2.17	1.15	1.15	.254	0.16
Understand the life experiences of people in cultures besides their own?	2.47	1.24	2.25	1.20	0.99	.323	0.18
Study the geography of distant countries?	1.98	1.29	1.82	1.17	0.80	.428	0.12
Reflect on how their own experiences and local issues are connected to global issues?	2.36	1.24	2.22	1.21	0.65	.516	0.16
I have tried to develop students' global connections skills	2.47	1.24	2.29	1.14	0.84	.403	0.18
Most students have learned global connections skills while in my class	2.31	1.20	2.14	1.14	0.84	.402	0.17
I have been able to effectively assess students' global connections skills	2.17	1.20	2.05	1.10	0.61	.538	0.15

Hypothesis 7

Hypothesis 7 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess local connections skills compared to non-participating teachers in 10 comparable high schools in Arkansas. No outliers were found within the participating group. Three outliers were found within the non-participating group sample, and the Levene's test of equality of variances indicated homogeneity of variances were not assumed across the groups The dependent variables were normally distributed within the participating group. The dependent variables were not normally distributed within the non-participating group. Because the two-tailed *t* test is robust to violations of normality, no adjustments were made (Morgan et al., 2011).

No statistically significant difference between the participating and the non-participating group in local connections skills existed, $t(121) = 0.48$, $p = .634$, $d = 0.08$. The participating group ($M = 19.31$, $SD = 8.75$), on average, had a higher mean than the non-participating group ($M = 18.64$, $SD = 6.96$. The effect size was small according to Cohen's (1988) guidelines. Sufficient evidence existed based on the difference of the means to fail to reject the null hypothesis. Differences in the mean scores for the subscale items for local connection practices and extensiveness of use items were analyzed for further findings (see Table 8).

Table 8

Descriptive Statistics and t Test Results for Local Connection Skills Subscale Items with Participation in Project-Based Learning as the Independent Variable

	Participation						
	Participants (n = 65)		Non-Participants (n = 65)				
Local Connections Skills	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Investigate topics or issues that are relevant to their family or community?	2.80	1.23	2.92	1.10	0.60	.550	0.20
Apply what they are learning to local situations, issues, or problems?	2.69	1.29	2.95	1.17	1.21	.229	0.17
Talk to one or more members of the community about a class project or activity?	2.31	1.22	1.86	1.01	2.26	.025	0.19
Analyze how different stakeholder groups or community members view an issue?	2.20	1.21	1.98	1.11	1.05	.293	0.16
Respond to a question or task in a way that weighs the concerns of different community members or groups?	2.20	1.25	1.98	1.05	1.06	.291	0.16
I have tried to develop students' local connection skills	2.62	1.19	2.49	1.03	0.63	.531	0.20
Most students have learned local connection skills while in my class	2.32	1.12	2.34	0.96	0.08	.933	0.18
I have been able to effectively assess students' local connection skills	2.17	1.16	2.11	0.98	0.33	.746	0.16

Hypothesis 8

Hypothesis 8 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess technology skills compared to non-participating teachers in 10 comparable high schools in Arkansas. No outliers were found within the group sample, and the Levene's test of equality of variances indicated homogeneity of variance across the groups. The dependent variables were normally distributed within the participating group and the non-participating group.

A statistically significant difference between the participating and the non-participating group in technology skills existed, $t(127) = 5.50$, $p = .000$, $d = 0.97$. The participating group ($M = 41.05$, $SD = 9.54$), on average, had a higher mean than the non-participating group ($M = 31.32$, $SD = 10.51$). The effect size was large according to Cohen's (1988) guidelines. Sufficient evidence existed based on the difference of the means to reject the null hypothesis. Differences in the mean scores for the subscale items for technology practices and extensiveness of use items were analyzed for further findings (see Table 9).

Table 9

Descriptive Statistics and t Test Results for Technology Skills Subscale Items with Participation in Project-Based Learning as the Independent Variable

Technology Skills	Participation						
	Participants (n = 65)		Non-Participants (n = 64)				
	M	*SD*	*M*	*SD*	*t*	*p*	*d*
Use technology or the internet for self-instruction	3.89	1.21	3.16	1.41	3.19	.002	0.29
Select appropriate technology for completing a task?	4.14	0.93	3.42	1.18	3.83	.000	0.35
Evaluate the credibility and relevance of online resources?	3.37	1.34	2.88	1.19	2.21	.029	0.25
Use technology to analyze information (e.g. databases, spreadsheets, graphic programs, etc.)?	3.25	1.54	2.75	1.31	1.97	.051	0.21
Use technology to help share information (e.g. multimedia presentations video, presentation software, podcasts, etc.)?	3.88	1.14	2.77	1.33	5.10	.000	0.33
Use technology to support team work (e.g. shared work spaces, email exchanges, feedback, etc.)?	4.18	1.04	2.53	1.23	8.21	.000	0.42
Use technology to interact directly with members of local/global communities?	2.62	1.56	2.13	1.19	2.01	.047	0.16
Use technology to keep track of work on extended tasks or assignments?	4.29	1.10	2.77	1.34	7.07	.000	0.39
I have tried to develop students' local connections skills	4.05	0.89	3.06	1.12	5.51	.000	0.38
Most students have learned local connections skills while in my class	3.78	0.09	3.02	1.11	4.35	.000	0.45
I have been able to effectively assess students' local connections skills	3.60	1.00	2.86	1.10	4.02	.000	0.33

Summary

In summary, statistically significant differences existed between the means of teachers participating in professional development on project-based learning under the New Tech model and high school teachers not participating in professional development for six of the eight hypotheses (see Table 10).

Table 10

Descriptive Statistics and t Test Results for the Teaching and Learning Survey Subtopics with Participation in Project-Based Learning as the Independent Variable

	Participation						
	Participants (n = 65)		Non-Participants (n = 65)				
Teaching/Learning Survey	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Critical Thinking Skills	28.00	6.12	25.37	6.43	2.39	.018	0.42
Collaboration Skills	28.51	5.72	23.75	7.18	4.18	.000	0.74
Communication Skills	25.25	6.28	21.43	6.83	3.32	.001	0.58
Creativity/Innovation Skills	24.00	6.54	20.97	7.66	2.75	.007	0.48
Self-Direction Skills	33.01	8.54	28.54	8.76	2.94	.004	0.52
Global Connections Skills	21.23	10.73	19.25	9.71	1.10	.272	0.19
Local Connections Skills	19.31	8.75	18.64	6.96	0.48	.634	0.08
Technology Skills	41.05	9.54	31.32	10.51	5.50	.000	0.97

The participating group had greater means for frequency and extensiveness of teaching practices in the following skills: critical thinking skills, collaboration skills, communication skills, creativity and innovative thinking skills, self-direction skills, and

use of technology skills. The participating group also had greater means for frequency and extensiveness of teaching practices of making local connections and global connections, yet there was not a significant difference between the group means.

