POLISHING THE MIRROR: A MULTIPLE METHODS STUDY OF THE RELATIONSHIP BETWEEN TEACHING STYLE AND THE APPLICATION OF TECHNOLOGY IN ALASKA'S RURAL ONE TO ONE DIGITAL CLASSROOMS.

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A

DISSERTATION

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DOCTOR OF PHILOSOPHY

By

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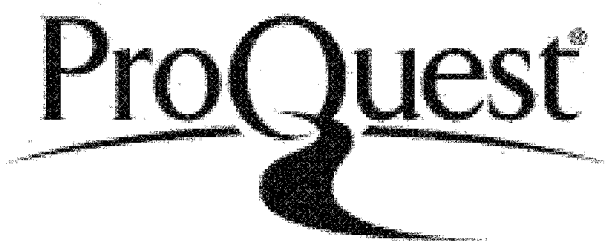

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Abstract

This mixed method survey study examined the inter-relationships between teaching styles and the depth of classroom-based technology applications used by teachers participating in 1:1 digitally enhanced classrooms in thirteen of Alaska's rural school districts.

The promise of technology to catalyze the transformation of schools into learner centric environments preparing students to be 21st century learners has not been realized. Significant first order barriers have limited the digital learning resources necessary to systemically affect pedagogical change. During the last six years, various entities have sponsored digitally enhanced learning environments to stimulate the process of education reform. These initiatives, labeled as one-to-one (1:1), brought teachers face-to-face with the challenges related to second order education reform while creating an opportunity to study changes in instructional philosophy and practice as a result of teaching in an environment rich in technology.

This study explored three questions formulated to probe the relationship between pedagogical philosophy and the application of 1:1 technology to support learning:

- "What is the relationship between instructional philosophy and the way teachers use technology to support learning in Alaskan high school 1:1 laptop programs?"
- "How does access to a 1:1 classroom affect a teacher's instructional philosophy or practice?"
- "Does access to a 1:1 digitally enhanced teaching environment facilitate the use of instructional practices consistent with Alaska Native and 21st century learner outcomes?"

Ninety-four rural high school teachers responded to a survey that assessed teaching styles on a continuum from transmission to constructivist. The level of technology adoption was examined using three indices that respectively measure the professional, personal and classroom use of technology by teachers. Information derived

from open ended questions was triangulated with quantitative data to develop a meaningful understanding of the study questions.

Quantitative and qualitative data suggested that the majority of responding teachers identified with constructivist beliefs over traditional transmission. Teachers noted a strong positive relationship between teaching and the application of technology, yet analysis showed that constructivist beliefs were attenuated by several challenges related to management of technology. While teachers were generally aware of the potential for digital learning technologies to support Alaska Native and 21st century methods, they were outweighed by operational concerns related to the integration of technology.

These study questions are significant. Digitally enhanced instructional practices help to equip students with the skills expected of 21st century learners. Perhaps even more significant is the congruence between the teaching styles traditionally used by Alaska Natives and the digitally enhanced constructivist practices made possible when using technology to augment processes for acquiring knowledge.

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Biographical Information

Larry LeDoux grew up in the rich, multi-cultural environment of Kodiak, Alaska where he was the third son in a family that included seven boys and one girl. Larry's parents believed both in a strong work ethic and that education was the key to success. Larry earned a B.S. in Biology from the University of Alaska in Fairbanks. Summertime work as a camp counselor while in college drew him away from further scientific pursuits and influenced him to become a teacher. In the fall of 1978, he began teaching electronics, general math and biology at Kodiak High School during the day and chemistry, computer programming and biology at the local college in the evening.

The lessons from experience, an MAT in Biology and an Ed. Specialist degree in Alaska Native Studies opened the door to a variety of administrative responsibilities that included 22 years as an elementary, secondary and rural principal in the Kodiak School District. Larry also served as the district's Director of Technology, Career and Technical Education and Strategic Planning. While Director of Technology, he initiated innovative distance education programs that enhanced student learning in the district's six rural schools. During his tenure as principal of the rural Chiniak School, Chiniak teacher Elaine Griffin served as the National Teacher of the Year. Larry became a student as he observed Elaine work her instructional magic with her students. Over the years, he has been appointed to serve on a variety of state and professional boards including the presidency of the Alaska Association of Secondary Principals. Larry served as the superintendent of schools for the Kodiak School District prior to his appointment as the state education commissioner.

The appointment as Commissioner of Education afforded Larry the opportunity to meet with thousands of educators, students, parents and community members throughout the State of Alaska. The highlights of his tenure include the development and implementation of a State Education Plan, new options for digitally enhanced distance learning, a merit scholarship program and closer relationships with early learning and postsecondary institutions.

Larry is employed as a private consultant while pursuing a doctorate in education.

Dedication

I wish to dedicate this dissertation to three individuals who have inspired and encouraged me to pursue my goals.

My father was one of the most intelligent individuals I have every met. While a World War II disability prevented his dream of attending college, he passed on his love of learning and respect for education to his children. He refused to allow me to consider any permanent occupation that did not begin with a college education.

My mother shared a quiet passion for learning that encouraged each of her eight children to pursue further learning. Mom carried a vision for me until I had the courage, confidence and will to carry it for myself. Her wit, wisdom and discourse always kept me on my toes.

Finally, I wish to dedicate this dissertation to my wife Jeannie. Over the last 30 years, Jeannie has relentlessly encouraged me to pursue a doctorate while I have steadfastly resisted. I lost. If not for her absolute refusal to consider any task that would take time from her personal and professional children, she would be writing a dedication for her own dissertation. The smile on her face as she receives the smiles, hugs and hello's from her music students evidences her professional priorities. She has been my anchor, encourager and friend during all of my professional pursuits.

Acknowledgements

It has been my practice when achieving any academic or personal milestone to take a silent moment to remember and thank the many dedicated teachers who protected and nurtured my curiosity. Those teachers who patiently listened to my questions yet never surrendered an answer without provoking a new question. They helped me understand that knowledge is simply the fuel, curiosity the engine and questions the vehicle of life long learning. It is time to recognize a few.

Mr. Spessard, my high school biology teacher who freed me from the tyranny of the textbook to discover the joy that comes from personal exploration.

Mr. Nuttall who promised me an "A" in algebra and no homework if I could draw a regular pentagon with only a straight edge and a compass. I never did solve the challenge but the thousands of hours trying created a love for math that continues today.

Dr. Barnhardt has been inspiring and guiding my career since I decided to become a teacher over 35 years ago. He has always been there to ask an evocative question, share insight or offer support. While his published legacy as a researcher will certainly stand the test of time, the hundreds of students mentored and inspired through the years will amplify and extend his work for generations

I owe many others for their contribution to this dissertation.

Dr. John Monahan invited and encouraged me to initiate a doctoral program. He has been there every step of the way. His professionalism and sense of personal and professional sacrifice are a tribute to his profession. Thank you John.

Dr. Barbara Adams created a positive yet challenging learning environment. Her patience, clarity and laughter as my old mind learned to stretch again was appreciated.

Dr. Scott Smiley, who reminded me how wonderful it is to be the student of a master. His honesty, wit and incredible knowledge-base set an example for professional research and ethics that I will certainly endeavor to follow.

I extend a special thanks to the other three members of the technology research cohort, Dr. Pam Lloyd, Dr. Bob Whicker and Dr. Mark Standley. Their help, support and honesty gave hope, laughter and inspiration. They were always there. Thank you to all.

Chapter 1: Introduction

This sequential mixed method study examined the relationship between teaching style and applications of technology within the cross-cultural environment of Alaska's 1:1 high school digital learning programs. According to R. Johnson, Onwuegbuzie and Turner, (2007) "Mixed methods research combines elements of qualitative and quantitative research approaches for the broad purposes of breadth and depth of understanding and corroboration" (p. 123). This methodology provides a more complete understanding of the relationship between teaching style and digital learning technology (DLT) than any single approach. One-to-one classrooms are technology rich learning environments specifically designed to overcome the barriers that are reported to limit the use of digital learning technologies; i.e., bandwidth, software, hardware, technical support and staff development (Groff & Mouza, 2008). In 1:1 classrooms, every student is provided a laptop computer for school and home use.

High school teachers in thirteen of twenty-two rural Alaska school districts with 1:1 classrooms were invited to participate in the study by completing an online survey. The survey was designed to collect data relevant to the relationship between a teacher's style of instruction and the application of digital learning technologies to support learning. Information gleaned from the initial survey was used to design a follow-up survey to qualitatively probe this relationship by asking teachers to reflect on the role teaching style and DLT play in developing learner environments that support both Alaska Native and 21st century learners.

1.1 Statement of Problem

The late Dr. William Demmert Jr. (2011) lists teachers as "one of the most important aspects of *Atuarfitsialak*" (p. 3). *Atuarfitsialak* is an Inuit word for schools "that are able to help motivate students to achieve academically" as well as culturally (Demmert, 2011, p. 3). *Atuarfitsialak* infers unity and harmony between school and home. Traditional Alaskan indigenous education enjoyed a consistency of worldview, practice and ownership (Ongtooguk, 2000). In those days, the entire community took responsibility for helping children acquire knowledge and find meaning within their

culture. Dr. Soboleff, a Tlingit Elder, described traditional instruction as follows: "Learning was by observing, hearing, and hands-on methods. Each day was a time of learning without sitting at a desk with book, pencil, paper, and a teacher standing before the class taking roll" (Soboleff, 1998, p. 4). The unity suggested by *Atuarfitsialak* ended when a dominant Western culture contested with parents and communities for the authority to educate Alaska's Native youth.

Early Western attempts to use schools as a vehicle to assimilate Alaska's Native cultures produced a legacy of distrust that continues to underline the differences between Alaska Native and Western traditions of education. Away from school, Alaska Native students learn from members of the community using methods of instruction honed by thousands of years of practiced application (Roderick, 2010). The subjects and methods of instruction are consistent with their cultural worldview (Cannon, 2010; Kawagley, 2006; Ongtooguk, 2000). Immersed within this learning environment, children develop a style of learning that mirrors the instructional methods used to pass on their culture (Appleton & King, 2002; Hughes & More, 1997; Swisher, 1991). Alaska Native children who enter the schoolhouse for the first time generally encounter a learning environment with a new set of rules. While in school, students learn according to Western pedagogical practices. This Western influence is shaped by past practice, disregard for indigenous pedagogy, and the belief that educational methods should reflect Western values. Unless there is reconciliation between these epistemologies in schools and homes, students will be disadvantaged in both cultures.

All students pay a price when there is education dissonance between the school and home. Ignoring a child's culturally engendered learning style may drive student alienation that could ultimately lead to scholastic failure. Kumar-Singh (2011) describes this pathway to failure:

> When students perceive that the school setting is hostile and incongruous, or when there is a cultural mismatch or cultural incompatibility between students and their school, there inevitably occurs miscommunication; confrontations between the student, the teacher, and the home, leading to hostility, alienation,

diminished self-esteem, and eventual school failure. (p. 14)

Concerns regarding these issues are of major significance; Alaska Native students score significantly lower on state assessments and drop out of school at twice the rate of Caucasian students (Faircloth & Tippeconnic, 2010; Mackety, 2011; McCormick, 2009). See *Figure* 1 for dropout comparisons among ethnic and racial groups.

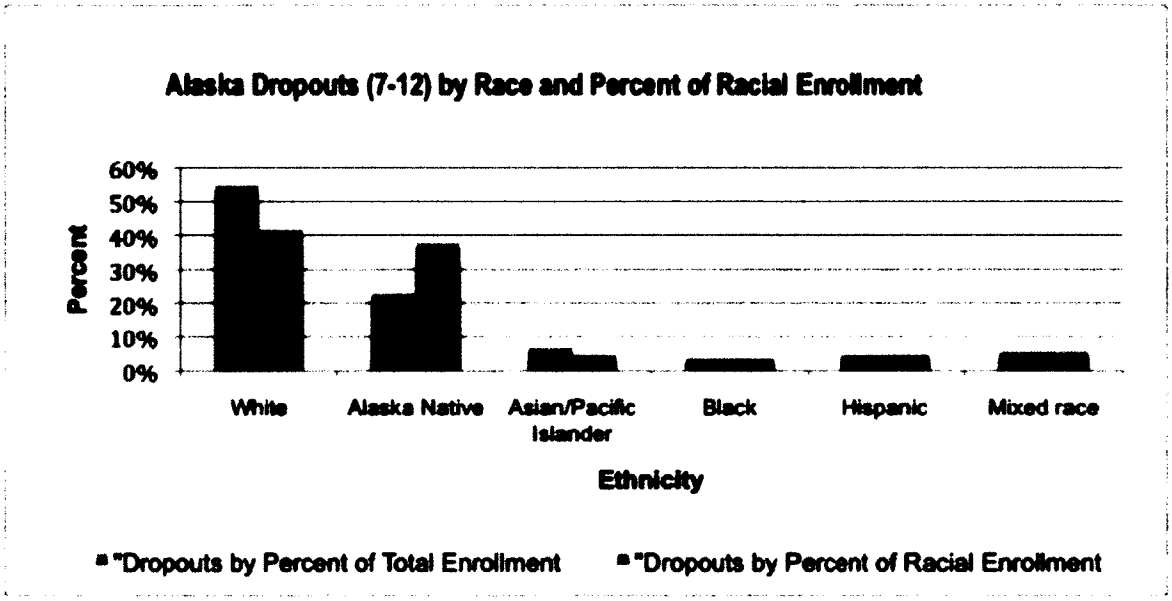

Figure 1. Comparison of dropout rates by population and by percent of enrollment.

Despite considerable effort to close this achievement divide, it remains an unfortunate truth in Alaskan education (Arenas, Reyes, & Wyman, 2007; R. Barnhardt, 2005a; DeVoe & Darling-Churchill, 2008). The teacher will be a key determinant in strategies to help Alaska Native students find success in the classroom (R. Barnhardt & Kushman, 2001; Marzano, 2003; Rhodes, 1994).

Teachers must be equipped with the cultural knowledge necessary to institute a coherent program of instruction integrating both Alaska Native and Western educational traditions. However, it is challenging for teachers trained in the Western traditions to carry out what (Berry, 2003) describes as their responsibility to "teach their lessons in ways assuring that diverse students can learn; and to know both how and why their students learn" (p. 2). An integrated program requires teachers who are knowledgeable in both cultures. This is challenging when only six percent of Alaska's teachers are

themselves Alaska Natives. Additionally, a turnover rate for teachers that averages a quarter for rural Alaska, compared to a rate of 12% statewide, limits what cultural knowledge can be accumulated through experience (Hirshberg & Hill, 2006).

Teachers who wish to deliver an instructional program involving both traditions are often constrained by forces external to the classroom. Limitations related to cultural knowledge can thwart the best of intentions. A fear of governmental knowledge-based accountability systems discourages teachers from practices that may affect assessments. Consequently, teachers may feel compelled to surrender to pragmatic compromises while just maintaining the status quo. This may explain the lack of congruency between the respect for Alaska Native teaching methodologies and observed classroom practice.

There is hope. The calls for education reform voiced by the Alaska Native community have been joined by national leaders who are concerned that graduates will soon be competing in a technologically accelerating global economy. Educational methods and performance standards, designed to feed the industrial workforce of the last century, are not sufficient to meet emerging challenges created by the "Information Age." This new age will not only require new educational outcomes but also new methods to achieve them.

Digitally enhanced communication technologies have equipped the world with a complex and competitive global economy that is evolving so fast it is challenging to predict what students will need to know to be effectively prepared. Robinson (2009) emphasizes this point: "This dynamic combination of a global economy and rapidly changing technology leads to one inescapable conclusion: we can not predict what the future will be" (p. 22). Graduation outcomes must no longer be based on specific skills that promise to quickly become irrelevant. Graduates must have both the knowledge and intellectual poise to flex with the accelerating pace of change (H. Adams, 1983). Employment value for the next century will be based on the use of higher order thinking to adapt to ongoing change (King, Goodson, & Rohani, 1998; Partnership for 21st Century Schools, 2008).

Higher order thinking skills as described by (King et al., 1998) are "critical,

logical, reflective, metacognitive, and creative thinking. They are activated when individuals encounter unfamiliar problems, uncertainties, questions, or dilemmas" (p. 1). These cognitive skills are suited to an unpredictable 21st century as well as the subsistence lifestyle that has been practiced by Alaska Natives for thousands of years. These skills have been proven not to be achieved through the current system of education with its emphasis on the acquisition of static knowledge and applied learning strategies. The skills sufficient for an industrial society represent the starting point for educational restructuring. Schools must be transformed into learner centric environments provoking students to act in innovative ways. Meaning and understanding are best learned through activities related to interest and place (R. Barnhardt, 2005a).

Educational strategies designed to develop high order thinking are not new or innovative to Alaska Native traditions of instruction (Kawagley, 2006). Alaska Native teaching methods emphasize problem-solving, decision-making and critical thinking, along with respect for the wisdom of Elders, place-based knowledge and responsibility to the community (R. Barnhardt & Kawagley, 2005; Hild, 1994; Kawagley, 2006). The challenge for educators is to create a learning environment that will help instill in students the willingness to engage in a wide range of learning activities.