CHAPTER V

DISCUSSION

In the current climate of increased accountability, schools are searching for ways to increase college and career readiness as well as to prepare students with 21st-century skills. Project-based learning is one approach that school administrators are utilizing to allow students to practice these skills while seeking to increase student achievement. Schools in Arkansas are receiving encouragement to engage in this approach.

The Arkansas Governor's Workforce Cabinet promotes STEM Works which focuses on preparation of science, technology, engineering, and mathematics teachers in a number of ways. One approach is to train teachers how to develop problem-based learning skills. Another is the creation of secondary schools designed around hands-on learning, student teams, and projects that integrate elements of the Common Core State Standards curriculum from multiple subjects. Finally, STEM Works fosters 21st-century student skill development to match the needs of regional industry clusters (Arkansas STEM Works Facts, 2012). The STEM Works initiative awarded $1.5 million dollars to 10 Arkansas schools to participate in the NTN model of school reform based on project-based learning and 21st-century skills with a long term goal that one half of the state's high school become New Tech schools within the next ten years (Arkansas STEM Works Facts, 2012). However, a comprehensive study has not been conducted in Arkansas to

determine the effects of project-based learning on teacher perceptions of their ability to teach and assess 21st-century skills.

The focus of this study was to examine the effects of project-based learning professional development under the New Tech model on teacher perceptions of how they taught and assessed 21st-century skills. A casual-comparative study was conducted. The study sample was obtained by matching teachers participating in the NTN professional development focused on project-based learning with teachers not participating in the professional development. Teachers were employed by schools of similar enrollments, including free and reduced lunch status, and geographical regions of the state.

First, this chapter includes a description of the data collected and analyzed in this study. Second, recommendations, based on the conclusions found in the data analysis, are included for school administrators involved in this study as well as those interested in implementing project-based learning. Finally, the implications and significance of this study are discussed.

Conclusions

To address each hypothesis, eight independent samples *t* tests were conducted using participation in project-based learning professional development as the independent variable, and teachers' perceived abilities to teach and assess the eight 21st-century skills served as the dependent variables. Differences in means between the groups were examined. To test the null hypotheses, the researcher used a two-tailed test with a .05 level of significance. For further analysis of the data, mean scores for the subscale items of each 21st-century skill were examined. The following hypotheses were tested, and conclusions were determined.

Hypothesis 1

Hypothesis 1 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess critical thinking skills compared to non-participating teachers in 10 comparable high schools in Arkansas. There was a statistically significant difference between means of the participating and non-participating group in the area of critical thinking skills. Sufficient evidence existed based on the difference of the means to reject the null hypothesis.

Further, review of the data showed the participating group had greater means for frequency of use on each of the five practices associated with the critical thinking skills. Among the practices of critical thinking, "compare information from different sources before completing a task or assignment" was indicated with the greatest frequency of use among both groups. The greatest difference in means between the two groups was for the practice "try to solve complex problems or answer questions that have no single correct solution or answer". Among the teacher extensiveness of use measures, the participating group had greater means for the three measures associated with the critical thinking skills. Both groups scored the lowest means in their ability to "effectively assess critical thinking skills".

Of the eight 21st-century skills measured, critical thinking skills had the fourth greatest amount of instruction among the participating group, and the third greatest amount of instruction among the non-participating group. NRC (2012) identified critical thinking skills as a cognitive domain and found many overlaps when comparing Common

Core State Standards, The Next Generation of Science Standards, and NRC definitions of deeper learning and 21st-century competencies, indicating disciplinary goals have expanded beyond traditional focus of basic content. With increased emphasis on critical thinking skills, teachers need professional development to support instructional practices in order to teach skills such as comparing information from different sources, drawing conclusions based in analysis of numbers and facts, and analyzing competing arguments, perspectives, or solutions to problems. These findings provide evidence that participation in project-based learning professional development can have an effect on the use of critical thinking practices in the classroom.

Hypothesis 2

Hypothesis 2 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess collaboration skills compared to non-participating teachers in 10 comparable high schools in Arkansas. There was a statistically significant difference between the means for the participating and non-participating group on collaboration skills. The participating group had greater means for frequency of use and extensiveness of use of practices. Sufficient evidence existed based on the difference of the means to reject the null hypothesis.

Further, review of the data showed the participating group had greater means for frequency of use on each of the five practices associated with the collaboration skills. Among the practices of collaboration skills, “work in pairs or small groups to complete a task together” had the greatest frequency of use among both groups. The greatest

difference in means between the two groups was for the practice “create joint products using contributions from each student”. Among the teacher extensiveness of use measures, the participating group had greater means for the three measures associated with collaboration skills. Both groups had the lowest means in their ability to “effectively assess collaboration skills”.

Collaboration skills had the third greatest amount of instruction in the participating group, and the fourth greatest amount of instruction in the non-participating group. The participating group had greater means for collaborative skills than critical thinking skills. While project-based learning can be designed for individual work or team collaboration, the NTN model emphasizes a professional culture of responsibility. Collaboration, and practices such as working with other students to set goals, creating plans for teams, presenting group work to others and providing feedback are considered performance standards embedded into the formative assessment of student projects. Participating teachers had higher means for their ability to assess collaboration than for any of the other seven critical thinking skills. These findings suggest that making collaboration a cultural expectation as well as part of the instructional approach of project-based learning can have an effect on the use of collaborative skills practices and assessment in the classroom.

Hypothesis 3

Hypothesis 3 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess communication skills compared to non-participating teachers in 10 comparable

high schools in Arkansas. There was a statistically significant difference between the means of the participating and non-participating group on communication skills. The participating group had greater means for frequency of use and extensiveness of use of practices. Sufficient evidence existed based on the difference of the means to reject the null hypothesis.