A shift in Western educational practice to a more holistic, student-centric model will reduce the separation between Western and traditional Alaska Native teaching methods (R. Barnhardt, 2005a). Such a shift will also provide an opportunity to develop an integrated model faithful to both Alaska Native and Western worldviews. Alaska Native communities will enjoy a school-based teaching environment consistent with their traditional methods while students from Western traditions will benefit from a learning environment that encourages engagement and problem-solving. Instructional congruence will provide all youth with the prerequisites needed to effectively engage in 21st century life while supporting a cultural foundation connected to Alaska Native traditions (Jennings, 2004). It is a bit ironic that the same indigenous teaching traditions that have resisted assimilation for over 250 years may provide a model to guide the transformation of Western education into a 21st century model.

Digital teaching assets can help mediate between Western and Alaska Native education. Digital learning applications can bring Alaska Native culture directly into the classroom. Specially designed software can help students become immersed in virtual simulations that emulate cultural activities, some no longer possible to experience in real life. Social networking applications connect Alaska Natives, separated by geography and distance, to virtual communities defined by common interests. Modern communications technology does not limit the wisdom of Elders or first language speakers to a specific location. Effective distance learning applications provide new opportunities for students to access qualified instructors, specialized courses and age-level peers. Technology can connect teachers – only marginally familiar with Alaska Native teaching and learning strategies – with the resources to integrate such strategies into the daily instruction.

The promise of technology to create a digitally enhanced learning environment facilitating instruction has not been realized due to barriers, both internal and external (Hew & Brush, 2007). Resource limitations continue to dog effective application of new instructional technologies (Norton & Hathaway, 2011). These challenges have made it difficult for technology to transition from the instructional sidelines to center stage in learning methodologies (Bingimlas, 2009). Teachers are resistant to instructional innovations that are unproven as instruments of student growth. As a result, technology's role remains secondary, on the periphery of education, rather than as a potent catalyst at the center of restructuring. The value of a tool is not vested in its potential but on how it is actually used (Cuban, 2006).

During the last six years, various state, corporate and district initiatives have addressed these concerns by sponsoring 1:1 digital classrooms in a number of rural Alaskan schools whose students are predominantly Alaska Native. One-to-one classrooms provide 24-hour access to a personal laptop for every student, while at the same time the program increases bandwidth, integrates staff training, along with technical support and access to a variety of educational software applications (CDL, 2006; Ohler, 2011). The intent of these initiatives is to stimulate changes related to academic performance, the environment for learning and instructional practice.

However, preliminary achievement data from 1:1 programs across the United States and in Alaska shows only marginal gains in student performance (Cuban, 2006; Weston & Bain, 2010). Clearly, other factors are influencing the integration of these programs as instruments of student achievement. What are these other factors and how do they influence the creation of a digitally enhanced, culturally congruent learning environment? The removal of the common barriers to technology implementation in these classrooms forms a basis from which to study the relationship between a teacher's pedagogical philosophy and the use of technology in support of learning. Acting consistently with their individual styles of instruction, teachers make all decisions related to the frequency, purpose and application of technology within a 1:1 classroom.

Instructional or teaching style is defined as the operational philosophy used by a teacher to design, deliver and assess instruction. It is the sum of the social, personal and professional compromises negotiated between philosophy and external constraints that affect practice. A deeper understanding of the role DLT plays in supporting a student-centered learning environment must begin with an exploration of the relationship between teaching style and the software applications selected by the teacher to support learning.

The potential of DLT to increase student achievement is enhanced by teachers who practice from a constructivist philosophical foundation (Matusevich, 1995). Constructivism is a learning theory suggesting that learning is an individual process of constructing knowledge and finding meaning through negotiating between what is known and what is observed. Vygotsky (1978) emphasized the importance of peer relationships and "more able adults" as significant factors in the development of cognitive meaning and understanding among children (Vygotsky, 1978). The teaching portfolio of a constructivist teacher includes opportunities for students to engage in collaborative studies especially those that have contextual relevance for the learner. Teaching styles based on constructivist theories are consistent with Alaska Native teaching methodologies (Hughes & More, 1997).

Constructivism is also an instructional philosophy often associated with

stimulation of the previously described higher order skills (King et al., 1998) demanded of a 21st century workforce (Partnership for 21st Century Schools, 2008). Students must be fluent in cognitive skills that transform data into meaningful information. A constructivist learning environment encourages students to use critical thinking, problem-solving, collaboration and communication as tools to develop ideas and realize new understandings. Small group, project-based learning, experimentation, out-of-classroom experiences and reflective writing are all seminal characteristics of a constructivist learning environment. Graduates will not be able to incorporate these skills into a comprehensive learning portfolio if they do not hone them through meaningful, contextual learning. Conversely, student engagement in active learning can be stifled without a broad knowledge base on which to draw.

Hannafin and Hill (2002) view constructivism and technology as "mutually reinforcing concepts in the design of engaged, student-led instruction in pursuit of goals and problem-solving activities" (p. 77). However, education related reform cannot move faster than allowed by the classroom teacher who can "close the classroom door" to any change that conflicts with teaching style or a preference for the status quo. The choice of a teaching style consistent with 21st century skills and Alaska Native learning is determined by the teacher, as are all decisions related to the use of technology in support of learning (Dalgarno, 2009). Among the most promising educational initiatives are those that have never crossed the threshold separating conception from practice—and expired.

Clearly, a teacher is the captain of the classroom instructional ship and the final arbiter of efforts to implement change. Beyond the factors that may influence the learning of any individual child, the effectiveness of the classroom teacher is the primary determinant (Rice, 2003). Given this, it is important to understand those factors that influence instructional decision-making before undertaking reform.

1.2 Background

Classroom-based digital technology as an instrument of reform continues to be an active area of research (Cuban, 2006; Duncan, 2010; Polly, 2011). However, almost forty years after the invention of the desktop computer, educators continue to debate the merit

of digitally-assisted instruction. While technology is primarily used to support the didactic instruction used by the majority of teachers, the literature clearly supports the potential for digital learning technology to be used constructively by students engaged in modeling, simulations and social networking.

Recently, initiatives have been implemented in select schools to provide every child with 24-hour access to a laptop computer. These 1:1 initiatives have been designed to address barriers identified as hindering the integration of technology into mainstream education (A. Barron, Kemker, Harmes, & Kalaydjian, 2003; Becker, Ravitz, & Wong, 2000; Harwood & Asal, 2007; Howard, 1994; Sandholtz & Reilly, 2004). Initial studies addressed questions relating to student achievement, cost effectiveness and learner attitudes. Several more recent studies investigated the relationship between teaching style and the ways in which technology was used to support instruction (Becker & Ravitz, 1999; Ohler, 2011).

This present study was constructed to examine the relationship between the application of technology and pedagogical style within the cross-cultural environment of Alaska's 1:1 digital learning programs in thirteen Alaska school districts. A review of Alaska Native cultures and the history related to education provided the cultural context to guide the study, including design, methods and conclusions. Other elements include a review of the literature relevant to Western and Alaska Native teaching practices; the process of learning; teaching styles; 21st century skills and 1:1 initiatives in Alaska's rural high schools. *Figure 2* is a map of participating Alaska school sites participating in the survey.

Instructional philosophy and pedagogy are common research topics in education. A number of researchers have compared and contrasted Western and contemporary Alaska Native approaches to instruction (R. Barnhardt & Kawagley, 2005; Grubiss, 1992; Kawagley, 2006; Kleinfeld, McDiarmid, & Parrett, 1992; Morgan, 2010). Collectively these studies demonstrate a wide divergence between the dominant Western pedagogic traditions emphasizing reductionist, teacher-centric models and the holistic, student-centric models that characterize traditional Alaska Native teaching methods. This

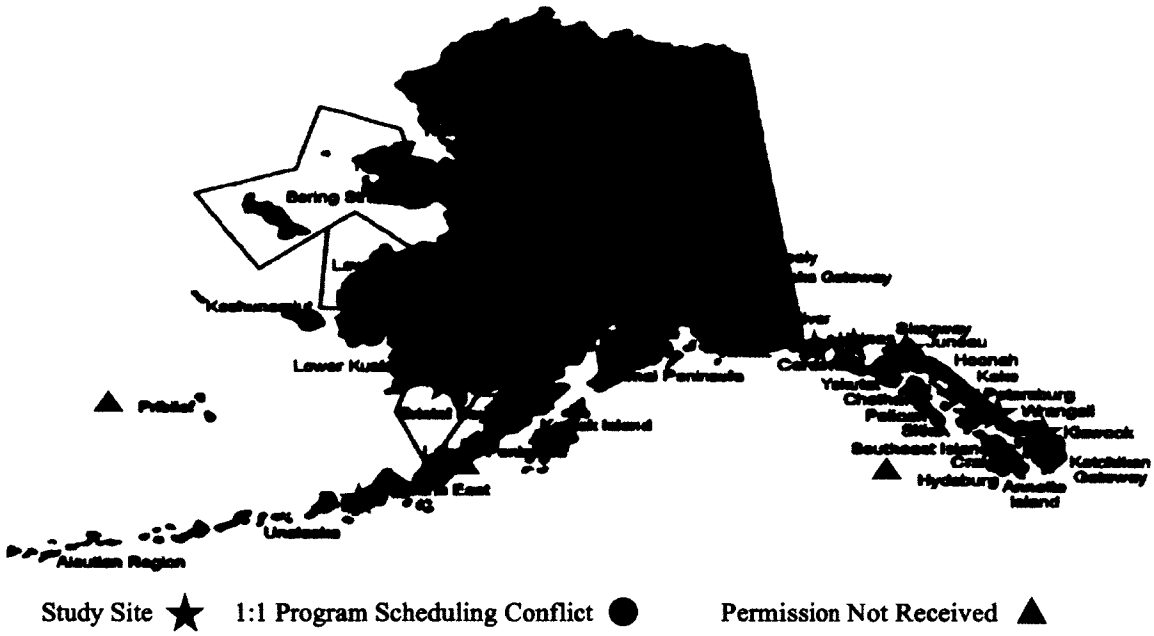

Figure 2. Map of 1:1 districts in Alaska with 1:1 laptop programs.
Districts included in the study as determined by (a) the study definition of a 1:1 laptop program, (b) district scheduling conflicts and (c) permission to conduct the survey.

dichotomy may change as both Alaska Native and Western education traditions confront a new world order in the 21st century likely to challenge the survival of both. However, it is from the chaos at the interface of change (R. Barnhardt & Kawagley, 2006), that arises the potential to craft an education program honoring both cultures.

The phrase "21st century skills" is a catch-phrase for those skills futurists believe will be necessary for workers in the 21st century (Magner, 2011; Wagner, 2008). However, as technologically inspired change accelerates, futurists find it challenging to define a single emerging skill set - much less predict the suite of sets necessary for the remainder of the 21st century. Our brave new age of uncertainty can be a particularly challenging time for Alaska Native youth as they search for an identity between a cultural past that is slowly slipping away and a future inspired in unpredictable directions. They are not alone. Australian researcher Kral (2010) noted that Australian Aboriginal youth are:

> Seeking new ways of expressing a contemporary indigenous identity: they are change agents, drawing on existing knowledge and skills from the local

> community, but also seeking to know more about the outside world. And many, ... are successfully mediating between old knowledge and new technologies to create new forms of cultural production. (p. 10)

Digital applications are allowing students to construct an identity uniquely suited to the challenges they face rather than navigating a philosophical gauntlet laid between conflicting cultural traditions largely irrelevant to the challenges of the 21st century. Kral (2010) goes on to conclude:

> This generation cannot replicate the traditional template set by their elders; instead they are seeking new ways of expressing a contemporary indigenous identity. The research shows that they are forming the understandings, skills and competencies they require to enter young adulthood as bilingual, bicultural beings, drawing on the language and culture transmitted by their elders, but also transforming it. (p. 10)

1.3 Significance of the Study

The conclusions derived from this study may represent additions to the body of knowledge related to effective application of digital learning technologies (DLT) to the development of skills expected from 21st century learners: collaboration, communication, creativity, problem solving and critical thinking. If this study shows a strong correlation between teaching style and the way technology is used to support learning, professional development programs may be expanded to include instructional methods that encourage students to use the full power of technology to extend their learning. Acquiring an appropriate philosophical foundation and teaching style—one that facilitates a student-centric learning environment—may be just as important in assisting teachers to become more effective, as helping teachers use the tools of technology.

There is a significant discrepancy between the teachers who report their teaching style as constructivist and those who actually implement constructivist methods in the classroom (Becker et al., 2000). While there are many possible explanations for this, some data suggests that access to the resources available in a 1:1 classroom can positively influence constructivist pedagogy (Becker & Ravitz, 1999; Wideman, 2005). If

information from the present study is consistent with this research, it would tend to support an initiative to provide all students and teachers with the digital learning resources currently available only in the 1:1 classrooms.

Perhaps even more significant is the potential to connect the Alaska Native and Western pedagogical traditions together into an integrated plan involving technology supported constructivist teaching methods. Further, linkages between the acquisition of 21st century skills and technology-mediated constructive teaching may hold the key to educational reform by transforming education into an effective, culturally integrated 21st model mirroring natural learning strategies.

1.4 Purpose of the Study

The purpose of this research is to use a sequential, mixed method strategy of inquiry to study the relationship between teaching style and the depth of classroom-based technology used to support student learning among high school teachers participating in Alaska's 1:1 high school laptop programs. The selection of a mixed methods research design is appropriate given the complexity of the study. Quantitative strategies can deal with data relevant to the relationship between teaching style and philosophy but the study questions also require qualitative strategies to fully explore the many determinants that affect instructional decision-making.

During the quantitative phase, survey data was collected from 1:1 high school teachers in thirteen of Alaska's twenty-two rural districts to test the relationship between teaching style (independent variable) and the use of technology to support learning (dependent variable). Open-ended questions included in the first survey queried this relationship. Incomplete responses from this initial survey instigated a brief follow-up survey that used four open-ended questions to further inquire on the respondents philosophy, teaching style and sensitivity to Alaska Native and 21st century instruction.

1.5 Research Questions

The mixed method design integrates quantitative and qualitative strategies into an approach that is more than simply a merger of separate research designs. Each contributes information necessary to build a deeper, more complete explanation of the relationship

between teaching style and the use of technology (Creswell, 2009). The power of a mixed methods design arises from integrating data generated from both methods.

In the first phase of the study, a survey instrument was designed to gather data relevant to the primary quantitative study question:

- "What is the relationship between instructional philosophy and the way teachers use technology to support learning within Alaskan high school 1:1 laptop programs?"

An analysis of the survey data will test the null hypotheses relevant to the study question:

- "There is no relationship between instructional philosophy and the way teachers use technology to support learning within Alaskan high school 1:1 laptop programs."

Open-ended questions embedded within the primary and follow-up surveys, as well as information derived from related research, provided a solid foundation of qualitative data to support the development of a grounded theory. The grounded theory will help elucidate the relationships between teaching philosophy, the use of technology, culturally based instruction and teaching strategies for 21st century skills. The qualitative questions were broad enough to allow the development of theory to proceed with minimal bias while still being focused enough to collect data relevant to further research questions:

- "How does access to a 1:1 classroom affect a teacher's instructional philosophy or practice?"
- "Does access to a 1:1 digitally enhanced teaching environment facilitate the use of instructional practices consistent with Alaska Native and 21st century learner outcomes?"

1.6 Alaska Native Cultures

The phrase "Alaska Native" will often be used to refer to Alaska's indigenous cultures. This designation is used for literary convenience rather than as an inference that the diverse cultures of Alaska's Native people can be generalized into a single voice. When appropriate, specific cultural names will be used to identify cultural groups. While

each culture in Alaska has distinct histories, languages, traditions, worldviews and knowledge systems, they do share common values that unite them. Athabaskan leader Will Mayo expanded on this theme as he recognized a shared set of values that supersedes the visible differences between Alaska's Native cultures:

> As an Athabascan child, I became aware of the differences between the various Native peoples and did not realize that there were far more instances of shared values and beliefs... The similarities are easily matched by the ways in which the tribes differ. These differences are seen in any number of striking examples, such as language, dance styles, clothing styles and art, to name a few. Still these are to me just different manifestations of the same core values that bind together Alaska's native peoples. (Corral & Mayo, 2002, p. 13)

The use of the term Alaska Native also recognizes the difference and variation within a culture. Reyhner (2006a) writes:

> Native students today vary from traditional to assimilated. Some are bicultural, capable of moving back and forth from white to traditional Indian culture. Because of the tremendous variation among Indians of different tribes and different degrees of assimilation, it is impossible to study "the Indian" and determine what is the best instructional approach for them. (p. 21)

The references to Alaska's rural schools are equally general. Rural schools are diverse in history, demographics, philosophy, and academic performance. Each has a unique character. However, rural schools face many common challenges and opportunities.