Further, review of the data showed the participating group had greater means for frequency of use of four of the five practices associated with communication skills. The non-participating group had a slightly greater mean for the practice of asking students to "answer questions in front of an audience". Among the practices of communication, asking students to "convey their ideas using media other than a written paper" had the greatest frequency of use among the participating group. This practice also held the greatest difference in means between the two groups. Among the teacher extensiveness of use measures, the participating group had greater means for the three measures associated with the communication skills. Both groups had the lowest means in their ability to "effectively assess communication skills".

Of the eight 21st-century skills measured, communication skills had the fifth greatest mean among the both groups, placing communication skills near the middle of the eight skills for both groups. The participating group had greatest means with the practices of allowing students to convey their ideas using media other than written paper and structuring data for use in written products or oral presentations. The NTN emphasis of ubiquitous access to technology along with emphasis on technology skills may have an effect on these practices, allowing students in participating classrooms more options for communicating and sharing presentations.

Hypothesis 4

Hypothesis 4 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess creativity and innovation skills compared to non-participating teachers in 10 comparable high schools in Arkansas. There was a statistically significant difference between the participating and non-participating group on creativity and innovation skills. The participating group had greater means for frequency of use and extensiveness of use of practices. Sufficient evidence existed based on the difference of the means to reject the null hypothesis.

Further, review of the data showed the participating group had greater means for frequency of use on each of the five practices associated with the creativity and innovation skills. Among the practices of creativity and innovation, "generate their own ideas about how to control a problem or question" and "create an original product or performance to express their ideas" had the greatest frequency of use among the participating group. The greatest difference in means between the two groups was for the practice "create an original product or performance to express their ideas". Among the teacher extensiveness of use measures, the participating group had greater means for the three measures associated with creativity and innovation skills. The participating group had the lowest mean in the ability to "effectively assess creativity and innovation".

Compared to the other seven 21st-century skills, creativity and innovation practices had lower means than critical thinking, collaboration, communication, self-direction skills, and use of technology for both the participating and the non-participating

group. Creativity and innovation practices had means higher only than local and global connection skills. More focus and professional development on practices such as generating, testing, and inventing own ideas and solutions to complex problems is needed for both groups.

Hypothesis 5

Hypothesis 5 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess self-direction skills compared to non-participating teachers in 10 comparable high schools in Arkansas. There was a statistically significant difference between the means of the participating and non-participating group on self-direction skills. The participating group had greater means of frequency of use and extensiveness of use of practices. Sufficient evidence existed based on the difference of the means to reject the null hypothesis.

Further, review of the data showed the participating group had greater means for frequency of use on all of the seven practices associated with the self-direction skills. Among the practices of self-direction, "taking initiative when confronted with a difficult problem or question" had with the greatest frequency of use among both groups. The greatest difference in means between the two groups was for the practice of requiring students to "use specific criteria to assess the quality of their work before it is complete". Among the teacher extensiveness of use measures, the participating group had greater means for the three measures associated with the self-direction skills. Both groups had the lowest means in their ability to "effectively assess skills".

Self-direction skills had the second highest overall mean for both groups. Even though this 21st-century skill ranked similar between both groups, the participating group had consistently greater means for each of the practices and extensiveness of use measures. These findings provide evidence that participation in project-based learning professional development can have an effect on use of self-direction practices in the classroom.

Hypothesis 6

Hypothesis 6 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess global connection skills compared to non-participating teachers in 10 comparable high schools in Arkansas. There was no statistically significant difference between the participating and non-participating group on global connection skills. The participating group had greater means on frequency of use and extensiveness of use of practices. Sufficient evidence existed based on the difference of the means to fail to reject the null hypothesis.

Further, review of the data showed that global connections skills held the next to lowest means for both groups among the eight hypotheses tested. The participating group had greater means for frequency of use on each of the six practices associated with global connection skills. Among the practices of global connection skills, "study information about other countries or cultures" was the greatest frequency of use among the participating group, while "understand the life experiences of people in cultures beside their own" was the greatest frequency among the non-participating group. The greatest

difference in means between the two groups was for the practice "study information about other countries or cultures". The lowest mean for both groups was having students "study geography of distant countries". Among the teacher extensiveness of use measures, the participating group had greater mean scores for the three measures associated with global connection skills. Both groups had the lowest means in their ability to "effectively assess global connection skills".

Global connections received the least amount of instruction from both groups. Perhaps practices such as the study of different cultures, use of information about other countries or cultures, and discussion of issues related to global interdependency are viewed as content objectives in social studies courses rather than interdisciplinary skills. Hixson et al. (2012) found similar results with a lack of significant differences between participants of project-based learning and non-participants in use of global connections practices and extensiveness of use measures. These findings lack evidence that participation in project-based learning professional development had an effect on use of global connections practices in the classroom.

Hypothesis 7

Hypothesis 7 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess local connection skills compared to non-participating teachers in 10 comparable high schools in Arkansas. There was no statistically significant difference between the participating and non-participating group on local connection skills. The participating group had greater means for frequency of use and extensiveness of use of practices.

Sufficient evidence existed based on the difference of the means to fail to reject the null hypothesis.

Further, review of the data showed the participating group had greater means for frequency of use for three of the five practices associated with the local connection skills. Among the practices of local connection skills, the non-participating group had greater frequency of use with the practices of having students "investigate topics or issues that are relevant to their family or community" and having students "apply what they are learning to local situations, issues, or problems". The greatest difference in means between the two groups was for the practice of having students "talk to one or more members of the community about a class project or activity". Among the teacher extensiveness of use measures, the participating group had greater means for two of the three measures associated with the local connections skills. The non-participating group had higher means for the measure "most students have learned to make local connections while in my class". Both groups had the lowest means in their ability to "effectively assess local connections skills".

Local connections received the next to the least amount of instruction from both groups. While Hixson et al. (2012) reported significant differences between participants of project-based learning and non-participants in use of local connections practices and extensiveness of use measures, global and local connections received the least amount of instruction. These findings lack evidence that participation in project-based learning professional development had an effect on use of local connection practices in the classroom.

Hypothesis 8

Hypothesis 8 stated that no significant difference will exist between the perceptions of teachers in 10 high schools in Arkansas who participated in project-based learning professional development in the New Tech model on their ability to teach and assess technology skills compared to non-participating teachers in 10 comparable high schools in Arkansas. There was a statistically significant difference between the participating and non-participating group on using technology as a skill. The participating group had greater means for frequency of use and extensiveness of use of practices. Sufficient evidence existed based on the difference of the means to reject the null hypothesis.

Further, review of the data showed the participating group had greater means for frequency of use on each of the eight practices associated with using technology as a skill. Among the practices of use of technology, "use of technology to keep track of their work on extended tasks or assignments" was the greatest frequency of use among the participating group, while "select appropriate technology tools or resources for completing a task" was the highest frequency of use among the non-participating group The greatest difference in means between the two groups was the practice "using technology to support team-work or collaboration (e.g. shared work spaces, email exchanges, giving and receiving feedback, etc.)". Among the teacher extensiveness of use measures, the participating group had greater means for the three measures associated with using technology as a skill. Both groups had the lowest means in their ability to "effectively assess using technology as a skill".

Among the eight hypotheses tested, both groups had greatest mean for technology use skills. The difference between means was greatest between the two groups for this hypothesis. These findings could be attributed to differences in technology access between groups. The New Tech model places emphasis on providing ubiquitous access to technology for staff and students in order to enhance professional development and differentiated learning, develop more empowered and active learners, and support real-time student performance data to influence instruction (NTN, 2012). Since project-based learning can be accomplished without emphasis on technology, and both groups had greater means for technology use among the eight skills, perhaps greater means for the participating group could be attributed to the NTN model emphasis which combines use of technology with project-based learning rather than on project-based learning alone.

Recommendations

Although comparison group teachers might find ways to teach 21st-century skills using their own practices, teachers participating in professional development had the opportunity to learn about teaching these skills through project-based learning. Overall, teachers trained in project-based learning reported teaching 21st-century skills more often and more extensively. These findings mirror the findings of the West Virginia Department of Education study, providing evidence that "project-based learning used in combination with project-based learning professional development can have an impact on 21st-century teaching" (Hixson et al., 2012, p. 31). Therefore, one recommendation is for the continued support for development of the 10 Arkansas schools implementing the NTN model.

The Governor's Workforce Cabinet's goal is for one half of Arkansas's high schools to become New Tech schools within the next decade (Arkansas STEM Works Facts, 2012). In order for this goal to be realized, Arkansas New Tech schools must demonstrate gains in student achievement as well gains in attendance, discipline, and college eligibility data. Continued funding for network participation costs, professional development costs, and technology access costs is necessary for participating schools to sustain and improve their levels of implementation. In addition, statewide opportunities such as conferences for New Tech schools' administrators, teachers and students to network and share best practices with those from non-participating schools might increase administrator and teacher interest in project-based learning and the NTN model.

Of the participating schools in this study, 8 of 10 were in year 1 of implementation, during which teachers experience a high learning curve. Both teachers and students had to adjust to the transition from traditional instruction to project-based learning. Even though participating schools scored greater means in each of the eight 21st-century skills, the greatest mean in any one skill was 3.73 out of 5. Therefore a second recommendation is to continue support for teachers implementing project-based learning with time for professional development, project planning and curriculum development. Adequate time for enacting new teaching practices is also needed; administrators in New Tech schools should give continued consideration to structures of the daily time schedule to provide collaborative planning periods to assist teachers in the development of interdisciplinary projects designed to integrate 21st-century skills with content knowledge through project-based learning.

Teachers in both groups recorded the lowest scores relative to frequency of use and extensiveness in use with global connection skills and local connections skills. Therefore, the third recommendation is that this data be used by non-participating schools as well as within the NTN for continued professional development and resource development to support teachers as they teach and assess these skills. Schools should explore ways to develop and use partnerships with local advisory boards, chambers of commerce, and business partnerships to assist teachers and students in making global connections and local connections with course content and skills beyond classroom assignments.

Teachers in both groups scored greatest means in the area of developing the 21st-century skills, and both groups scored the lowest means in the area of effectively assessing these skills. Research has shown that assessment and feedback play an essential role in the deeper learning of cognitive competencies (Marzano, Pickering, & Pollock, 2001). Therefore, a fourth recommendation is for professional development focused on authentic assessment of 21st-century skills. On-going formative assessments by teachers can provide guidance to students to support and extend learning, encouraging deeper learning and transfer of competencies. “Instruction is most effective when it includes the use of quality assessments,” (Stiggins, Arter, Chappuis, & Chappuis, 2004, p. 99). Teachers need the opportunity to learn about use of quality assessments, and support as they implement this into their teaching practices.

Implications

Significance and Expansion of Knowledge Base

In order to teach every child in the U.S. 21st-century knowledge and skills, teachers will need to teach in ways that are different from how most have been teaching. Research on the 21st-century skills revealed an emerging base of cognitive domain and base research but there is a need to clarify and define the 21st-century skills and associated terms. A large amount of research supports project-based learning as an effective instructional strategy to build 21st-century skills including critical thinking, collaboration, communication, creativity and innovation, self-direction, making global connections, making local connections, and using technology as a tool. While reform models, including NTN, leverage project-based learning as a means to increase 21st-century skills claiming increased student outcomes such as graduation, college retention, and career readiness (NTN, 2012), there is little empirical research associated with the impact of professional development on teacher execution of 21st-century skills within the classroom.

This study helps fill in the gap in the areas of project-based learning professional development and 21st-century skills by building on the research presented in the West Virginia Department of Education study *Extended professional development in project-based learning: Impacts on teaching and student achievement* (Hixson et al., 2012). It specifically examines how project-based learning professional development impacts teacher use and perceived abilities to teach and assess 21st-century learning in Arkansas.

Future Research Implications

Although the focus of this study was on teacher perceptions, it is important to look at all aspects of the classroom when assessing benefits of a program. There are at least four measures that could be considered. Future researchers might build on this study by researching aspects of project-based learning including levels of implementation, measures of teacher self-efficacy, student perceptions, and student achievement.

First, future research might consider building on this research by using experimental or quasi-experimental design. This would allow the researcher to manipulate the intervention and ensure implementation of project-based learning with fidelity. Researchers might guarantee the time for project-based learning participants to meet, plan, and problem-solve together. Results from these types of studies may be more valid.

Second, the survey could be revised to include valid measures of teacher self-efficacy to allow researchers to examine the relationship of teacher self-efficacy, project-based learning professional development, and integration of teaching and assessing 21st-century skills as well as course content. Efficacy research indicates that self-efficacy in a specific context impacts focus, determination, and willingness to experiment (Bandura, 1997). As a motivation construct, the level of efficacy affects the amount of effort a teacher will expend in a teaching situation and the persistence a teacher will show in the face of obstacles. Examination of teacher self-efficacy in relationship to frequency of use and extensiveness of use of project-based learning could assist in improvement to professional development and teacher support for project-based learning.