1.7 Respecting Cultural Knowledge

The "Guidelines for Respecting Cultural Knowledge" (Alaska Native Knowledge Network, 2000) were approved by a representative group of Alaska Natives to guide researchers exploring topics related to Alaska Native culture. Because the present study asks questions relevant to the interests of Alaska's Native community, it was considered necessary to evaluate the survey design to ensure that it conformed to both the word and the spirit of the code. The data-collection methodology for this study will not seek to collect cultural knowledge by interview or survey. Further, collection of Alaska Native

historical or cultural knowledge that is collated in this study will come from previously published sources. Therefore under the Alaska Native Knowledge Network guidelines, it was not necessary to seek a formal memorandum of research for this project. However, in the spirit of respect, recognized Alaska Natives and educators were consulted during the design of this research program.

1.8 Limitations of the Study

The goal of the study is to construct meaningful and accurate conclusions from the data (Creswell, 2007). In pursuit of this goal, every decision has been influenced by the question, "How will this decision affect the validity and reliability of the conclusions?" Careful adherence to accepted standards of both ethics and research protocols is a major objective of scientific research.

It is important to avoid projecting conclusions beyond what the scope of the study design and the data can support. The response to the survey represents a sample of the population of 1:1 high school teachers in thirteen rural districts and an even smaller sample when compared to the entire population of Alaska's high school teachers. While the study conclusions may invite connections to the broader population, it will be prudent to limit these to the population being sampled. It is more important to define conclusions that are strongly supported by the data than to make broad generalizations that weaken the construct validity of the entire study. A comprehensive literature review embeds the study within the framework of Alaska educational research, particularly as it applies to Alaska Native education.

Chapter 2: Literature Review

The literature review explores the complex relationship between teaching style and the applications of technology selected by a teacher to encourage learning in Alaska's 1:1 classrooms. Five major themes guided the scale and scope of the research: 21st century skills, Alaska Native education history - practices and outcomes, learning, teaching and digital learning technology. The extensive literature foundation was necessary to embed the study questions and conclusions within the context of contemporary issues in education reform.

While the study questions explore the simple relationship between teaching style and the use of technology for learning, the nature of this relationship will ultimately determine the quality, pace and efficacy of efforts to transform education into a 21st century model. Digital learning technologies (DLT) are well suited to connect Alaska Native and Western systems of education into a model that treats Alaska Native cultures as a senior partner in a new relationship (R. Barnhardt, 2005a). Digital learning technologies also have the potential to revitalize Western educational practices - to develop student-centric constructivist classrooms that build on a rigorous body of knowledge that students will need to prosper in the unpredictable world of the 21st century (Bentley, 2003; Collins & Halverson, 2009). The key to unlocking this technology in education is held by the classroom teacher who can (a) invite technology into the classroom, (b) ignore DLT, or (c) refuse entry and slam the classroom door. Teaching style is the gatekeeper of this critical pathway to reform. Research is devalued if it is not contextually anchored to relevant issues. The extensive review of Alaska Native education is necessary to contextually embed this study in the contemporary education challenges in Alaska. *Figure 3* provides a graphical representation of the research landscape that hosts the study.

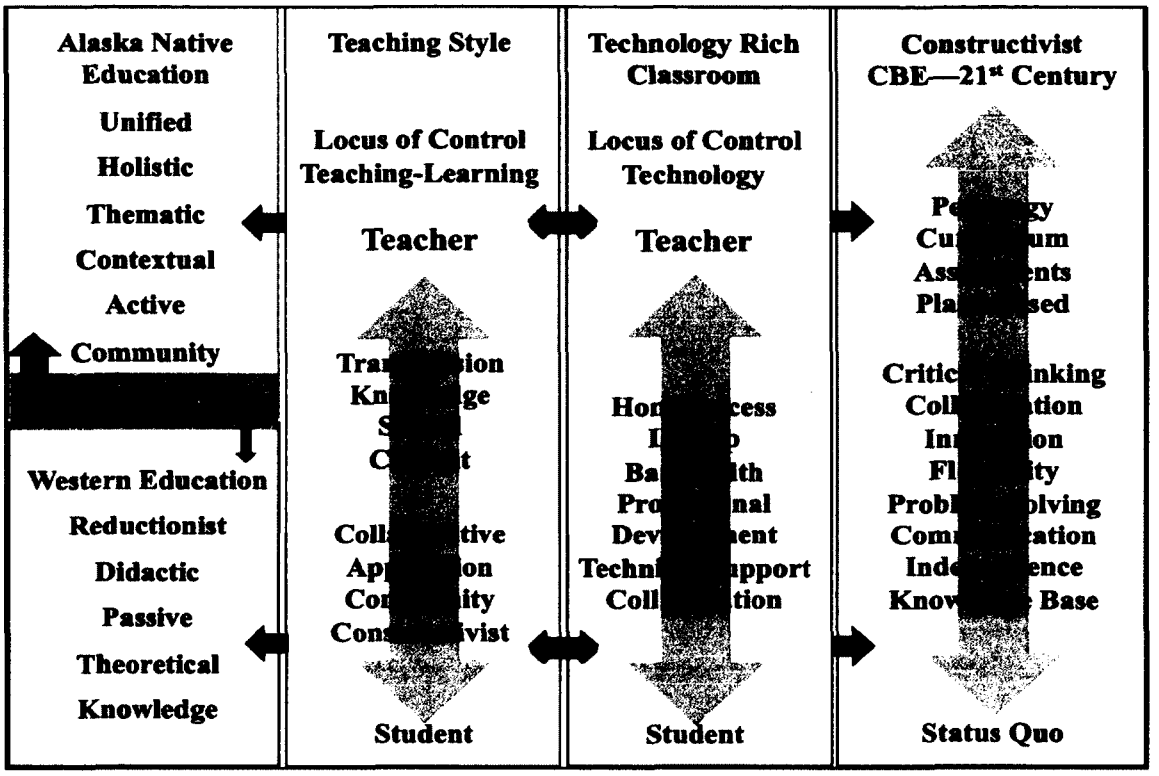

Figure 3. The research landscape. The relationship between a 1:1, technology rich classroom and teaching style is graphically embedded within broader efforts to transform education into a model sufficient to meet the needs of all 21st century learners. Culture-based education is represented by the acronym "CBE".

This literature review focuses on the philosophies and the methods appropriate to both quantitative and qualitative research; research relevant to the causal correlation between teaching styles and the use of DLT. This provided a foundation for examining the relationship between IT moderated, student-centric instructional practices as well as the knowledge, skills and attitudes expected of both Alaska Native and non-Native students.

The review was of sufficient scope and depth to support the formulation of a phenomenological theory and yet specific enough to guide the direction of the study and to inform decisions related to the transformation of research data into information relevant to the study questions. Over 700 studies, peer reviewed papers, reports, books and other documents were reviewed and evaluated over the course of the study. The review begins with an analysis of 21st century skills and outcomes.

2.1 Twenty-First Century Skills

Twenty-first century skills will require a renewed emphasis on the application and processing of knowledge. Burkhardt et al., (2003) suggest that technology is both an agent of change and a tool to manage it: "Technology changes the way the world works. As technology evolves, so must the skill sets of those who use it. In order to remain competitive tomorrow, today's students need to develop techniques that readily adapt to changes as they occur" (p.1). The phrases "twenty-first century" and "high order" refer to those competencies necessary for students to become self-motivated learners (Casner-Lotto & Benner, 2006; Jerald, 2009). The Partnership for 21st Century Skills (2008) groups these skills into three categories: "(a) creativity and innovation; (b) critical thinking and problem solving; (c) communication and collaboration (p. 2).

The Partnership for 21st Century Skills (2008) argues that: "The nation needs to do a much better job teaching and measuring advanced, 21st century skills that are the indispensible currency for participation, achievement and competitiveness in the global economy" (p. 10). Dede (2007) describes them as the: "core capabilities people will need in the first part of the 21st century – say fifteen to thirty years hence – to qualify for an attractive, prosperous job and lifestyle" (p. 3). Casner-Lotto and Benner (2006) compares the basic knowledge emphasized in current education practice with the applied skills prioritized as 21st century outcomes in Table 1.

Twenty-first century skills are not the result of a high tech recalibration of contemporary standards, a new advance in cognitive research or the ascension of a new epistemological framework. They represent the reconciliation of knowledge with the cognitive attributes transforming them into action. Creativity, innovation, critical thinking, problem solving, communication and collaboration—long side-lined by a knowledge-focused industrial era educational system—must be reintroduced into education to bring meaning to the highly competitive workforce of the 21st century. High order skills are not the endpoint of education; they represent cognitive mechanisms. It is understanding that provides the capability to prosper in the future. Dede (2007) argues: "Categorizing what students need for the 21st century as understandings based on

Table 1

News Skills for the 21st Century.

Basic Knowledge	Applied Skills
English Language	Critical thinking/Problem Solving
Reading Comprehension	Oral Communication
Writing in English	Written Communication
Mathematics	Teamwork/Collaboration
Science	Appreciation of Diversity
Government/Economics	Information Technology Application
Humanities/Arts	Leadership
Foreign Languages	Creativity/Innovation
History/Geography	Lifelong Learning/Self-Direction
Professionalism/Work Ethic	Ethics/Social Responsibility

Note: Adapted from Casner-Lotto and Benner, (2006)

interwoven content knowledge and process skills is a more accurate depiction of how the mind works than the separation between these that current frameworks typically impose, and how students actualize those understandings in practice or performances" (p. 4).

The education system envisioned for the 21st century is not a new vision. Alaska Natives and other indigenous cultures have been effectively teaching for thousands of years. These skills not only informed the decisions necessary to survive in dangerous environments, they affirmed the connections between knowledge and meaning that defined their culture's worldview. Retooling Western educational practices and outcomes to reflect a new emphasis on understanding will help to heal the schism that has divided Western and Alaska Native systems of education. "Our challenge now is to devise a system of education for all people that respects the epistemological and pedagogical foundations provided by both indigenous and Western cultural traditions" (R. Barnhardt & Kawagley, 2005, p. 9).

Schools are ill-equipped to facilitate the transformation from a knowledge-centric, theoretical environment to a learning atmosphere providing opportunities to practice the high order cognitive skills. These skills are not learned from books or from teachers; they

are acquired through direct experience. The introduction of complex software allowing students maximum control over the application provides a venue mimicking real-life experiences. These constructivist digital applications are of particular use to Alaska Native students because their cultural values can be integrated into the learning experience.

The integration of digital learning technology (DLT) into instruction is a key element in strategies to reform education. DLT can provide the opportunity for teachers to create a student-centric learning environment with the freedom to engage in higher order skills such as creativity, innovation, critical thinking, problem solving, communication and collaboration. Teachers will integrate DLT into teaching styles while students will integrate DLT into their individual learning styles.

In the past, the potential for information technology to assist in educational reform has been limited by access to the basic IT infrastructure and staff resources necessary, as well as the beliefs and teaching styles of teachers. One-to-one laptop computer programs eliminated access and resource barriers, leaving teaching style identified as the keystone to effective information technology-based education reform. The chance to take advantage of what R. Barnhardt and Kawagley (2006) describe as opportunities at the edge of chaos, to create an information technology assisted, student centric learning environment, is primarily dependent on each teacher's willingness to integrate technology into instruction and the adoption by students of information technology into their learning styles. The research questions will explore this relationship.

2.2 Alaska's Native Cultures

The history of Alaska's indigenous cultures did not begin when German naturalist George Steller stepped ashore on Kayak Island near Mount St. Elias on July 20, 1741. It began perhaps as much as 16,000 years earlier as bands of emigrants from Asia moved through the vast plain known as Beringia, the land bridge that connected Asia with North America (Goebel, Waters, and O'Rourke, 2008). While the exact origin and timing of this migration remains a subject of debate, archaeological, linguistic and molecular evidence

increasingly supports a southward migration into North and then South America reaching back almost 16,000 years ago (Alaska History and Cultural Studies, 2012). *Figure 4* shows the geography of the major cultural traditions resident in Alaska.

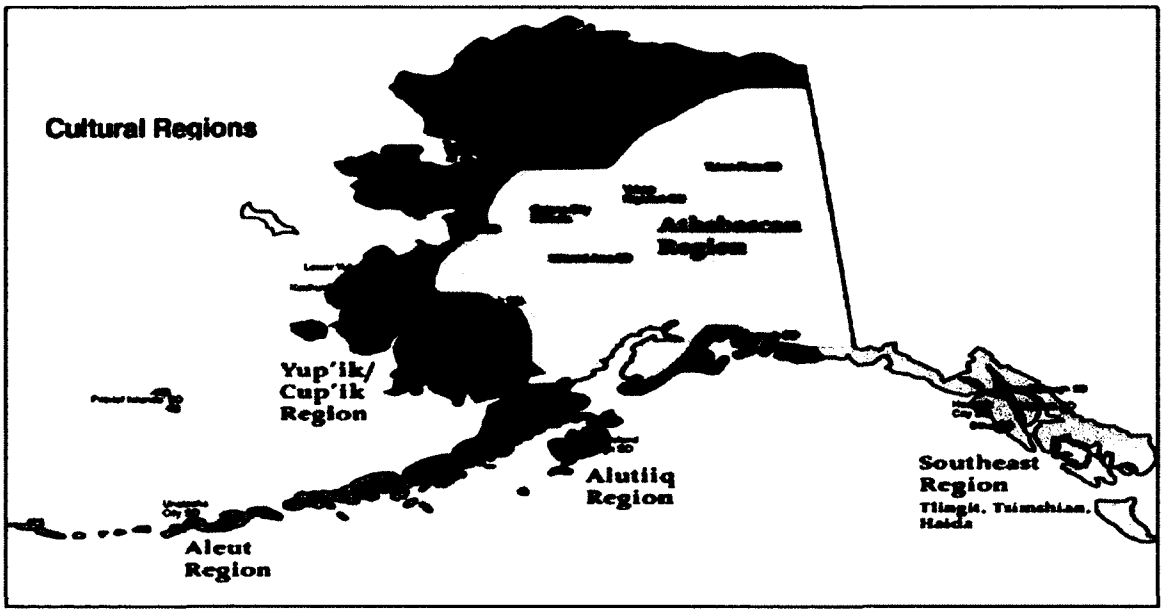

Figure 4. Map of Alaska's major cultural regions. Adapted from R. Barnhardt, (2005a).

Most scientists believe this migration eventually resulted in the population of both American continents. A number of anthropologists believe that subsequent Asian migrations into Alaska brought the ancestors of the Athabaskan/Tlingkit and the Aleut/Eskimo peoples. Goebel et al. (2008) suggest that the Aleut and Eskimo populations of Alaska, based upon genetic sampling and archaeological evidence, are the result of a separate late-Pleistocene migration from northeast Siberia. The recent discovery in central Alaska of the remains of a child estimated to be 11,500 years old may provide more information related to the cultural heritage and geographic origin of these early Alaskans (Potter, Irish, Reuther, Gelvin-Reymiller, & Holliday, 2011).

As these first Alaskans spread throughout the state they learned to adapt to the specific environments that they settled in (Naske & Slotnick, 1987). Over time, distinct cultures emerged with varied languages, knowledge systems, traditions and beliefs. The Alaska Native Heritage Center (2010) has identified five major indigenous cultures in Alaska: (a) Athabaskin, (b) Yup'ik and Cup'ik Eskimo culture, (c) the Inupiaq and St.

Lawrence Island Yupik culture, (d) the Aleut and Alutiiq culture, and the (e) Eyak, Tlingit, Haida and Tsimshian culture.

Each Alaskan Native culture enjoys a number of unique characteristics: language, dialect, geography and history; yet they also share many analogous values, technologies, skills and beliefs (Kawagley, 2006). There is substantial historical evidence that there were active social and economic interactions between cultures (Alaska History and Cultural Studies, 2012; Alaska Native Knowledge Network, 2006; Townsend, 1970). This is the explanation of their common beliefs related to spirituality, technology and natural history (Alaska Native Science Commission, 2012). The Alaska Native Knowledge Network (ANKN) has identified ten values in Table 2 that are shared by multiple Alaska Native cultures (Alaska Native Knowledge Network, 2005).

Table 2

Shared Values Among Alaska Natives

Shared Values	
Show respect to others	Each person has a special gift
Share what you have	Giving makes you richer
Know who you are	You are a reflection on your family
Accepts what life brings	You cannot control many things
Have patience	Some things cannot be rushed
Live carefully	What you do will come back to you
Take care of others	You cannot live without them
Honor your Elders	They show you the way in life
Pray for guidance	Many things are not known
See connections	All things are related

Note: Adapted from Alaska Native Knowledge Network, (2005 , p. 1).