Third, researchers might examine student perceptions about project-based learning to demonstrate and master 21st-century skills. Just as teacher self-efficacy affects the amount of time and effort a teacher will expend in a teaching situation and the persistence a teacher will show in the face of obstacles, self-efficacy can impact efforts of the learner. Researchers might examine impact of project-based learning on self-efficacy, motivation, and 21st-century skills. Teachers often attribute lack of student achievement on factors such as motivation. Examination of student efficacy in relationship to frequency of use and extensiveness of use of project-based learning could assist in increasing teacher interest in the use of project-based learning.

Fourth, researchers might examine student achievement as associated with project-based learning and 21st-century skills. This study did not compare student achievement between participating and non-participating groups because of small sample size, and because current state assessments are designed to assess content knowledge of state standards, which are not necessarily written to include or are aligned to 21st-century skills. Content knowledge is an important part of 21st-century skills and deeper learning. Deeper learning occurs when students learn complex problem-solving within the content area, and are able to transfer that learning to different content areas and in different contexts (NRC, 2012). As the next generations of assessments emerge, researchers might examine student achievement on these assessments in content areas as associated with project-based learning and 21st-century skills.

Potential Policy Changes

Findings from this study will provide useful information for policymakers to consider regarding STEM and 21st-century skills reform initiatives. There are at least

four considerations for policy-makers concerning 21st-century learning, including policy regarding the current STEM Work initiative, professional development requirements for 21st-century skills, professional development requirements for formative assessment of 21st-century skills, and policies regarding standardized assessments.

First, the Arkansas STEM Works initiative recognizes the importance of increasing the number of graduates who possess 21st-century skills and seeks to support schools by funding school participation in the NTN. While this funding offsets a portion of the initial start-up costs, schools could benefit with funding to purchase technology equipment and broadband access, as well as on-going costs associated with consulting, professional development, and support to allow teachers time for collaboration and project development.

Second, while increasing the number of graduates with 21st-century skills is an economic imperative for the state, and schools face increasing accountability measures, there is currently no requirement for professional development on 21st-century skill development. While schools participating in project-based learning under the NTN model focus on project-based learning to master 21st-century skills, non-participating schools may or may not be involved with professional development on 21st-century skills. Project-based learning is one teaching strategy and NTN is one model associated with 21st-century skills attainment. While schools may choose to pursue 21st-century skills in a number of ways, policy-makers might consider requirements of professional development on 21st-century skills to increase awareness and likelihood of schools to take action to address 21st-century skills.

Third, results from this study indicate the need for professional development on assessment of 21st-century skills. Both participating schools and non-participating schools scored lowest average means on the extensiveness of assessing 21st-century skills. Policy-makers might consider requirements of professional development on formative assessment of 21st-century skills to increase awareness and support for schools to improve how they monitor and assess 21st-century skills.

Finally, policy-makers and assessment developers should consider findings on 21st-century skills and the challenges of obtaining valid assessments. Assessment and feedback play an essential role in deeper learning of cognitive competencies (NRC, 2012). Ongoing formative assessment by teachers can provide guidance to students to support and extend learning. Yet, those teachers participating in this study indicate this is an area of weakness as associated with 21st-century skills. Additionally, current educational policies focus on summative assessments that measure content and hold schools accountable for student scores these assessments.

New English language arts and math standards and the science framework articulate goals for deeper learning and the development of 21st-century competencies (NRC, 2012). The extent of which the goals are realized will be strongly influenced by how they are measured in district, state, and national summative assessments. Standardized end-of-year tests for purposes of accountability have not been conducive or supportive to deeper learning (NRC, 2012). There is much work to be done to organize, align and define the constructs of 21st-century skills. Teachers and policy-makers must better understand the development and facilitation of richer performance and curriculum-based assessments that better measure 21st-century skills; even though they may be more

expensive to develop, administer and score. Significant attention should be given to the design of tasks and situations that incorporate 21st-century skills in content areas for summative assessment.

In the current climate of increased accountability, schools, policy-makers, and government officials are searching for ways to increase college and career readiness as well as to prepare students with 21st-century skills. Project-based learning is one approach that school administrators are utilizing to allow students to practice these skills while seeking to increase student achievement. Before students can access these skills, those providing classroom instruction must become competent in and comfortable with methods which promote deep learning. Based on this study's findings, policy-makers must take action to accomplish these goals. They will do so by continued support, including expanding funding opportunities for New Tech schools, sponsoring events to report and share the results of the New Tech schools, requiring professional development for all teachers on 21st-century skills and formative assessment of these skills, and ensuring accountability measures and standardized assessments take into account authentic assessment of 21st-century skills.

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APPENDICES

APPENDIX A

21st-Century Skills Framework

Student's 21st-Century Skills (ITL/SRI Version)

- **Knowledge Building** – Students move beyond the reproduction of information to construct knowledge that is new to them.
- **Problem-Solving and Innovation** – Students solve problems for which there is no previously learned solution, make choices in their approach, and implement their solutions in the real world.
- **Skilled Communication** – Students present their ideas in ways that are clear and compelling, and present sufficient relevant evidence on a topic or theme.
- Collaboration – Students work together in groups, take on roles, and produce a joint work product.
- **Self-Regulation** – Students plan and monitor their work, make revisions based on feedback or self-assessment.
- **Use of ICT for Learning** – Students use ICT to construct knowledge; choose when, where, and how to use it; and evaluate the credibility and relevance of on-line resources.

The William and Flora Hewlett Foundation Deeper Learning Framework

An early draft (12/24/2010) was focused on giving students opportunities to learn

- **Content Knowledge**
  - To acquire a deep understanding of the academic content
  - To apply their knowledge to novel tasks and situations
  - To create new knowledge
- **Cognitive Strategies**
  - To think critically and solve complex problems
  - To communicate effectively orally and in writing
- **Learning Behavior**
  - To actively engage in their own learning
  - To work collaboratively with others

Their web site (as of July 15, 2012) states that deeper learning prepares students to

- **Master core academic content**
- **Think critically and solve complex problems**
- **Work collaboratively**
- **Communicate effectively**
- **Learn how to learn (e.g., self-directed learning)**

http://www.hewlett.org/programs/education-program/deeper-learning

APPENDIX B

21st-century Skills Teaching and Learning Survey

1. Introduction

Thank you for agreeing to participate in this important survey. Your response will help researchers understand trends in instructional practices in Arkansas schools.

There are no correct or incorrect answers. Please be candid in your responses and rest assured that the results of this survey are confidential.