2.2.1 Western intervention. During Steller's brief exploration of Kayak Island in Island in 1741, he found evidence of a resident indigenous population (R. Barnhardt & Kawagley, 2006; Ford, 1966; Langdon, 1993). Even though he did not make contact with the resident population, Steller accurately linked tools to those used by Eskimo cultures in Kamchatka (Ford, 1966). The design of their tools, the craftsmanship of structures, the technology used with food, and the knowledgeable use of the local flora and fauna all

impressed Steller, who wrote in his journal:

> Under a tree I found an old piece of a log hollowed out in the shape of a trough, in which, a couple of hours before, the savages, for lack of pots and vessels, had cooked their meat by means of red-hot stones, just as the Kamchadals did formerly. I discovered further, not far from the fireplace ... a wooden apparatus for making fire. It was so cleanly and well prepared that I have never seen it as good in Kamchatka. (as cited in Ford, 1966, p. 77)

After further exploration, Steller came upon a cache hidden along a forest trail:

> Utensils made of bark, one and a half ells high, filled with smoked fish...; A quantity of sweet grass from which liquor is distilled; three different kinds of plants, whose outer skin had been removed like hemp...; the dried inner bark from the larch or spruce tree done up in rolls and dried; large bales of thongs made of seaweed which, by making a test, we found to be uncommon strength. Under these I found also some arrows in size greatly exceeding those in Kamchatka... scraped very smooth and painted black, so that one might well conjecture that the natives possessed iron instruments and knives. (p. 79)

The artistry of the artifacts noted by Steller during his ten-hour exploration did not stop him from referring to the indigenous population as "savages" or plundering their food and supply cache. This was an unfortunate but prophetic beginning of an ongoing conflict between powerful Western industrial and Alaska Native hunter-gatherer cultures (R. Barnhardt & Kawagley, 2005; Gaffney, 2011; Kawagley, 2006, 2009; Kawagley, Norris-Tull, & Norris-Tull, 1998).

Steller's use of the word "savages" is consistent with the prevailing idea of "civilizing missions" as moral justification for the colonial exploitation of indigenous populations (Kohn, 2011). By definition, "civilizing missions" assumes that indigenous cultures are less civilized and would benefit from Western cultural intervention. However in point of fact, the Russian tenure in Alaska was largely motivated by economic forces rather than by governmental efforts to "civilize" Alaska Native cultures. Naske and Slotnick (1987) write: "The initiative for Russian expansion and settlement in the New

World came from private individuals and groups, not from the government. Russian America and its interests received little support from the imperial regime" (p. 61). The Russian government, other than supporting the fur trade, did not attempt to colonize Alaska. According to Naske and Slotnick, (1987) "the number of Russians in Alaska was never above 800 and few, if any of those were planning to stay" (p. 61).

2.2.2 Education. The first Western school in Alaska was established by the Russian fur trader Gregor Shelikov in the late eighteenth century on Kodiak Island (Black, 2004). By the time the Russians sold their Alaska holdings to the US in 1867, the Russian church, the Russian American Company and the local Russian government were supporting a number of schools for Alaska Native and Creole children. Although supporting these schools, the colonial government did not have a policy to provide for the universal education of Alaska Natives (Bancroft, Bates, Petroff, & Nernos, 1886; Peratrovich, 1971). The Russian government neither supported universal Native education nor a policy of school-based cultural assimilation however, both these policies characterized subsequent American control over Alaska (Dauenhauer, 1997; Oleksa & Bates, 2007).

The 1867 Treaty of Cession that authorized the transfer of Russia's Alaska claims to the United States did not address the education of "the uncivilized tribes" (Arnold, et al., 1978). The American government was not prepared by law, policy or budget to provide for the education of Alaska's Native people. Chevigny (1966) reported that twenty years after the U.S. purchase of Alaska, the Russian church was spending more on Alaska's schools than the U.S. government. It was not until 1884, seventeen years after Seward's folly, that Congress took the initial steps to provide for universal education in Alaska. The Organic Act of 1884 authorized a civil government for Alaska and appropriated $15,000 for the operation of schools for both Caucasian and Alaska Native children. John Adkins, U.S. Commissioner of Indian Affairs, in his 1889 report to Congress, clearly stated the purpose, process and scope of American Indian and Alaska Native education policies:

The Indians must conform to "the white man's ways," peaceably if they will,

> forcibly if they must. They must adjust themselves to their environment, and conform their mode of living substantially to our civilization. This civilization may not be the best possible, but it is the best the Indians can get. They cannot escape it, and must either conform to it or be crushed by it. (Atkins, 1890, p. 3)

Adkins' forceful statement was consistent with a national Indian reform movement that supported the cultural assimilation of American Indian and Alaska Native cultures into the United States (Haycox, 1984; Swisher & Deyhle, 1997).

In 1885, Sheldon Jackson, a Presbyterian minister, was appointed the federal education agent for Alaska. Ritter (2009) writes: "Jackson's goal was to protect young Natives within a framework of law and, through education, prepare them to cope with modern times" (p. 55). Critics note Jackson's use of government funds to support Christian affiliated contract schools and his rigid enforcement of the federal government's "English only policy" (Haycox, 1984). Dauenhauer (1997) suggested that the suppression of Alaska Native languages under Jackson's tenure irreparably harmed Alaska's Native cultures (Haycox, 1984). Dauenhaur (1997) asks, "What kind of government and educational system takes a culture highly literate [sic] in its own language and deliberately proceeds to eradicate both the language and the literacy?" (P. 19). The fact that the "melting pot" was the cornerstone of America's invitation to the world was of small comfort to peoples that did not immigrate to this country. Haycox (1984) noted that, "Jackson resisted taking native youngsters away from their villages for education and acculturation: (para 5). Jackson's defenders remember his tireless advocacy in providing educational opportunities for Alaska Native people, while the federal government's demand for the suppression of Alaska Native languages during Jackson's tenure remains a bitter legacy of Alaska's assimilative past.

Governmental policies have evolved over time as changing state and national priorities have influenced educational policy-making for Alaska Native students. Historians and educators have defined a number of useful timelines that chronicle the critical events helping to shape education in Alaska (Alaskakool, n.d.; C. Barnhardt, 2001; Darnell & Hoem, 1996; Langdon, 1993; McDiarmid, 1984; Naske & Slotnick,

1987; Ritter, 2009).

The Alaska Native community remembers these events through personal experience as well as written and oral accounts (E. Alexander & Weiser, 2007; R. Barnhardt & Kawagley, 2010; Hensley, 2009; Huntington, 2009; Jackson, 1998; John, 1996; Kawagley, 1999, 2006; Kirkness, 1992; Merculieff, 2010; Metrokin, 1985; Napoleon, 1996; Ongtooguk, 2000; Oquilluk, 1973; Soboleff, 2010; Williams, 2009). Alaska Natives are archiving their voice to ensure that their story is not forgotten (Alaska Native Knowledge Network, 2000). Historical accounts from both Western and Alaska Native perspectives present a more complete understanding of the events that shaped contemporary educational challenges. The lessons gleaned from history are made more powerful when addressed by those seeking mutual understanding.

2.2.3 Impact of Western education policies. For thousands of years, Alaska's diverse Native cultures enjoyed an efficient and stable means of educating the next generation. Alaska Natives passed on their indigenous knowledge from generation to generation with sufficient precision that they were able to thrive in some of the most unforgiving environments on Earth (MacLean, 2010). The development of Alaska Native educational traditions was honed by the collective need to survive under these conditions. If the community's cultural knowledge was not passed accurately to the next generation, the survival of the community was at risk. Jervis (2006) highlights the critical role education plays in the survival of a culture. "All culture is learned; none is inherited. And it is passed on from one generation to the next, which is why schools and families are so important in cultural transmission" (para. 20). The death of an individual provided powerful incentives for an effective system of knowledge transmission or education.

The arrival of Westerners in Alaska had devastating effects on Alaska Natives. Thousands of Alaska Natives died from the disruption of their traditional lifestyles. During the influenza and measles epidemics of 1900 it is estimated that 25% of the Western Eskimo population perished (Wolfe, 1982). The Spanish Influenza epidemic of 1918 killed thousands more (Crosby, 2003). In a pre-literate society, every death represented the loss of unique cultural knowledge while the forced redirection of

traditional lifestyles affected both the integrity of cultural knowledge and the traditional practices used to transmit it to the next generation. A recent blogger commenting on the National Museum of the American Indian wrote: "Losing an Elder is equated with having a library burn up with all its content" (Newman, 2011). It is from this weakened state that Alaska Natives confronted a powerful immigrant culture that used education as a vehicle for cultural assimilation. The history of education in Alaska has been that of a no-limit poker game, with the survival of Alaska's Native cultures being the ante.

Contact with the West also brought cultural attributes at odds with those held by Alaska Natives. "The encroachment of Western civilization in the Yupiaq world changed a people that did not seek changing" (Kawagley, 2006, p. 47). Yupik scholar Kawagley, (1999) wrote:

> The Yupiaq peoples systems of education, governance, spirituality, economy, being and behavior were very much in conformity with their philosophy of life and provided for harmonious living. The people were satisfied with the quality of their life and felt that their technology was in accord with it. (p. 22)

The work of Western educators, while well-intentioned, institutionalized the assimilation of Native cultures into the dominant Western tradition (Darnell & Hoem, 1996). Teachers introduced Native youth to Western cultural elements that were very different from those learned in their community. At the same time, teachers, many of whom were part-time missionaries, discouraged traditional cultural practices at variance with Christian Western cultural norms. Alaska Native education practices that had worked effectively for thousands of years were cast aside by a dominant power intent on assimilation (Atkins, 1890). As a result, traditional education practices became covert and separated from the children's formal education. The dual philosophies of education created by the forced introduction of the divergent Western system continues to confuse and disorient students. "Most of the instruction is from the viewpoint of the Euro-American teacher, and there remains a wide gap between the culture of the child at home and the culture of the child in school" (Kawagley, D. Norris-Tull, & R. Norris-Tull, 1998, p. 138). Children continue to be asked to reconcile two inhomogeneous cultures; one

learned at home and in the community; and another, learned at school (Jordan, 1984). Adults may understand the nature of this complicated mixture but children, at a time when they are developing their learning esteem, can interpret the turmoil between school and home as personal failure (Davidson & Napoleon, 1974; Morotti, 2005; Reyhner, 2006b).

Alaska Native parents are frustrated by a Western-dominated system of education that they perceive as ignoring their cultural knowledge. A mother, speaking at a recent community gathering in a remote Yup'ik village shared her frustration:

> Our children cannot be successful in both the Western and Yup'ik culture. They are forced to choose between learning about their culture or being a good student in school. Either choice leaves them confused, guilty, and angry. My son left high school but he knows his culture. Why can't schools help student do both? Kids shouldn't have to choose. (Anonymous, personal communication, September, 2009)

Yup'ik Elder Harold Napoleon shared his concerns: "Our young people are often not prepared in practical ways to live in either world" (as cited in Davidson & Napoleon, 1974). Napoleon goes on to write:

> It is not our intent to wage war on Western civilization. We merely want to come to terms with it—on our own grounds...We simply treasure our young and our culture. It is our belief that both can live together side-by-side, but not necessarily eating out of the same bowl. We can share potlatches and Christmas together. (p. 242)

Bernice Joseph's 1995 keynote speech to the Alaska Federation of Natives, (as cited in R. Barnhardt and Kawagley, 2010) noted the need for Western education "BUT not at the expense of our cultures" (p. 120). Clearly, Native children cannot learn to stand in both cultures if Western education demands repudiation of Alaska Native cultural knowledge as a prerequisite (R. Barnhardt & Kawagley, 2005).

While educators have long renounced efforts to assimilate Alaska Native youth, the Western philosophical foundation that justified these actions remains subtly

embedded within Alaska's rural schools. The continued emphasis on Western-dominated worldviews marginalizes the Alaska Native traditional ways of teaching (A. Grant & Gillespie, 1993; Kleinfeld, 1979). Further, the subtle nature of the Western bias makes it difficult for Native parents to identify the influence and at the same time problematic for Western educators to filter this out of instructional practice (Kana'iaupuni, Ledward, & Keohokalole, 2011; Wauters, Bruce, Black, & Hocker, 1989). Ongtooguk (2010) noted that a school curriculum should "incorporate an informed Native perspective" (p. 239) to ensure that it will achieve the expectations desired by the Native community it serves.

2.2.4 Alaska Native worldview. The conflict between Western and Alaska's Native education traditions is not seen as a simple disagreement so much as having the hallmarks of a struggle for cultural survival. Acceptance of the Western epistemological paradigm by Alaska Natives requires a concurrent denial of that which defines Alaska Native worldviews. Once the worldview is lost, the traditions, stories and knowledge of the culture will become artifacts rather than reflections of a vibrant and vital society.

Kawagley (2006) in his book "A Yupiaq Worldview" described Yupiaq worldview as "the principles we acquire to make sense of the world around us" (p. 7); "a summation of coping devices that have worked in the past and may or may not be as effective the present"; (p. 8); and "a synthesis of information gathered from interaction with the natural and spiritual worlds so as to accommodate and live in harmony with natural principles and exhibit the values of sharing, cooperation and respect" (p.11). Kawagley (2006) noted that the Yupiaq worldview shares many fundamental beliefs with other Alaska Native cultures. Royal (2002) provides further insight into the nature of worldview. "Cultures pattern perceptions of reality into conceptualizations of what they perceive reality to be; of what is to be regarded as actual, probable, possible or impossible" (p. 2).

Kawagley (2006) used a tetrahedron as shown in *Figure 5* to describe the dynamic relationship between the natural, spiritual, human realms and worldview in Yupiaq culture.

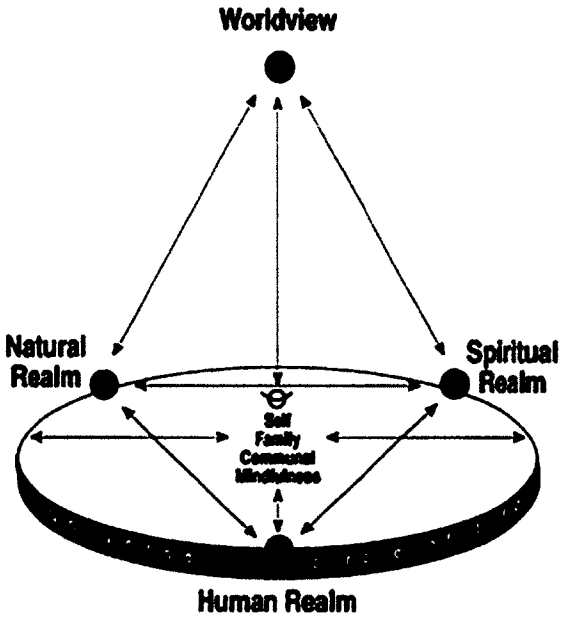

Figure 5. Yupiaq universe: Unity with the natural, human and spiritual realms. (adapted from Kawagley, 2006, P.16).

Kawagley (2006), "allows for triangulation whereby human beings can locate themselves in relation to the other domains of their existence and check to make sure that the values and traditions are in balance" (p.16). The realization of worldview provides concurrent awareness of an individual's place in the world. In Yupiaq culture, every action must be considered carefully because it may adversely affect other facets of the natural, human or spiritual environment. Table 3 highlights the differences between Western and Alaska Native worldviews.

2.2.5 Indigenous knowledge systems. Hammersmith (2007) suggested that indigenous knowledge is "both the content and context of intricate knowledge systems acquired over generations by Indigenous communities as they interact with their environment" (p. 26). Given meaning by the circular universe defined by Kawagley (1995), cultural knowledge forms a feedback system with the culture's worldview. Indigenous knowledge is contemporary in that it evolves and adapts in accordance with the beliefs, values and worldview of the culture (Kawagley & R. Barnhardt, 1998).

Table 3

Contrasts Between Alaska Native and Western Worldviews

Indigenous Worldviews	Western Worldview
Spirituality is imbedded in all elements of the cosmos	Spirituality is centered in a single Supreme Being
Humans have responsibility for maintaining harmonious relationship with the natural world	Humans exercise dominion over nature to use it for personal and economic gain
Need for reciprocity between human and natural worlds - resources are viewed as gifts	Natural resources are available for unilateral human exploitation
Nature is honored routinely through daily spiritual practice	Spiritual practices are intermittent and set apart from daily life
Wisdom and ethics are derived from direct experience with the natural world	Human reason transcends the natural world and can produce insights independently
Universe is made up of dynamic, ever-changing natural forces	Universe is made up of an array of static physical objects
Universe is viewed as a holistic, integrative system with a unifying life force	Universe is compartmentalized in dualistic forms and reduced to progressively smaller conceptual parts
Time is circular with natural cycles that sustain all life	Time is a linear chronology of "human progress"
Nature will always possess unfathomable mysteries	Nature is completely decipherable to the rational human mind
Human thought, feelings and words are inextricably bound to all other aspects of the universe	Human thought, feeling and words are formed apart from the surrounding world
Human role is to participate in the orderly designs of nature	Human role is to dissect, analyze and manipulate nature for own ends
Respect for elders is based on their compassion and reconciliation of outer- and inner-directed knowledge	Respect for others is based on material achievement and chronological old age
Sense of empathy and kinship with other forms of life	Sense of separateness from and superiority over other forms of life
View proper human relationship with nature as a continuous two-way, transactional dialogue	View relationship of humans to nature as a one-way, hierarchical imperative

Note: Adapted from Knudtson and Suzuki, 1992, p. 13-15 (R. Barnhardt & Kawagley, 1998).

Archival literature, found in the journals of early explorers, missionaries, governmental officials and teachers, provides detailed descriptions of indigenous languages, dances, art forms, tools, social traditions, and other external cultural expressions. But the literature is relatively silent regarding expressions of deep cultural knowledge: values, beliefs and connections to place (Aldrich, 1891; Cracroft, 1981; A. Harris, 1996; Jackson, 1998; Jenkins, 1945; Muir, 1998; Wickersham, 1938; Wood, 1882).

The "civilizing mission" of the Westerners provided the justification and impetus to supplant local culture in the name of a superior civilization. Brendtro, Borkenleg, and Bockern (1990) summarize the early Western view of indigenous knowledge:

> The accumulated scientific, medicinal and technological knowledge acquired and passed down for thousands of years was ignored, patronized or discounted. Indians were conquered by militarily and technologically superior European invaders who saw them as primitive peoples who had much to learn but little to offer to a modern society. (p. 44)

It is only in the last several decades that Western governments have recognized the value of indigenous knowledge (United Nations, 2008). Until there is a mutually respectful reconciliation between Western and Alaska Native beliefs, efforts to develop an integrated model of education will continue to be peripheral rather than systemically transformative (R. Barnhardt, 2005b).

The design of an integrated approach to education must begin with a deeper understanding of Alaska Native knowledge. The purpose of Alaska Native education has not changed through the centuries, "A child's realization of a worldview consistent with their resident culture can be considered as the primary outcome of indigenous education" (Kawagley, 1995, p. 59). Stories, songs, dancing, language, sacred practices and other expressions of culture reflect the reciprocal relationship between Alaska Native people and their land (R. Barnhardt & Kawagley, 2005; Cajete, 2000; Kawagley, 2006). While the exclusion of indigenous knowledge from education will weaken the bonds that tie Alaska Natives to their land, the loss of the land will sever the connection between the

culture and the land that gave it meaning.

2.2.6 Indigenous ways of knowing. Indigenous knowledge is the sum of the knowledge, beliefs, technology and values that define a culture's relationship with the land. "Yupiaq knowledge systems are based on observation of the natural world coupled with direct experimentation in the natural setting" (Kawagley, et al., 1998, p. 39). Kawagley (1995) describes science as a "quest for knowledge" (p. 58). Kawagley's view represents a major difference between Western science that acquires knowledge as a byproduct of hypothesis testing rather than as a search for knowledge and meaning. Cajete (2000) defines Native knowledge as "a story, an explanation of the ways of nature and sources of life, embedded in the guiding stories of a people and the language and way of life that convey their stories" (p. 74). It is the depth of the relationship between indigenous knowledge and place that has allowed Alaska's Native cultures to weather the forces of assimilation and acculturation (R. Barnhardt & Kawagley, 2005; Kawagley, 2006). Kawagley (1998) notes the adaptability of Alaska Native culture: "This survival continues as Yupiaq values, beliefs, practices and problem-solving strategies are modified and adapted to fit contemporary political, educational, economic, social, and religious institutions" (p. 91). R. Barnhardt & Kawagley (1998) highlighted the relevance of traditional knowledge in the modern world:

> Indigenous peoples throughout the world have sustained their unique worldviews and associated knowledge systems for millennia, even while undergoing major social upheavals as a result of transformative forces beyond their control. Many of the core values, beliefs, and practices associated with those worldviews have survived and are beginning to be recognized as being just as valid for today's generations as they were for generations past. (p. 1)

While Alaska Native knowledge systems have undergone substantial change in response to Western influence (Bielawski, 1990), cultural knowledge retains a strong influence on Alaska's Native people and on their children (R. Barnhardt, 2009). Aleut Llarion Merculieff (2010) wrote about the strength of his culture:

> Despite daunting challenges to cultural integrity and ways of life, Alaska's Native

> peoples retain vast storehouses of their traditional knowledge, wisdom, and lifeways. Thus, many traditional Alaska Native lifeways and understandings about how human beings fit into the bigger matrix of creation remain relatively intact. These ways have allowed our cultures to survive and thrive for thousands of years, even in the face of many daunting ecological and economic crises. (p. 2)

Tlingit Elder Dr. Soboleff, when asked about the loss of Alaska Native language and cultural knowledge, referred to the unseen deep culture:

> The visible parts of our culture or what most non-Natives see, including our language, our dance and music and our traditions will eventually fade. We know that, but that part of our culture that you cannot see; that is in the heart, the part that connects us as Natives. That will not pass away. It is who we are. (D.W. Soboleff, personal communication, 2009)

Kawagley (1995) quoting a Yupiaq Elder, wrote: "The majority of prime land is owned by newcomers, but the few real Yupiaqs are still vigorously Yupiaq. You can educate us, change our dress, change our ways, but we still have black hair, brown eyes, yellow skin, language, and are Yupiaq as hell" (Kawagley, 1995 p. 84). The nature-based consciousness of Yupiaq society provides the basis to adapt to a changing environment without losing their identity as a culture (Kawagley, 1995).

R. Barnhardt (1990) in his case study of St. Mary's place-based education program, noted the deep ties that unite the Yupiit: ". . . being Yup'ik Eskimo also means a way of thinking, a way of seeing, a way of behaving, a way of doing things, and a way of relating to the world around them" (p. 65). R. Barnhardt (2005a) uses the structure of an iceberg as a metaphor to convey the difference between external culture that can be observed and internal culture that cannot. Alaska Native cultures maintain a strong cultural identity. This identity and the cultural practices that support it are passed on to children in traditional ways: story, observation and practice, play and direct instruction.

2.2.7 Culturally consistent framework for education. Inupiat scholar Ongtooguk (2000) summarizes the challenges faced by Alaska Natives as they move to reconstruct an indigenous education model that is culturally consistent with their worldview, ways of

knowing and methods of teaching.

> Decades of changes in society coupled with the demands of compulsory education mean that traditional learning and ways of learning have been obscured and many pieces have been lost. While there are some obvious elements still in place, they tend to be fragmented and are seldom recognized as portions of an entire way of learning. (para 8)

Indigenous cultures often view time and history as cyclic, where the past and future are connected by the present into a circle of life (Kawagley & R. Barnhardt, 1998). Elders play a critical role in this circle by connecting the knowledge and wisdom of past generations to new generations. Within this capacity, Elders continue to act as interpreters of cultural wisdom and knowledge. Ramoth-Sampson (2012) writes: "Whenever younger people were around, older people had the responsibility of giving them *algaqsruun* (advice). Such advice included being respectful of Elders" (p. 43). Graves, et al. (2005), described the role of Elders in education:

> Elders take on the role of instructors and leaders within the oral tradition, teaching values. The values are intrinsically connected with becoming a healthy human being and assist with maintaining a positive life-path and balance and harmony with the natural world. The Elders stress the importance of mindfulness and learning by observation, which are components of the tradition of listening. Elders intuitively know when balance is needed and they will restore the balance by singing a song and/or telling a story. (p. 12)

Many of today's Elders are just one conversational generation removed from pre-Western Alaska Native cultures. These Elders learned from adults who learned their traditional ways before the arrival of Western cultural interference. Labelle and Peden (2003), writing about the indigenous peoples of Canada, noted that "the aboriginal method of educating children has been nurtured through thousands of years and is still found today in the oral traditions and cultural practices of Aboriginal peoples" (p. 13).

The same is true for Alaska's Native people. In a 2005 study of Elder abuse, (Graves et al., 2005) Elders were asked to describe their role:

> When I was growing up, I may not remember my grandmother completely, but I remember being held and being told stories. Naturally, I always fell asleep but that is how I learned some of my stories by being held in my grandparent's lap and hearing our lessons ...I wish that would continue..." (p. 5); "Teach what they know, teach younger people to sing Native songs. Tell them old stories, how they used to be back then. (p. 5)

The knowledge held by Elders represented the cornerstone of Pre-Western Alaska Native Education. Elders maintained a special relationship with youth who were taught the knowledge and wisdom of Elders. Leonard (2007) writes: "The construction of knowledge, and the passing on of this knowledge through oral and written traditions becomes an inter-cultural endeavor between older and younger generations" (p. 35). Inupiaq writer Wells (1974) wrote: "Ipani Eskimo stories are often told to the younger generation so they might know what to do in case of an emergency....During these cold winter months it is always good to remember the advice of the old folks" (p. 1). While the effects of assimilation have compromised this relationship, Elders have resisted attempts to marginalize their continuing responsibility to convey culture to the next generation. Changes in context have not diminished either the responsibility or the key role Elders play in education. Elders continue to honor their responsibility as educators:

> We have turned over the education of our children to people that have no concept of how to be a human being and how to relate to all of creation, yourself, your community, all of creation, all animals, plants, birds, fish, water and how everything is connected. We have not followed the direction of our ancestors on how to be teachers. My grandparents' generation was the last of the real Native teachers". (Aloysius, 2005, p. 1)

Another Elder comments: "...We need to remind them about our ways for future generations to survive. Before we as Elders die off, we need to share and pass on your Yup'ik traditions and ways of life to the younger generation. We are all they have left to pass and maintain our ways..." (Graves, et al., 2005, p. 6). Clearly, Elders continue to represent a relevant source of information regarding early Alaska Native education.

Traditional teaching "approaches emerged from cultures where the central purpose of life was the education and empowerment of children" (Brendtro et. al., 1990 p. 33). It is no surprise that Indigenous populations around the world share a common set of teaching methods that encourage emulation (R. Barnhardt, 2005b; S. Harris, 1980; Hughes & More, 1997; Pewewardy, 2002; Toulouse, 2008). Ongtooguk (2000) provides a glimpse of several traditional teaching methods that could be used to prepare a youth for hunting in a contemporary Inupiat community: (a) "observation and trial", (b) "immersion in stories and customs", (c) "apprenticeship", (d) "community-based learning", and, (e) "play" (p. 8). While these strategies focused on hunting, they provided a framework to ensure that a child learned important values. Learning activities were embedded within a framework that emphasized the relationship with place. Professor Kawagley (1995) affirms, "Young people learn these principles including values, traditions, and customs, from myths, legends, stories, family, community, and examples set by leaders" (p. 7). The evidence suggests that regarding this culturally consistent framework for education, there was no artificial separation between the formal processes of learning and application of learning in daily life.

Several assumptions can be inferred regarding pre-Western methods of education. First, Indigenous cultures were certainly aware that survival was dependent on the effectiveness of education. To this end, little was left to chance; the methods, content and instructional responsibilities of education were embedded in cultural life (Ongtooguk, 2000). The evolution of complex Alaska Native cultures shows that educational activities were effective in transmitting indigenous knowledge necessary for a subsistence lifestyle.

Active participation in various cultural activities provided avenues for youth to learn and adults to share knowledge. Learning was not restricted to a specified stage of life. Survival of an individual was linked to learning, and survival of the community was linked to teaching. Parents, relatives, Elders and the community at large modulated learning activities as they occurred in real time. The endpoint of learning was mastery rather than achieving a minimum passing score.

Thirdly, the development of strategies for problem solving was as critical to

survival as the acquisition of raw knowledge (King, et al., 1998). Children not only had to master the subject matter, they had to learn how to interpret changeable details within it and to make relevant decisions directly affecting their survival (Lewis & Smith, 1993; Wallis, 1994).

Finally, Alaska Natives were motivated by a communal purpose in their endeavor to survive and prosper. To this end, every member of a community had to communicate effectively and work collaboratively for the collective good. A unified purpose served to motivate youth to acquire the skills necessary to sustain their families and to contribute to the community. Learning was both an avenue of survival and a gateway to a revealed life. An education system composed of motivated participants committed to a common outcome is a clear goal of Western education, and the hallmark of traditional Alaska Native education.

2.2.8 Culture-based education. Constructing an integrated learning environment that affirms Alaska's Native education practice while preparing students to subsume Western content continues to challenge Alaskans. A cultural divide separates the school from an Alaska Native child's environment at home and within their local community (Lipka, 1994; Lipka & Adams, 2004). R. Barnhardt & Kawagley (2005) suggest that common beliefs shared by both Western and Alaska Native cultures can connect the pedagogical traditions of both cultures (Alaska Science Standards, 2006; R. Barnhardt & Kawagley, 2005; Stephens, 2003). Table 4 highlights some differences and areas of commonality between Western and Alaska Native worldviews.

Kawagley et. al., (1998) writes that an integrated approach is possible, but only if it is constructed upon an Alaska Native epistemological framework. Alaska Native blogger Aqukkasuk (2011) posted the same:

> The intention of any school system operating in Alaska Native communities today must be to produce .... individuals rooted in their respective languages, cultures and communities and whose primary function is to safeguard what is essential to our cultural continuity while navigating the course forward for future generations. (para 2)

Table 4

Common Ground--Connecting Alaska Native and Western Worldviews

Traditional Alaska Native Knowledge	Common Ground	Western Science
	Organizing Principles	
• holistic • includes physical and metaphysical world linked to moral code • emphasis on practical application of skills and knowledge	• **universe is unified** • **body of knowledge stable** • **but subject to modification**	• part to whole • limited to evidence and explanation within physical world • emphasis on understanding how
	Habits of Mind	
• trust for inherited wisdom • respect for all things	• **honesty, inquisitiveness** • **perseverance** • **open-mindedness**	skepticism
	Skills and Procedures	
• practical experimentation • qualitative oral record • local verification • communication of metaphor and story connected to life, values, and proper behavior	• **empirical observation in natural settings** • **pattern recognition** • **verification through repetition** • **inference and prediction**	• tools expand scale of direct and indirect observation & measurement • hypothesis falsification • global verification • quantitative written record • communication of procedures, evidence and theory
	Knowledge	
• integrated and applied to daily living and traditional subsistence practices	• **plant and animal behavior, cycles, habitat needs, interdependence;** • **properties of objects and materials;** • **positions and motion of objects;** • **cycles and changes in earth and sky**	• discipline-based • micro and macro theory (e.g. cell biology & physiology, atomic theory, plate tectonics, etc.) • mathematical models

Note: Adapted from (Stephens, 2003, p. 11)

A growing body of research shows the importance of systemic integration as a critical element of reform (Alaska Native Indicators, 2005; R. Barnhardt, Hill, & Kawagley, 2006; R. Barnhardt & Kawagley, 2005; R. Barnhardt & Kushman, 1999, 2001; Congress, 1996; Goto, Irvin, Sherry, & Eberhart, 2004; Jennings, 2004; Native Perspectives, 2003; Oleksa & Bates, 2007; Stevens & Chenault, 2011). Collectively these

varied recommendations share a common theme: reform initiatives will not be successful unless the locus of decision-making in their education is repatriated back to Alaska Natives. Integrating these two education traditions will require concurrent recognition of the integrity and legitimacy of both cultures. If communities are going to become collaborative partners in the educational system they must be allowed to be equally active participants (Battiste, 2005; Bryk & Schneider, 2004; Hensley, 1981; Hopsen, 1975; O'Neill, 2010). Systemic integration should not be interpreted as a euphemism for cultural assimilation; neither is it an attempt to prepare students of either culture to stand equally in both. R. Barnhardt (2005a) provides a graphic in *Figure 6* that portrays the evolving relationship between Western and Alaska Native methods of education.

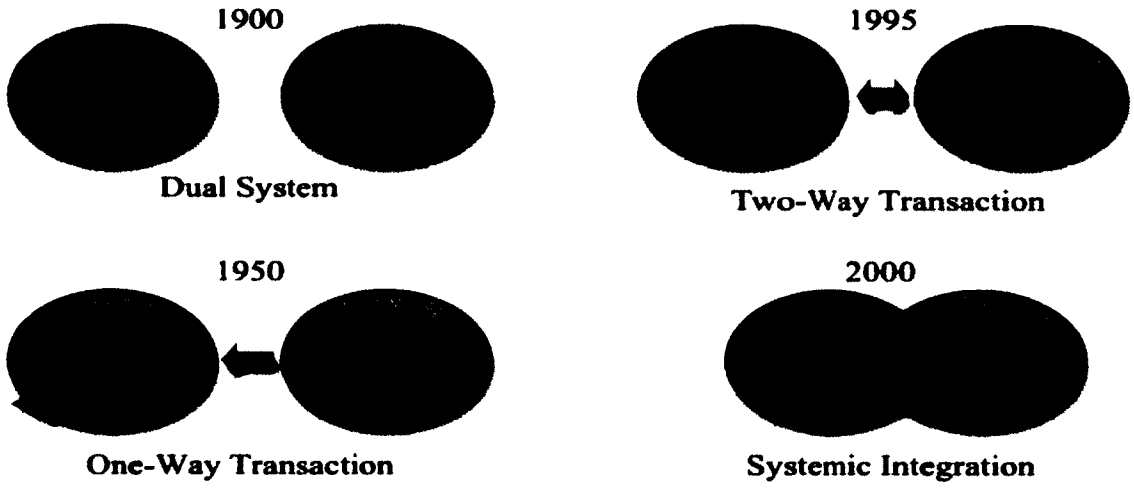

Figure 6. Evolution of Western and Alaska Native education policy. Adapted from R. Barnhardt (2005a).