Information will be used to develop a research dissertation. No schools or teachers will be identified in the study. Participation is voluntary and no one beyond the researcher will see responses.

Time is precious. This survey should take no more than 20 minutes. In recognition of your time, drawings will be held for $10 Amazon.com gift cards for participation.

Should you have any questions about this survey, please contact the researcher (datwell@harding.edu).

Participation is voluntary, refusal to participate will involve no penalty, and participants may discontinue participation at any time without loss of benefits to which they otherwise would be entitled. In filling out the survey, you are acknowledging your consent to participate in the study. All surveys are coded to protect confidentiality.

2. Professional Development Focus

In recent years, since 2011, has your teaching or professional development included a SIGNIFICANT FOCUS on . . . .

1. TECHNOLOGY INTEGRATION

- ○ Yes, a significant focus in recent years
- ○ No

2. FORMATIVE AND SUMMATIVE ASSESSMENT?

- ○ Yes, a significant focus in recent years
- ○ No

3. PROJECT-BASED LEARNING (PBL)?

- ○ Yes, a significant focus in recent years
- ○ No

3. New Tech Network Professional Development

1. In what year did you attend New School Training or New Teacher Track at New Tech Annual conference?

- ☐ 2010 or earlier
- ☐ 2011
- ☐ 2012
- ☐ I did not attend NST or New Teacher Track at NTAC

2. Did you participate in any of the following professional developments? Check all that apply.

- ☐ Coaching Days - One on One Support
- ☐ Meeting of the Minds Conference
- ☐ other

3. THIS SEMESTER, did you use Project-based learning (PBL) in your teaching of core academic or elective subjects?

- ☐ Yes
- ☐ No

4. Target Class

This survey asks you to pick a "TARGET CLASS". This is the class in which you felt your teaching was the most effective. (If your teaching was equally effective in all your classes, pick the class that you think learned the most.)

1. Select the subject that you teach and will consider as the "TARGET CLASS" for the rest of this survey.

- English Language Arts
- Math
- Social Studies
- Science
- Fine Arts
- Foreign Language
- CTE courses
- Health/PE
- Oral Communications
- EAST
- Project Lead the Way Course
- other

5. Frequency and Duration

Refer to the TARGET CLASS when answering the rest of the questions for the survey.

1. In your TARGET CLASS this semester, HOW MANY extended (week or longer) assignments, questions, projects, or investigations did students complete?

0	1	2	3	4	5	6 or more
○	○	○	○	○	○	○

2. How many TOTAL WEEKS were students involved in conducting these extended (week or longer) assignments, projects, investigations?

0	1-2 Weeks	3-4 Weeks	5-6 Weeks	7-8 Weeks	9-10 Weeks	10 or More weeks
○	○	○	○	○	○	○

3. What proportion of OVERALL CLASS TIME - for the entire semester - was devoted to these extended (week or longer) assignments, questions, projects, or investigations?

0-10% Class time	11-25% Class time	26-50% Class time	51-75% Class time	76-100% Class time
○	○	○	○	○

4. Did your TARGET CLASS have block scheduling, extended periods lasting more than an hour at a time?

Yes	No
○	○

6. Target Class Information

1. What is the best description of the majority of students in your target class? (Choose one)

- ○ Students whose academic performance is at the expected level for their age.
- ○ Students whose academic performance is behind the expected level for their age.
- ○ Students whose academic performance is ahead of the expected level for their age.

2. These questions ask for your assessment of student learning of ACADEMIC CONTENT in your TARGET CLASS.

Please ESTIMATE how many students in your TARGET CLASS . . .

	Very Few	Some	Most	Nearly All
a. Have learned what they will need to know to do well on standardized tests?	○	○	○	○
b. Can apply and transfer what they have learned to new tasks and situations?	○	○	○	○
c. Feel that what they learned was personally relevant?	○	○	○	○
d. Are motivated to learn more about the subjects they studied?	○	○	○	○

3. For your TARGET CLASS, how many HOURS PER WEEK do you expect an average student to spend working OUTSIDE OF CLASS - doing homework, completing assignments, or studying?

Less than 1 hour per week	1-2 Hours	3-5 Hours	6-9 Hours	10 or more hours
○	○	○	○	○

4. In your TARGET CLASS this semester, how much time have you spent having students practice taking standardized tests and learning to improve their TEST TAKING SKILLS?

None	Less than 4 hours	4-12 Hours	13-20 Hours	More than 20 hours
○	○	○	○	○

21st-century Skills
7. 21st-century Skills

The rest of this survey is going to ask about your teaching practices that might support student learning of the following 21st-century Skills.
Critical Thinking
Collaboration
Communication
Creativity & Innovation
Self-Direction
Making Global Connections
Making Local Connections
Using Technology as a Tool

For each of the above you will be asked about your general teaching of the skills, and about a few specific practices you may have used. There are no correct or incorrect answers and all responses will be kept confidential.

8. Critical Thinking Skills

In general, **CRITICAL THINKING SKILLS** refer to students being able to analyze complex problems, investigate questions for which there are no clear-cut answers, evaluate different points of view or sources of information, and draw appropriate conclusions based on evidence and reasoning.

1. Here are some examples of practices that may help students learn **CRITICAL THINKING SKILLS.**

In your teaching of your TARGET CLASS, how often have you asked students to do the following?

	Almost Never	Few Times per Semester	1-3 Times per Month	1-3 Times per Week	Almost Daily
a. Compare information from different sources before completing a task or assignment?	○	○	○	○	○
b. Draw their own conclusions based in analysis of numbers, facts, or relevant information?	○	○	○	○	○
c. Summarize or create their own interpretation of what they have read or been taught?	○	○	○	○	○
d. Analyze competing arguments, perspectives, or solutions to a problem?	○	○	○	○	○
e. Try to solve complex problems or answer questions that have no single correct solution or answer?	○	○	○	○	○

2. To what extent do you agree with these statements about your TARGET CLASS?

	Not really	To a minor extent	To a moderate extent	To a great extent	To a very great extent
a. I have tried to develop students' critical thinking skills	○	○	○	○	○
b. Most students have learned critical thinking skills while in my class	○	○	○	○	○
c. I have been able to effectively assess students'	○	○	○	○	○

critical thinking skills					

9. Collaboration Skills

In general, **COLLABORATION SKILLS** refer to students being able to work together to solve problems or answer questions, to work effectively and respectfully in teams to accomplish goals and to assume shared responsibility for completing a task.