These methods, in all their forms, have left students culturally confused and often unprepared to successfully engage in either culture (Brayboy, Faircloth, Lee, Maaka, & Richardson, 2012). Alternatively, schools in an integrated model build upon the cultural teaching foundations established within Alaska Native homes and communities. An Alaska Native learner must realize a personal cultural identity of sufficient maturity to explore the content of Western education. Brayboy (et al., 2012) suggest that "the continuation of our cultures and languages, the survival and prosperity of our peoples, and the protection and sustainability of our lands and resources" are dependent on

education CBE [Culture Based Education] programming (p. 98).

Kana'yiaupuni (2007) defines culture based education (CBE) as "the grounding of instruction and student learning in the values, norms, knowledge, beliefs, practices, and language that are the foundation of an indigenous culture" (p. 1). CBE is designed to achieve cultural balance as suggested by Hughes and More (1997). Gollnick and Chinn (2009) argue that CBE "affirms the cultures of students, views the cultures and experiences of students as strengths, and reflects the students' cultures in the teaching process" (p. 380). Demmert & Towner (2003) define six elements that should be included in a CBE program:

- Recognition and use of Native American .... languages;
- Pedagogy that stresses traditional cultural characteristics and adult-child interactions as the starting place for one's education;
- Pedagogy in which teaching strategies are congruent with the traditional culture as well as contemporary ways of knowing and learning;
- Curriculum that is based on traditional culture, which recognizes the importance of Native spirituality, and places the education of young children in a contemporary context;
- Strong Native community participation in educating children and evident in the curriculum, planning, and operation of school/community activities; and,
- Knowledge and use of the social and political mores of the community. (p. 9)

The relationship between CBE and student achievement remains unclear. A number of studies have identified some correlation (Demmert & Towner, 2003; R. Barnhardt, Hill &, Kawagley, 2006; R. Barnhardt & Kushman, 2001; Kana'iaupuni, et al., 2011; Kisker et al., 2012; Lipka & Adams, 2004; Lipka, et al., 2005; Lipka, Sharp, Adams, & Sharp, 2007) between culturally integrated learning and student achievement. Other researchers, (August, Goldenbert, & Rueda, 2006) argue that there is not sufficient reliable data to establish a positive link between CBE and student achievement. However, (Kisker et al., 2012) reported significant gains in performance among second grade students randomly selected to participate in a culturally tuned math program.

Achievement is more evident when pedagogical process is consistent with a child's cultural experiences. According to Brayboy et al. (2012) a CBE environment is possible. "When schools and communities can develop a reciprocal relationship based on collaboration, respect, and shared decision-making, SCLR [CBE] education becomes more tangible and more easily realized" (Brayboy et al. 2012, p. 117).

Two major studies of CBE initiatives in Alaska—Alaska Onward To Excellence (AOTE), (R. Barnhardt & Kushman, 2001) and the Alaska Rural Systemic Initiative (AKRSI), (R. Barnhardt, Hill & Kawagley, 2006)—presented evidence for academic growth and increased community/school partnerships as a result of CBE activities. AOTE researchers concluded that successful CBE programs were the result of school and community partnerships that (a) sustain reform, (b) share leadership, (c) build trust, (d) work within new roles, (e) set and act on specific reform goals and (f) work to improve the health of communities (R. Barnhardt & Kushman, 1999). The effectiveness of each strategy is dependent on the willingness of school and community partners to be mutually committed to a culturally integrated teaching and learning environment.

In AKRSI, school engagement of the Alaska Native community in instruction, curriculum and evaluation was also identified as key to the program's phenomenal success (R. Barnhardt et al., 2006).

> The educational reform strategy we have chosen -- to foster interconnectivity and complementarily between the formal education system and the indigenous communities being served in rural Alaska based on current concepts, principles and theories associated with the study of complex adaptive systems -- has produced an initial increase in student achievement scores, a decrease in the dropout rate, an increase in the number of rural students attending college, and an increase in the number of Native students choosing to pursue studies in fields of science, math and engineering. (R. Barnhardt, Hill & Kawagley, 2006, para. 38)

Bryk and Schneider (2004) suggest that the critical first step and ultimate responsibility to initiate this new relationship, rests with the school. To this end, teachers must shift pedagogical practice to reflect an integrated model that respects both Alaska Native and

Western traditions of education.

Constructivism is a Western theory compatible with the traditional methods of instruction practiced by Alaska Natives (Hankes, 1996). The use of constructivist teaching practices unites both Alaska Native and Western cultures into an effective learning environment that can honor the knowledge systems of both cultures. Constructivism can be the theoretical basis for both Western and Alaska Native teaching styles (Barnhardt, 1990; Reyhner, 2011). Constructivist teachers working in indigenous classrooms find an audience of students who are culturally prepared to be active participants in learning activities.

However, the practice of constructivism by Western-trained teachers can be limited by (a) confusion regarding the application of constructivist-based teaching methods; (b) teacher preparation programs that emphasize teacher-centric instruction, and (c) accountability measures that define success by what students know rather than what they can do. Further, the management of a constructivist classroom is challenging (Means & Olson, 1995; Windschitl, 2002). As a result, constructivism as a philosophy of instruction is more of an ideal than an actual practice in most Western classrooms. Phillips, (1983) writes:

> Surprisingly little attention has been given to the ...methods used in teaching ethnic minority students in this country, particularly when the notion of culturally relevant curriculum materials has been around as long as it has. It is as if we have been able to recognize that there are cultural differences in what people learn, but not in how they learn. (pp. 132-133)

It is ironic to note that the skills believed to be necessary (Magner, 2011; Partnership for 21st Century Schools, 2008; Trilling & Fadel, 2009) for the 21st century —collaboration, communication, application and problem-solving—are alike those traditionally taught by indigenous cultures. Those seeking to transform education into a 21st century model need to look no further than indigenous cultures that have been effectively teaching such skills for thousands of years.

Digital learning technologies can assist in the constructivist mode of teaching

(Slavin & Lake, 2008). Nanjappa and Grant (2003) write: "A complementary relationship exists between technology and constructivism, the implementation of each one benefiting the other" (p.1). The technology of interactive software provides opportunities for the transmission of these 21st century skills. Ganatra (2012) outlines the assistance that technology can provide to the development of a student-centric learning environment:

> (a) provide multiple representations of reality, (b) represent the natural complexity of the real world in a simulated situation, (c) present authentic tasks (contextualizing rather than abstracting instruction); that are culture specific, (d) provide real-world, case-based learning environments, rather than pre-determined instructional sequences, (e) enable context-and content dependent knowledge construction, (f) give variety of experiences and (g) allow the teachers to monitor the performance and evaluate. (para 17)

Digital applications can also be tuned to reflect local cultural activities that are no longer available. However, the professional effort to take advantage of these resources is dependent on the teacher's teaching style.

2.3 Learning

Education is the process of acquiring and sharing knowledge. Within a cultural context, education has two main purposes. First, it represents the methodologies used to help children acquire the knowledge necessary to be contributing members of their culture. The second function can be metaphorically represented by a quote from the English philosopher G.K. Chesterton, "Education is simply the soul of a society as it passes from one generation to another. Whatever the soul is like, it will have to be passed on somehow, consciously or unconsciously, and that transition may be called education" (Chesterton, 1924).

Education directs the process of learning; the cognitive ability to transform information into knowledge. Yet learning is also a personal process of inquiry directed by the conscious mind to interrogate the world for meaning. Researcher David Bjorklund (2005) writes: "Unlike the brains of any other species, ours provides us with self-awareness and a behavioral flexibility that has allowed humans to create culture and to

adapt to a limitless diversity of environments. Only the human brain has led to language, mathematics, physics, and art" (p. 51).

Renowned psychologist Viktor Frankl (2006) wrote:

> Man's search for meaning is the primary motivation in his life and not a "secondary rationalization" of instinctual drives. This meaning is unique and specific in that it must and can be fulfilled by him alone; only then does it achieve a significance, which will satisfy his own will to meaning. (p. 99)

From Frankl's perspective, meaning is realized when an individual finds a place within the cognitive landscape of the external world. Education that limits the process of learning to facts denies individual meaning and the liberty of choice.

Some abilities develop with minimal interaction from their environment, while others require direct environmental stimulation to be initiated (Genovese, 2003 p. 131). Geary (1995) divided these abilities into biologically primary and secondary abilities. Biological primary abilities according to Geary (1995) are hardwired into the human brain. Major primary abilities include walking, language development and symbolic reasoning. The deep genetic architecture of primary abilities provides a foundation for learning (Bjorklund, 2005; Geary, 2002).

Secondary abilities often require practice, instruction and extrinsic motivation. Pinker (1997) summarizes secondary abilities from an education perspective:

> Education is a technology that tries to make up for what the human mind is innately bad at. Children don't have to go to school to learn to walk, talk recognize objects, or remember the personalities of their friends, even though these tasks are much harder than reading, adding, or remembering dates in history". (p. 222)

2.4 Theories of Learning

The ability of humans to acquire—and share information began with the development of symbolic reasoning; the basis for language (Medina, 2008). DeLoache (2004) defines symbols as "something intended to represent something other than itself", and notes their role in the evolution of language: "The emergence in evolution of the

symbolic capacity irrevocably transformed our species, vastly expanding our intellectual horizons and making possible the cultural transmission of knowledge to succeeding generations" (p. 66). Medina (2008) states: "There is an unbroken intellectual line between symbolic reasoning and the ability to create culture" (p.33). While the brain is well equipped to learn through the innate processes of cognition, some learning, particularly those skills related to biologically secondary abilities, require the purposeful intervention of a more knowledgeable person (Vygotsky, 1978). Fogarty, Strimling and Laland (2011) suggest "formal teaching began when culture evolved to a point where difficult-to-acquire information became available to teach" (p. 2770).

Indigenous education strategies were refined over thousands of years, becoming a mechanism of cultural transmission. Western traditions of education began to take form as hunter-gatherer cultures transitioned from migratory subsistence lifestyles into sedentary communities (Bar-Yosef, 1998). As the industrial age evolved, culturally integrated educational practices designed to pass on a wide spectrum of knowledge were replaced with formalized systems designed to transmit specialized knowledge to small segments of the population. The refinement of knowledge necessary to teach an industrial occupational skill required a specialist, a process of instruction and expected outcomes. Connecting these three conditions into a coherent model of education has become a strong focus of cognitive scientists.

Scientific and philosophical discourse related to the epistemology of learning is an ancient and resilient pastime. Early Greeks provided the philosophical foundations for modern theories of learning. Plato suggested that learning was the result of internal reorganization of knowledge directed by reason (rationalism). Aristotle theorized that learning came from the empirical or rational interpretation of experience (empiricism). From these ancient roots, contemporary cognitive scientists have formulated several distinct theories of learning; behaviorism, cognitivism and constructivism (Darling-Hammond, Rosso, Austin, Orcutt, & Martin, 2001).

Each theory has survived rigorous philosophic and scientific debates and represent distinct paradigms explaining the varied processes of learning. Learning

theories expand on the nature of learning while teaching theories are concerned with efficient ways to facilitate learning. Although pedagogical methods are often associated with a discrete theory of learning, the instructional purpose of any such strategy determines its theoretical justification. *Table 5* provides a brief comparison of the major learning theories common to professional dialogue.

Table 5

Major Learning Theories

Theory	Mental Activity	Learning Process	Learning Event
Behaviorism	Irrelevant	• Stimulus-response • Reinforcement • External event	Learning occurs when a correct response to a stimulus is observed
Cognitivism	Perception Attention Processing	• Cognitive process is an internal event. • New information is integrated into schema • Knowledge objective	Cognitive activities generate new patterns and relationships
Constructivism	Meaning is relative to individual	• Cognitive process is an internal event • Knowledge is constructed • Knowledge is relative	• Supports meaning-making • Growth by challenging existing ideas

Adapted from (Jordan, Carlile, & Stack, 2008 p. 55)

Behaviorism is concerned with the observable relationship between behavior and environment (Carlson, Buskist, Miller, Heth, & Donahoe, 2009). Behaviorism was the dominant learning theory from the beginning of the twentieth century until the elevation of cognitive theories in the late 1950s. The central theme of behaviorism is the Stimulus-Response or S-R event; that the teacher acts as a stimulus to cause a response in a student. Learning is reacting appropriately to a stimulus in a way that can be observed or measured. Teaching is the application of an efficient stimulus that will produce, reinforce or extinguish a behavior. Smiley (2012), in a personal communication, stated: "Teaching is an active intercession that occurs within the environment—The environment is the state and the teachers and students are the actors". Repetition and reinforcement, both

positive and negative, are the tools of the behaviorist teacher. The concept of a conscious mind, so central to the theories of cognitivism and constructivism, has little place in behaviorism. Watson (1924), one of the earliest proponents of behaviorism, writes: "Behaviorism . . . holds that the subject matter of human psychology is the behavior or activities of the human being. It is the claim of behaviorism that 'consciousness' is neither a definable nor a usable concept; that it is merely another word for the soul of more ancient times" (p. 3).

Teaching methods that reflect a behaviorist approach include memorization, repetition and the use of rewards or punishments (Saettler, 2004). Behaviorism is often linked to traditional teacher-centered transmission methods while cognitive and constructivist theories are considered the theoretical home of student-centered theories of instruction. While the proponents of behaviorism have declined during the rise in popularity of cognitive theories, instructional tools and methods associated with behaviorism remain firmly entrenched in the Western curriculum.

Cognitive theories recognize the importance of mental activities as an integral component of learning. Ertmer and Newby (1993) described cognitive theories as a way of "making knowledge meaningful and helping learners organize and relate new information to existing knowledge in memory" (p. 56). From a cognitive perspective, learning involves integrating new information into memory as an active process rather than as a response to simple stimuli.

Behaviorism and cognitivism are related in that both theories recognize the need to transfer knowledge from the teacher to the subject efficiently (Saettler, 2004). This often requires breaking down content into smaller units, which are more efficiently assimilated. Cognitivism asks teachers to become familiar with the learner so instruction can be differentiated according to each student's needs. Cognitive theory set the stage for research into individual student learning styles and introduced a new vocabulary.

Constructivist theory shares many of cognitivism's attributes but additionally asserts that knowledge is not uniform; it is constructed at the level of the individual and varies from person to person (Gill, Ashton, & Algina, 2004). Keengwe and Onchwari

(2009) write:

> Constructivism assumes three basic principles that include: (a) learners forming their own representations of knowledge, (b) learning through active experience and exploration that uncovers inconsistencies between current knowledge representation and their own experiences, and (c) learning within a social context, with interaction between learners, peers and other members of the learning community. (p. 15)

Learning is continuously subject to change as new experiences modify previous constructions (Bednar, Cunningham, Duffy, & Perry, 1995). Constructivism provides the theoretical foundation for student-centric instruction.

The work of Russian psychologist Vygotsky has contributed significantly to the development of social constructivist theories of learning. Vygotsky (1981) theorized that learning was dependent on the social relationships between peers and knowledgeable adults.

> Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (inter-psychological) and then inside the child (intra-psychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relationships between individuals. (p. 163)

Jonassen, Peck & Wilson (1999) believe that knowledge construction may be facilitated by learning environments that will "(a) provide multiple representations of reality, (b) present authentic tasks; (c) provide real-world case-based learning environments; (d) foster reflective practice, enable context and content dependent knowledge construction; and, (e) support collaborative construction of knowledge through social negotiation, not competition among learners for recognition" (p. 29). Iran-Nejad (1995) provides a rationale for the classroom-based constructivism:

> Classroom "learning" is unnatural and something that does not occur in the early years of life when a child learns a language, and something most adults avoid

> after they have escaped formal education. The implication of constructivism, and of our elaborations on it, are to argue that children must have access to the same natural learning processes they employ before they enter school, and later, outside traditional classroom environments where interest and dynamic functions operate. In the unnatural classroom environment this does not occur. (p. 24)

Advocates of constructivist learning point to a number of learning outcomes that are linked to constructivist practices: (a) transferability of knowledge; (b) creativity; (c) collaboration; (d) communication; (e) ownership; and (f) problem-solving (Gray, 2007).

A number of researchers challenge the effectiveness of constructivist teaching practices. Richardson (2003) asserts that the "elements of effective constructivist teaching are not known" (p.1269). Mayer (2004) argues that the "emphasis on discovery learning, in which students are free to work in a learning environment with little or no guidance," has been disproven by fifty years of research (p. 14). Kirschner, Sweller & Clark (2006) point to a number of studies that have emphasized the importance of instructional guidance (Aulls, 2002; P. Kirschner, Sweller, & Clark, 2006; Klar & Nigam, 2004; Moreno, 2004). The challenges related to effectively managing a student-centric vs. a teacher-centric classroom is perhaps one reason constructivism is respected as a theory more than it is used to guide instruction (Lea, Stephenson, & Troy, 2003).

2.5 Mind, Brain and Education Research

Learning theories provide relevant models from which teachers may construct instructional strategies consistent with their individual beliefs. Yet collectively, learning theories often represent contradictory, highly differentiated frameworks packaged into instructional programs. Consequently, the learning landscape for students is populated by teachers who practice according to individual preferences, using curricula and assessments selected by committee, to achieve outcomes diffuse enough to cover a range of learning styles. Clearly, the challenges presented by the emerging global network are unlikely to be met unless an integrated strategy connecting learning with instruction is developed. It is time to unify learning, to construct a consistent educational environment.

Scientists concerned with learning often work in isolation from one another:

neuroscientists explore the physiological basis of learning; cognitive scientists seek to understand the relationship between mind and behavior; and educators seek effective pedagogical practices and methods that maximize learning outcomes (Mayer, 2004). After years of disciplinary isolation, neuroscientists, molecular biologists, chemists, cognitive psychologists and educators are beginning to work collaboratively under the banner of Mind, Brain and Education science (MBE). "The development of MBE science results in innovative ways to consider old problems in education and offers evidence-based solutions for the classroom" (Tokuhama-Espinosa, 2011 p. 4). MBE represents a coherent model, an educational environment within which to unite cognitive research disciplines.

The purpose of MBE is to explore the physiological, psychological and pedagogical faces of learning so that teachers can provide an environment optimizing the brain processes associated with learning (McGeehan, 2001; Tokuhama-Espinosa, 2011). Neuroscience research, even in its infancy, has contributed to the design of effective methods of instruction and interventions (R. Caine, G. Caine, McClintic, & Klimek, 2009; Duman, 2010; Guadagnoli, Benjamin, DeBelle, Etnyre, & Polk, 2008; Hart, 1983; Medina, 2008; Saleh, 2011). Blakemore and Frith (2007) note: "Understanding the brain mechanisms that underlie learning and memory, and the effects of genetics, the environment, emotion, and age on learning could transform educational strategies and enable us to design programs that optimize learning for people of all ages and of all needs" (p. 1). MBE research can be used to evaluate practices for alignment with brain-compatible teaching strategies (Battro, Fischer, & Lena, 2010; Jensen, 2005; Organization for Economic Cooperation and Development, 2007). Many experienced educators have noted that MBE research often validates what they have learned from experience. This should not be a surprise, as teachers often retire what does not work for what does.

R. Caine and G. Caine (1990), collated available MBE research into twelve general "mind/brain principles of learning", (R. Caine & G. Caine, 1990, 1991; R. Caine et al., 2009). These principals connect research into a coherent framework of effective

teaching strategies. The principles as represented in *Figure 7* do not present explicit solutions. Rather, they present a foundation upon which to construct an appropriate learning environment.

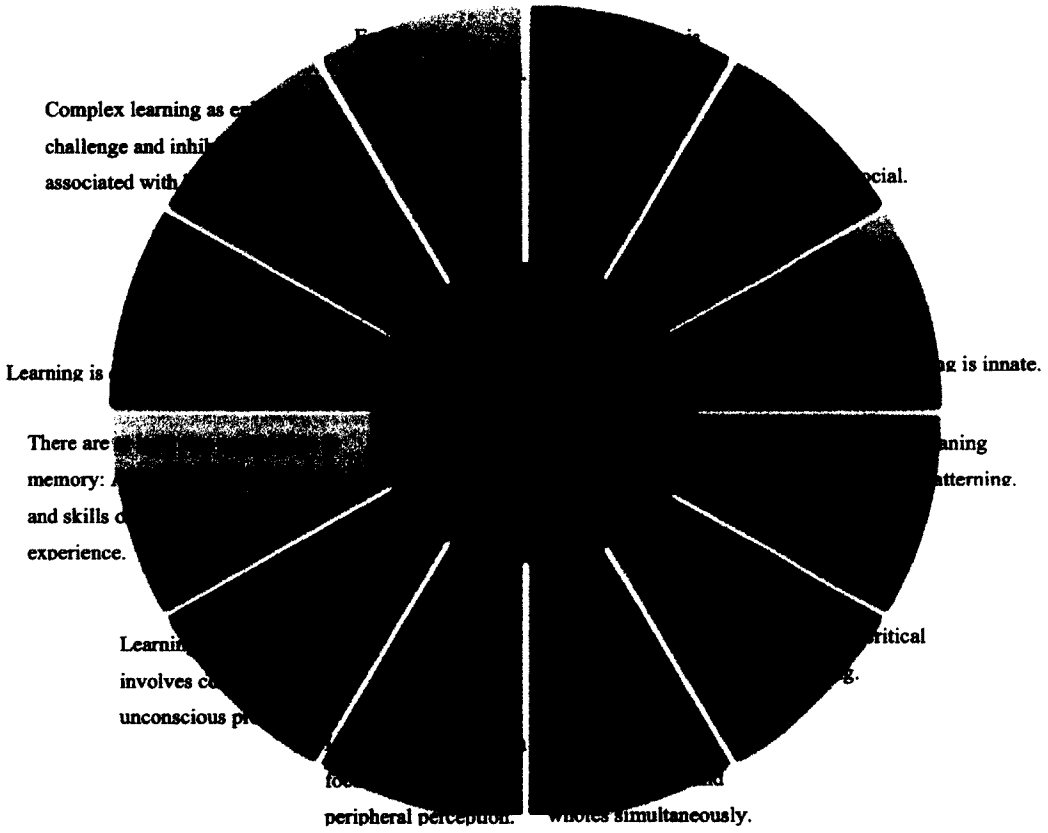

Figure 7. "Human Beings are Living Systems: Twelve Mind Brain Principles" (adapted from R. Caine and G. Caine, 1990).

An effective and MBE-consistent learning environment includes all three of the elements defined in *Bloom's Taxonomy,* (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956) that lead to complex learning: (a) the use of cognitive skills to remember, understand, apply, analyze, evaluate and create (Anderson & Krathwohl, 2001; Bloom et al., 1956); (b) the construction of knowledge into understanding and meaning; and (c) the transference and application of knowledge (Bloom et al. 1956). Kirschner and vanMerrienboer (2008) describe complex learning as "the integration of knowledge, skills and attitudes; coordinating qualitatively different constituent skills; and often

transferring what was learned in school or training to daily life and work" p. 244). R. Caine (2004) concluded that "complex learning is essentially constructivist and that constructivism engages the whole system" (p. 4). MBE research is consistent with teaching strategies that encourage students to be actively engaged and have ownership in the processes and outcomes of learning.

R. Caine, G. Caine and Klimek (2005) identified three conditions necessary for complex learning: "relaxed alertness, orchestrated immersion and active processing" (p.4). Relaxed alertness exists when the learning environment is safe and stimulating. Orchestrated immersion occurs when students are engaged in complex, student-directed learning. Active processing encourages students to construct meaning from their experience (p. 4-6). While the conditions of learning suggested by R. Caine et al. (2005) can be used as a template for teachers to create learning environments, they were initially intended to present the conditions necessary for an individual child to learn. A classroom that meets the conditions for learning as defined by R. Caine et al. (2005) is an environment where the conditions are optimized to fit the needs of every child. Learner-centered educators should stimulate the students' understanding of course content by enriching the classroom environment while adjusting the focal point of the classroom from teaching to learning (Kaufman et al., 2008, p. 3). Effective learning environments are constructed to be responsive to the learning needs of each child.

Mind-Brain-Education research presents ideas that can be used to make better decisions about the learning process (Jensen, 2008 p. 4). MBE researchers identified several cognitive assumptions related to the processes of learning:

> (a) the brain plays a role in learning; (b) the way the learning environment is constructed makes a difference; (c) learning is based on the associations or connections we make; (d) learning occurs in particular social and cultural environments; and (e) the different ways people think and feel about their own learning affects their development as learners. (Darling-Hammond et al., 2001 p.16)

Collectively, these assumptions provide a foundation for teachers to

design instructional strategies based on research rather than packaged teaching programs. Mayer (2008) asserts that "It will be up to teachers to take the next step by examining their teaching beliefs about learning and ultimately their pedagogical style based on MBE research" (p. 4). The science of instruction begins when teachers integrate MBE into the pedagogical planning relevant to the learning needs of each individual child. The art of teaching, however, begins when a teacher builds upon cognitive science to construct a student-centric learning environment, providing students with the opportunity to express their individual learning preferences. Teachers want to know what works best; MBE research is a place to start developing a deeper understanding of exactly those things.

2.6 Learning Styles

Researchers and educators have long noted that individual students exhibit what Davis (2009) describes as "characteristic and preferred ways of gathering, interpreting, organizing, recalling and thinking about information" (p. 274). A child's unique approach to learning is often referred to as a learning style. In the simplest definition, learning style is the way a child prefers to learn. Swisher (1991) described learning style as an "accustomed pattern used to acquire information, concepts and skills" (p. 1). Sprenger (2010) argued that learning style is a preference for sensory modalities used to send and receive information: visual, auditory or kinesthetic. Keefe and Jenkins (1997) suggested that learning style refers to the "composite of characteristic cognitive, affective and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with and responds to his or her learning environment" (p. 30). Learning styles are not static. Students may elect to use alternate styles of learning based upon content, instruction and environment (Tomei, 2010). The expression of a learning preference may be limited or masked by other factors including student attitude (Akey, 2006); context (E. Johnson, 2002); motivation (Tella, 2007); social, emotional and physical health (Maslow, 1943); environment (Opdenakker & Minnaert, 2011), cultural discontinuity and instruction practice (Darling-Hammond, 2000).

A growing body of research has examined the role culture plays in a child's learning style (Darling-Hammond et al., 2001; Demmert, 2003, 2004, 2011; Ozer, 2004;

Pewewardy, 2002; Swisher, 1991; Swisher & Deyhle, 1989). Hughes and More (1997) note the important influence of family and community:

> Most learning styles are learned as young children from mother, father, grandparents and close family friends with whom the child interacts regularly. From them the child learns content and skills. But the child also "learns how to learn" (learning styles). The learning styles of caregivers have considerable influence on the child's learning styles. By the time a child gets to school, many of the learning styles have already been established. (section 4.3.3)

Vygotsky (1978) provided a theoretical explanation for the close relationship between learning style and culture by suggesting that socio-cultural interactions shape thought, reason and language: "... learning results in mental development and sets in motion a variety of mental processes that would be impossible apart from learning. Thus, learning is a necessary and universal aspect of the process of developing culturally organized specifically human, psychological functions" (Vygotsky, 1997, p. 35). When culturally unique learning characteristics are identified, corresponding adjustment to instruction should follow (Pewewardy, 2002).

The exploration of learning styles began in earnest during the 1980s as cognitive scientists explored the relationship between a child's learning style, instruction and student performance. Bloom's *Taxonomy of Educational Objectives* (Bloom et al., 1956), set the stage for Gardner's (1983) *Theory of Multiple Intelligences* and Kolb's (1984) *Experiential Learning Theory*. Gardner (1983) suggests that humans are genetically gifted with a unique combination of learning intelligences that culture and experience act upon to produce learning strengths. Cognitive theorists have identified a number of models useful in categorizing learning styles (Dunn & Dunn, 1978; Fleming & Baume, 2006; H. Gardner & Hatch, 1989; Kolb, 1984). Each model infers related instructional strategies that mirror a child's individual learning style. Coffield, Mosely, Hall and Ecclestone (2004) identified over 70 learning style models.

The idea that pedagogy should be responsive to a child's unique learning style is presented in the "Matching Hypothesis" (Dunn & Dunn, 1978; Pashler, McDaniel,

Rohrer, & Bjork, 2008). This hypothesis suggests that student performance will increase if instruction is tuned to a child's individual learning style (Dunn & Dunn, 1978; Felder & Brent, 2005; Felder & Silverman, 1988; H. Gardner, 1983, 2011; H. Gardner & Hatch, 1989). The research supporting this hypothesis, while extensive, has yet to clearly connect student achievement with instruction specifically designed to target a child's learning style (Coffield et al., 2004; Pashler et al., 2008).

The research base supporting the matching hypothesis has been challenged by contemporary researchers who claim the relationship between teaching styles and instruction is not supported by research (Coffield et al., 2004; Constantinidou & Baker, 2002; Hattie, 2009; J. Kavale & Forness, 1987; K. Kavale & Forness, 1990; Massa & Mayer, 2006; Pashler et al., 2008). Investigators have been concerned with the quality of research supporting some of the common learning style models, research that has been referred to as of "low reliability, poor validity and negligible impact on pedagogy" (Coffield, et al., 2004, p. 138).

This conclusion is disputed by Zhang, Sternberg, and Rayner (2012, p. 9) who claim that Pashler, et al. (2008) ignored an extensive research foundation and addressed specific types of learning style measures while ignoring others. Kolb, as referenced by Glenn (2009), while supporting Sternberg's assertion that recent studies critiquing the validity of learning style research were shallow, agreed, "there is no strong evidence that teachers should tailor their instruction to their students' particular learning styles. Matching is not a particularly good idea" (p. 1). The existence of unique learning styles is not in question, however the significance of learning style as a factor in the effectiveness of pedagogical practice is the subject of professional disagreement.

Coffield et al. 2004 advise teachers to ensure that strategies are attentive to diverse cognitive learner styles rather than individualized to meet the unique learning styles of each learner. Felder and Brent (2005) go further, suggesting that the primary function of learning style research is to:

> ...help instructors design a balanced teaching approach that addresses the learning needs of all of their students. Designing such an approach does not require

> assessing the students' learning style preferences: it is enough for instructors to select a model and attempt to address all of its categories (in Kolb model terms, to teach around the cycle), knowing that every class probably contains students with every preference. (p. 62)

Willingham (2005) suggests that teachers should "...think about the modality that best suits the content...What does matter is whether the child is taught in the content's best modality" (p. 33). Alexander (2000) writes: "...different ways of knowing and understanding demand different ways of learning and teaching. Mathematical, linguistic, literary, historical, scientific, artistic, technological, economic, religious and civic understandings are not all the same" (p. 561). Instruction should consider both learning styles and the nature of the subject and content.

Attending to the learning style preference of students at the individual or class level may be more important when the locus of control is firmly centered on the teacher. Teacher-centric classrooms controlling the pace, activities, content and strategies must overtly accommodate the diverse learner needs within the classroom or risk ignoring the needs of some individual learners. Classrooms that provide the relaxed alertness, the orchestrated immersion and the active processing suggested by MBE researchers R. Caine et al. (2009) as characteristic of student-centric learning, create the environment for students to learn consistent with their individual styles. Such an environment provides an opportunity for teachers to assist students engaging in reflective activities that facilitate increased awareness of individual learning strengths. Awareness of an individual's learning preferences is particularly important when students confront a learning environment at odds with their own.

The relationship between learning styles and culture led to the natural assumption that cultures would display characteristic learning styles (Kleinfeld & Nelson, 1991). While it is clear that Alaska Native cultures have evolved educational practices tuned to their culture's worldview, researchers have been unable to identify learning styles expressly related to indigenous cultures (Hughes & More, 1997; Kleinfeld, 1973; Kleinfeld & Nelson, 1991; Pewewardy, 2002). Besides the diverse factors that influence

individual learning style, Alaska Native learners are separated by geography, degrees of assimilation and individual cultural identity. However, researchers have identified a number of learning attributes that are commonly associated with those indigenous populations that have maintained a strong cultural identity (Hilberg & Tharp, 2002; Rasmussen, Baydala, & Sherman, 2004). Pewewardy (2002) identified seven characteristics often common to these indigenous learners: "(a) field-dependent, (b) perceptual strengths—visual, auditory and kinesthetic, (c) reflectivity, (d) behavior, (e) importance of family, and, (f) cooperation" (p. 10-11). Rasmussen et. al. (2004) concluded that Aboriginal students tend to be learners who prefer collaborative group work and experiential learning techniques (p. 334). General learning style differences between Alaska Native and non-Native students have also been identified (R. Barnhardt, 2005b; R. Barnhardt & Kawagley, 2010; A Kawagley, 2006; Pewewardy, 2002; Swisher, 1991; Swisher & Deyhle, 1989; Wauters et al., 1989).