1. Here are some examples of practices that may help students learn **COLLABORATION SKILLS.**

In your teaching of your TARGET CLASS, how often have you asked students to do the following?

	Almost Never	Few Times per Semester	1-3 Times per Month	1-3 Times per Week	Almost Daily
a. Work in pairs or small groups to complete a task together?	○	○	○	○	○
b. Work with other students to set goals and create a plan for their team?	○	○	○	○	○
c. Create joint products using contributions from each student?	○	○	○	○	○
d. Present their group work to the class, teacher, or others?	○	○	○	○	○
e. Give feedback to peers or assess other students' work?	○	○	○	○	○

2. To what extent do you agree with these statements about your TARGET CLASS?

	Not really	To a minor extent	To a moderate extent	To a great extent	To a very great extent
a. I have tried to develop students' critical thinking skills	○	○	○	○	○
b. Most students have learned critical thinking skills while in my class	○	○	○	○	○
c. I have been able to effectively assess students' critical thinking skills	○	○	○	○	○

10. Communication Skills

In general, **COMMUNICATION SKILLS** refer to students being able to organize their thoughts, data and findings and share these effectively through a variety of media, as well as orally and in writing.

1. Here are some examples of practices that may help students learn **COMMUNICATION SKILLS.**

In your teaching of your TARGET CLASS, how often have you asked students to do the following?

	Almost Never	Few Times per Semester	1-3 Times per Month	1-3 Times per Week	Almost Daily
a. Structure data for use in written products or oral presentations (e.g., creating charts, tables or graphs)?	○	○	○	○	○
b. Convey their ideas using media other than a written paper (e.g. posters, video, blogs, etc.)?	○	○	○	○	○
c. Prepare and deliver an oral presentation to the teacher or others?	○	○	○	○	○
d. Answer questions in front of an audience?	○	○	○	○	○
e. Decide how they will present their work or demonstrate their learning?	○	○	○	○	○

2. To what extent do you agree with these statements about your TARGET CLASS?

	Not really	To a minor extent	To a moderate extent	To a great extent	To a very great extent
a. I have tried to develop students' communication skills	○	○	○	○	○
b. Most students have learned communication skills while in my class	○	○	○	○	○
c. I have been able to effectively assess students' communication skills	○	○	○	○	○

11. Creativity and Innovation Skills

In general, **CREATIVITY AND INNOVATION SKILLS** refer to students being able to generate and refine solutions to complex problems or tasks based on synthesis, analysis and then combining or presenting what they learned in new and original ways.

1. Here are some examples of practices that may help students learn **CREATIVITY AND INNOVATION SKILLS.**

In your teaching of your TARGET CLASS, how often have you asked students to do the following?

	Almost Never	Few Times per Semester	1-3 Times per Month	1-3 Times per Week	Almost Daily
a. Use idea creation techniques such as brainstorming or concept mapping?	○	○	○	○	○
b. Generate their own ideas about how to control a problem or question?	○	○	○	○	○
c. Test out different ideas and work to improve them?	○	○	○	○	○
d. Invent a solution to a complex, open-ended question or problem?	○	○	○	○	○
e. Create an original product or performance to express their ideas?	○	○	○	○	○

2. To what extent do you agree with these statements about your TARGET CLASS?

	Not really	To a minor extent	To a moderate extent	To a great extent	To a very great extent
a. I have tried to develop students' creativity and innovation skills	○	○	○	○	○
b. Most students have learned creativity and innovation skills while in my class	○	○	○	○	○
c. I have been able to effectively assess students' creativity and innovation skills	○	○	○	○	○

12. Self-Direction Skills

In general, **SELF-DIRECTION SKILLS** refer to students being able to take responsibility for their learning by identifying topics to pursue and processes for their own learning and being able to review their own work and respond to feedback.

1. Here are some examples of practices that may help students learn **SELF-DIRECTION SKILLS.**

In your teaching of your TARGET CLASS, how often have you asked students to do the following?

	Almost Never	Few Times per Semester	1-3 Times per Month	1-3 Times per Week	Almost Daily
a. Take initiative when confronted with a difficult problem or question?	○	○	○	○	○
b. Choose their own topics of learning or questions to pursue?	○	○	○	○	○
c. Plan steps they will take to accomplish a complex task?	○	○	○	○	○
d. Choose for themselves what examples to study or resources to use?	○	○	○	○	○
e. Monitor their own progress towards completion of a complex task and modify their work before it is completed?	○	○	○	○	○
f. Use specific criteria to assess the quality of their work before it is complete?	○	○	○	○	○
g. Use peer, teacher or expert feedback to revise their work?	○	○	○	○	○

2. To what extent do you agree with these statements about your TARGET CLASS?

	Not really	To a minor extent	To a moderate extent	To a great extent	To a very great extent
a. I have tried to develop students' self-direction skills	○	○	○	○	○
b. Most students have learned self-direction skills while in my class	○	○	○	○	○
c. I have been able to effectively assess students' self-direction skills	○	○	○	○	○

13. Global Connections Skills

In general, **GLOBAL CONNECTIONS** refer to students being able to understand global, geo-political issues including awareness of geography, culture, language, history, and literature from other countries.

1. Here are some examples of practices that may help students learn **GLOBAL CONNECTIONS.**

In your teaching of your TARGET CLASS, how often have you asked students to do the following?

	Almost Never	Few Times per Semester	1-3 Times per Month	1-3 Times per Week	Almost Daily
a. Study information about other countries or cultures?	○	○	○	○	○
b. Use information about other countries or culture?	○	○	○	○	○
c. Discuss issues related to global interdependency (for example, global environment trends, global market economy)?	○	○	○	○	○
d. Understand the life experiences of people in cultures besides their own?	○	○	○	○	○
e. Study the geography of distant countries?	○	○	○	○	○
f. Reflect on how their own experiences and local issues are connected to global issues?	○	○	○	○	○

2. To what extent do you agree with these statements about your TARGET CLASS?

	Not really	To a minor extent	To a moderate extent	To a great extent	To a very great extent
a. I have tried to develop students' global connections skills	○	○	○	○	○
b. Most students have learned global connections skills while in my class	○	○	○	○	○
c. I have been able to effectively assess students' global connections skills	○	○	○	○	○

14. Local Connections
In general, **LOCAL CONNECTIONS** refer to students being able to apply what they have learned to local contexts and community issues.

1. Here are some examples of practices that may help students learn **LOCAL CONNECTIONS.**
In your teaching of your TARGET CLASS, how often have you asked students to do the following?

	Almost Never	Few Times per Semester	1-3 Times per Month	1-3 Times per Week	Almost Daily
a. Investigate topics or issues that are relevant to their family or community?	○	○	○	○	○
b. Apply what they are learning to local situations, issues, or problems?	○	○	○	○	○
c. Talk to one or more members of the community about a class project or activity?	○	○	○	○	○
d. Analyze how different stakeholder groups or community members view an issue?	○	○	○	○	○
e. Respond to a question or task in a way that weighs the concerns of different community members or groups?	○	○	○	○	○

2. To what extent do you agree with these statements about your TARGET CLASS?

	Not really	To a minor extent	To a moderate extent	To a great extent	To a very great extent
a. I have tried to develop students' local connections skills	○	○	○	○	○
b. Most students have learned local connections skills while in my class	○	○	○	○	○
c. I have been able to effectively assess students' local connections skills	○	○	○	○	○

15. Using Technology as a Tool

In general, **USING TECHNOLOGY AS A TOOL FOR LEARNING** refers to students being able to manage their learning and produce products using appropriate information and communication technologies.

1. Here are some examples of practices that may help students learn to **USE TECHNOLOGY as TOOL FOR LEARNING**

In your teaching of your TARGET CLASS, how often have you asked students to do the following?

	Almost Never	Few Times per Semester	1-3 Times per Month	1-3 Times per Week	Almost Daily
a. Use technology or the internet for self-instruction (e.g. Kahn Academy or other videos, tutorials, self-instructional websites, etc.)?	○	○	○	○	○
b. Select Appropriate technology tools or resources for completing a task?	○	○	○	○	○
c. Evaluate the credibility and relevance of online resources?	○	○	○	○	○
d. Use technology to analyze information (e.g. databases, spreadsheets, graphic programs, etc.)?	○	○	○	○	○
e. Use technology to help share information (e.g. multimedia presentations using sound, video, presentation software, blogs, podcasts, etc.)?	○	○	○	○	○
f. Use technology to support team work or collaboration (e.g. shared work spaces, email exchanges, giving and receiving feedback, etc.)?	○	○	○	○	○
g. Use technology to interact directly with experts or members of local/global communities?	○	○	○	○	○
h. Use technology to keep track of their work on extended tasks or assignments?	○	○	○	○	○

15. Using Technology as a Tool (Continued)

2. To what extent do you agree with these statements about your TARGET CLASS?

	Not really	To a minor extent	To a moderate extent	To a great extent	To a very great extent
a. I have tried to develop students' use of technology skills	○	○	○	○	○
b. Most students have learned use of technology skills while in my class	○	○	○	○	○
c. I have been able to effectively assess students' use of technology skills	○	○	○	○	○

16. Completion Information

THANK YOU FOR COMPLETING THE SURVEY! Your feedback will assist in research about teaching and learning 21st-century Skills.

1. In recognition of the importance of this study, and as a small token of appreciation, drawings will be held to randomly select participants to receive $10 gift certificates from Amazon.com.

Do we have permission to contact you if you win an Amazon.com gift certificate?

- Yes, send me the gift if I win.
- No, someone else can have it.

APPENDIX C

March 15, 2013

Harding University Institutional Review Board
c/o Institutional Review Board
Box 12261
Searcy, AR 72143-2261

Please note that Debbie Atwell, Harding University Doctoral Candidate, has the permission to use the survey instrument from the study Extended Professional Development in Project-Based Learning: Impacts on 21st-century Skills Teaching and Student Achievement, giving attribution to study authors for the work.

If there are any questions, please feel free to contact my office.

Respectfully,

Name of School Representative: John Mergendoller
Title: Executive Director, Buck Institute for Education
Address: 18 Commercial Blvd
City, Arkansas Zip: Novato, CA 94949
Phone #: 415-883-0122

APPENDIX D

Descriptive Statistics for Time on Assignments with Participation in Project-Based Learning as the Independent Variable

	Participation						
	Participants (n = 65)		Non-Participants (n = 65)				
Teaching/Learning Survey	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Number of extended (week or longer) assignments (1 = 0, 2 = 1, 3 = 2, 4 = 3, 5 = 4, 6 = 5, 7 = 6 or more)	5.48	1.73	3.55	1.73	6.33	.000	0.36
Total weeks of extended assignments (1 = 0, 2 = 1-2, 3 = 3-4, 4 = 5-6, 5 = 7-8, 6 = 9-10, 7 = more than 10)	5.11	1.99	3.31	1.70	5.55	.000	0.31
Proportion of time devoted to extended assignments (1 = 0-10%, 2 = 11-25%, 3 = 26-50%, 4 = 51-75%, 5 = 76-100%)	4.09	1.17	2.20	1.15	9.31	.000	0.44
Time spent having students practice taking standardized tests (1 = less than 1, 2 = less than 4, 3 = 4-12, 4 = 13-20, 5 = more than 20	2.37	1.05	2.37	0.96	.000	1.00	0.20
Hours per week an average student is expected to work outside of class (1 = less than 1, 2 = 1-2, 3 = 3-5, 4 = 6-9, 5 = 10 or more)	2.00	0.79	2.18	0.10	-1.35	.18	0.27

APPENDIX E

HARDING UNIVERSITY
INSTITUTIONAL REVIEW BOARD

Status of Request for Exemption from IRB Review

(For Board Use Only)

Date: April 9, 2013

Proposal Number: 2013 – 039

Title of Project: Effects of Project-Based Learning Professional Development on 21st Century Skills

Name and Contact Information for the Principal Investigator: Debbie Atwell; datwell@harding.edu

■ Research exempted from IRB review.

☐ Research requires IRB review.

☐ More information is needed before a determination can be made. (See attachment.)

I have reviewed the proposal referenced above and have rendered the decision noted above. This study has been found to fall under the following exemption(s):

1 ☐ 2 ■ 3 ☐ 4 ☐ 5 ☐ 6 ☐

In the event that, after this exemption is granted, this research proposal is changed, it may require a review by the full IRB. In such case, a ***Request for Amendment to Approved Research*** form must be completed and submitted.

This exemption is granted for one year from the date of this letter. Renewals will need to be reviewed and granted before expiration.

The IRB reserves the right to observe, review and evaluate this study and its procedures during the course of the study.

Rebecca O. Weaver

Chair
Harding University Institutional Review Board