Clearly, regardless of specific indicators, Alaska Native youth bring to the schoolhouse door individualized, culturally modulated learning styles that reflect the methods used by parents and the broader community to pass on their culture (Bennett, 2007; More, 1987; Morgan, 2009, 2010). Demmert (2004) argues the logical necessity for educators to recognize and respond to the influence of a child's culture on learning:

> If culture influences an individual's view of the world; if cultural experiences determine how one approaches a problem and attempts to solve it; if cultural environment influences the way a person thinks and approaches life; and if early experiences and our environments significantly influence what each of us become as individuals, issues of culture, language, cognition, community, and socialization are central to learning --- if all of this is true, then each of these factors must be adjusted for in the context of learning, in our social development, in our theories of education, and in our assessment and research. (p. 3)

Zhang (2007) suggests that the match between a teacher's style of learning and a child's style should be expanded to link the learning environment created by teachers with the learning needs of students. "If a teacher is 'teaching' in a way that fails to meet

the learning needs of the student, the teacher is not really teaching" (p. 9). However, Swisher (1991) argues that the identification of similar learning attributes should not be used as the basis to create stereotypic templates for instruction. Kolb (1984), a proponent of the matching theory, describes the challenges and dangers inherent in identifying learning style categories from the wide range of human learning variance: "Psychological categorizations of people such as those depicted by psychological 'types' can too easily become stereotypes that tend to trivialize human complexity and thus end up denying human individuality rather than characterizing it" (p. 63). Variance in individual learning styles within a culturally related group may be more significant than the broadly defined learning styles generally associated with a culture (Morgan, 2010). Hughes and More (1997) write:

> The recurrent styles among Aboriginal learners occurs often enough to warrant careful attention by teachers provided teachers also attend to individual differences between students. One is left, then, with the task of describing a balance between learning styles that recur among members of a cultural group and individual variations between members of that cultural group. (sec. 3.2, para. 9)

An awareness of culturally influenced learning styles provides a foundation for teachers to construct a culturally congruent learning environment that reflects the environment used by parents and the community to pass on knowledge (Lipka & Adams, 2004). Yet, if a culturally tuned instructional program is implemented at the expense of a child's unique style of learning, it can lead to the same deleterious effects on student learning as those Western education practices that devalued Alaska Native culture for the last 250 years. Teachers may believe that treating all students the same way avoids discriminating against any group, but that practice in itself is discriminatory (Banks, 2006; Gollnick and Chinn, 2009). Awareness of culturally influenced differences in learning styles should not be ignored by educators in the planning or conduct of instruction or used as wide ranging excuse to justify low performance. The history of education in Alaska should be a reminder that the best of intentions, if applied out of context, can cause great harm.

2.7 Teaching Styles

Efforts to reform formal education must begin with instruction. The National Commission on Teaching and America's Future (1996) defined three primary assumptions for education reform: "(a) What teachers know and can do is the most important influence on what students learn. (b) Recruiting, preparing and retaining good teachers is the central strategy for improving our schools. (c) School reform cannot succeed unless it focuses on creating the conditions in which teachers can teach, and teach well." (p. 10).

The Institute for Education Leadership (2001) concurred: "No single principle of school reform is more valid or durable than the maxim that student learning depends first, last, and always on the quality of the teachers." (p.1). Instructional quality, according the Schreyer Institute for Teaching Excellence, (Schreyer Institute, 2012) is determined by a positive learning environment created by a caring, committed educator who has the pedagogical prowess and content expertise to deliver and assess instruction.

Demmert (2011) summarized several characteristics of quality teachers: "High quality teachers that know context, pedagogy, and understand the different learning periods and preferences can be effective teachers" (p. 5). "The challenge of teaching may be viewed as the creation of bridges between the knowledge embodied in the subject matter, on the one hand, and the minds and motives of students, on the other hand" Darling-Hammond et al., 2001, p. 15).

A number of studies have examined the relationship between quality teaching and student achievement. Nye, Konstantopoulos and Hedges (2004), using data generated from the Tennessee Student Teacher Achievement Ratio (STAR), concluded that teacher quality was a greater determinant in student achievement than class size, ethnicity, income level or school attended (Howland, Jonassen, & Marra, 2012). Nye et al. (2005) agree, "The results of this study support the idea that there are substantial differences among teachers in the ability to produce achievement gains in their students" (p. 253). Researchers found that the effect of a quality teacher was enhanced for minority and low income students and cumulative for students who receive poor instruction (Collins &

Halverson, 2009). The STAR multi-year study of the Texas Schools Project reported similar results (Rivkin, Hanushek, and Kain, 2005). Studies conducted by Sanders and Rivers (1996) and Aaronson, Barrow, and Sander (2007) showed significant performance differences between students who have high quality teachers and those who have teachers of low quality. In a Tennessee study, Sanders and Rivers (1996) identified a 50% cumulative performance difference over three years between students who had quality teachers and those who did not.

Bransford, Brown, Cocking, Donovan, Bransford, & Pellegrino (2000) suggest that quality teachers create a student-centric learning environment that invites students to become active, self-directed learners. Student-centric teachers integrate practices that enable learners to engage in self-directed processes of learning. Within this constructivist learner environment, students are encouraged to find cognitive pathways that use their individual learning styles while being challenged to also utilize less preferred, but important, alternative learning strategies. Teachers who create an integrated, student-centric learning community can act as learning facilitators.

Teachers who focus instruction on the acquisition of specific content can stymie opportunities for students to access their own learning styles. Students often must adapt their unique learning styles to the teaching demands. Students limited in their ability to adapt may need the teacher to modulate instruction or be left behind. While individualized instruction is expected of teachers, it is often operationally impractical due to the number of students, the diverse clientele and the time available (Zhang et al., 2012). Learners who do not catch up may well become another casualty on left side of the bell-shaped performance curve. The design and delivery of a teacher-centric or a student-centric learning environment is a matter of choice, and that choice is a factor of teaching style.

Teachers teach with style. Efforts to reform educational practice to serve the needs of 21st century learners must begin with changes in pedagogical practice. Teaching style is often defined as the operational expression of a teacher's philosophy of learning. A teacher's style of instruction evolves: "Instructors develop a teaching style based on

their beliefs about what constitutes good teaching, personal preferences, their abilities, and the norms of their particular discipline" (Teaching Styles, 2012, para 1). A dissonance between a teachers preferred style of teaching and actual practice may be explained by a number of factors including (a) student learner styles, (b) external restraints related to school leadership, (c) federal, state and local policies, (d) curriculum and assessments, (e) community-based teaching and learning norms, (f) student performance levels and (e) behavior (Grasha, 1996, 2002).

Bain (2004) identifies teaching style as the primary determinant of the learning environment. Gagne (1976) asserts that the "essential task of the teacher is to arrange the conditions of the learner's environment so that the processes of learning will be activated, supported, enhanced, and maintained" (p. 42). While many factors influence teaching style and the nature of the learning environment created by it, teaching style is largely a professional choice (Bain, 2004).

Grasha (1996, 2002) offers an active definition of teaching style, suggesting that it is a dynamic outcome or a transactional compromise between the needs of teachers and those of learners; " a pattern of needs, beliefs and behaviors that faculty displayed in their classrooms" (p. 152). The class learning environment reflects the range of instructional behaviors used by the teacher in response to the diverse needs of children. Children, in turn, adapt their preferred ways of learning in response to the style and expectations of the teacher. While individual methods selected by a teacher may reflect a preferred teaching style, the selection of instructional strategies should be determined by purpose, application and outcome. Method and outcome validate intent. The extent that teachers engage in self-reflection relevant to lesson design determines whether instructional practices are malleable as opposed to being rigidly defined.

A number of teaching style models have been defined to categorize the pedagogical behaviors used to affect learning. While each model reflects a discrete epistemological foundation, they all attempt to describe the dynamics between instructional behaviors, learning styles and learner outcomes. Most importantly, each model provides a template for teachers to engage in activities related to instruction. Pratt

(2002) suggests that learning style models act as "a means of helping people identify, articulate, and, if necessary, justify their approach to teaching. ... Pre-conceived notions of good teaching are challenged as educators are asked to consider what teaching means to them" (p. 10).

Learning style models define a unique taxonomy of behaviors. Pratt (2002) defined five perspectives to categorize instruction: transmission, developmental, apprenticeship, nurturing and social reform. The perspectives are not selected from a continuum of behaviors, rather each "is an inter-related set of beliefs and intentions that gives direction and justification... Each of the perspectives ... is a unique blend of beliefs, intentions and actions" (Pratt, 2002, p. 1). Pratt (2002) writes that the majority of teachers (>90%) "hold only one or two perspectives as their dominant view of teaching and only marginally identify with one or two others. It could not be otherwise, given that perspectives vary in their views of knowledge, learning, and teaching" (p. 2).

Grasha (1996) defined five teaching styles separated across a continuum from teacher-centric to student-centric practices: (a) expert, (b) formal authority, (c) personal model, (d) facilitator and (e) delegator. At the "expert" end of Grasha's spectrum of teaching styles, the teacher determines the content, process and outcome of learning while at the opposite end, the "delegator" empowers students to become actively engaged in the process of learning. Using these styles as building blocks, Grasha defined four style clusters that collectively represent the majority of styles used by teachers.

Grasha (2002) outlined teaching methods commonly associated with each cluster. While instructional purpose allows methods to serve any style, the degree of student participation in the process provides a natural niche for clusters defined by the same measure. Teacher-centric styles are commonly associated with traditional didactic, knowledge-centric methods while student-centric models reflect constructivist methods.

The teacher-centric vs. student-centric contrast used by Grasha is a pervasive archetypal characterization that other models also use to represent the range of teaching behaviors. This relationship is no surprise because pedagogical practice will always seek equilibrium between the role of the teacher and the role of the student. Other common

spectrum models include the "Teaching Behavior Preferences Survey," (Behar-Horenstein, Mitchell, Notzer, & Penfield, 2006), "Spectrum Model," (Moston & Ashworth, 1990), "Principles of Adult Learning Scale,"(Conti, 2004). Becker and Anderson (1998) designed a survey to measure practices from traditional to constructivist as part of the National Survey of Teaching and Computing (TLC).

While the relationship between teaching and learning has been explicated by MBE research, teachers continue to wield considerable autonomy in the practice of instruction. Curriculum priorities, the practice of pedagogy, assessment benchmarks and teacher-learner relationships are all subject to instructor decisions. Classrooms in the same school at the same grade level using the same curriculum and assessments may display significant differences in the nature of the learning environment as well as in academic performance (Collins & Halverson, 2009; Ertmer & Albion, 2002). The point is that teachers make a significant difference.

Didactic, teacher-centric pedagogy worked well in knowledge-based accountability systems because learner outcomes could be achieved through application of a variety of methods. This is generally true except in highly unstructured learning environments that have been designed to facilitate constructed meaning (Mayer, 2004, 2011). However, the need to emphasize a new set of learning outcomes requires a new set of teaching practices that will provide a range of opportunities for students. Teachers must craft:

> Opportunities for 'active' learning experiences, in which students are asked to use ideas by writing and talking about them, creating models and demonstrations, applying these ideas to more complex problems, and constructing projects that require the integration of many ideas, have been found to promote deeper learning, especially when they are combined with reflective learning experiences. (Darling-Hammond et al., 2001, p. 13)

The systemic restructuring necessary to transform education from knowledge-based to process outcomes has been challenged by conflicting research. However, it is inaccurate to suggest that the obstacles to education reform are exclusively related to

instructor opposition. Teachers are often at the forefront of student-centric instructional innovation yet many are discouraged by knee-jerk short-term reform initiatives most often motivated by concerns other than student performance (Prensky, 2006).

Elmore (1996) noted that research-based reform initiatives over the past one hundred years have been unable to alter the core behaviors governing teacher-student instructional relationships. The old adage "Reform initiatives come and go but I am still here," is generally true. The history of education has featured many promising reforms that are now unfulfilled relics. Payne (2008) sums up the status of education reform: "So much reform: So little change" (p. 1).

Education reform initiatives must breech the classroom door if they are to be successfully integrated. In the absence of a coherent MBE-informed model, teachers will often choose the status quo, or passive compliance, rather than risk yet another program that will likely just waste more resources before eventually fading away. If education reforms are to take root, teachers must be able to trust that reforms are (a) constructed on a foundation of MBE research, (b) operationally efficient and (c) focused on the needs of the children. A number of education reforms critical to 21st century demands are knocking on the classroom door (Burkhardt et al., 2003; Casner-Lotto & Benner, 2006; Dede, 2007; Institute for Educational Leadership, 2001; Jerald, 2009; Magner, 2011; Rotherham, 2008).

2.8 Technology

Digital technologies have created a virtual world that invites everyone to become citizens of a global network – a network destroying conventional restrictions placed on the free exchange of ideas. Friedman (2007) asserts that digital communication technologies have penetrated barriers that have traditionally isolated countries, cultures and ideas. This new accessibility is not so much the result of an abrupt, digitally-powered revolution; rather it is the result of an accelerating process of globalization fueled by advances in multiple technologies. Pink (2006) postulates that human ages are delineated by concurrent advances in technology, wealth and expanded human contacts: "As individuals grow richer, as technologies become more powerful, and as the world grows

more connected, these three forces eventually gather enough collective momentum to nudge us into an new era" (p. 49).

The advent of the personal computer, increasingly sophisticated software, fiber optics technology and the internet have formed a technological nexus that flattened the world even further (Friedman, 2007) and set the stage for a transition into the Information Age, or what Pink (2006) describes as the "Conceptual Age" (p. 48). Friedman (2007) describes the challenges that will ultimately define this new age:

> It is now possible for more people than ever to collaborate and compete in real time with more other people on more different kinds of work from more different corners of the planet and on a more quality footing than at any previous time in the history of the world---using computers, email, fiber-optic networks, teleconferencing and dynamic new software. (Friedman, 2007 p. 8)

Collins and Halverson (2009) describe the differences: "While the imperatives of the industrial-age learning technologies can be thought of as uniformity, didacticism and teacher control, the knowledge-age learning technologies have their own imperatives of customization, interaction and user-control" (p. 4).

Well-being in this new age is dependent on the capability of educational institutions to redirect the processes of education in response to a digitally accelerated global environment. This will present significant challenges. Industrial Age education methods were tuned to the needs of the nation's industrial workforce (Coleman et al., 1974). In that world, the acquisition of a basic set of skills was an acceptable outcome rather than merely one component in the complex pathways that now leads to critical thinking.

Preparing all students for the unpredictable nature of the 21st century requires that the full spectrum of higher order skills be repatriated back to education. This will not devalue content; it will stimulate the balance between knowledge and critical thinking that has always been crucial to human cognitive heritage (Rotherham, 2008). Hoffer (1973) explains the criticality of preparing students to learn ***how to learn*** rather than to just learn:

> The central task of education is to implant a will and a facility for learning; it should produce not learned but learning people. The truly human society is a learning society, where grandparents, parents, and children are students together. In a time of drastic change, it is the learners who will inherit the future. The learned usually find themselves well equipped to live in a world that no longer exists". (p. 32)

The new challenge for education is to equip all youth with that which will be necessary to thrive in the digitally powered global community (Magner, 2011; Trilling & Fadel, 2009).

Those who can fathom the unpredictability of this new age will be able to sail over the waves of change. To this end, the outcomes of education must evolve from a specialized focus on knowledge and skills (Coleman et al., 1974) to a system immersing students in the analytic processes of learning. Education must shift the responsibility for learning back to the student. Rather than preparing students with the skills and knowledge for a predictable future, schools must ready students to be capable of identifying a place in a future that is as yet unwritten. In this global network with its accelerating pace of change, educating students for the present is preparing them for the past.

The higher order skills predicted to be necessary for success in the 21st century are not new to human history. They were vital to indigenous societies that had to respond to variations in the environment. Alaska Natives and other indigenous populations have been successfully teaching these skills for thousands of years, without the aid of digital technologies (R. Barnhardt & Kawagley, 2005; Kawagley, 2006). When students were age-grouped into classrooms to learn a defined content, the teacher became the focus of instruction, and the defined content the outcome. Students did not lose their innate capacity to process content into meaningful information; they were just denied the opportunity to carry their learning to its natural conclusion. Disallowing learners to ask questions relevant to their cognitive level compromises learning. Asking students to memorize content absent curiosity robs the satisfaction created from reconciling what is observed with what is known. To unmask higher order cognitive skills in schools,

education must reorient learning back to the student so that its complete cycle can be practiced.

Digital learning technologies (DLT) have provided students new opportunities to expand their learning abilities. Youth who struggle to meet core expectations in class, successfully engage sophisticated gaming systems requiring mastery of a complex body of knowledge after school. Children have incredible learning potential when allowed to learn relative to individual interests and cultural values.

The real question facing 21st century educators is how to create a learning environment presenting students these skills within the constraints of the modern classroom. Bentley (2003) writes: "It requires a shift in our thinking about the fundamental organizational unit of education, from the school, an institution where learning is organized, defined and contained, to the learner, an intelligent agent with the potential to learn from any and all of her encounters with the world around her" (p. 1). Collins and Halverson (2009) advise that the transformation of education is critical:

> If educators cannot successfully integrate new technologies in what it means to be in a school, then the long identification of schooling with education, developed over the past 150 years, will dissolve into a world where the students with the means and ability will pursue their learning outside of the school. (p. 15)

School reform for the 21st century will not be accomplished by using technology to amplify what is already known not to work.

Two recent studies found that teachers, while increasing focus on rigorous content, continued to utilize methods discordant with moving beyond the acquisition of knowledge (Kane & Staiger, 2012; Sartain, Stoelinga, & Brown, 2011). Sartain et.al. (2011) write: "... across all instruments, raters rarely found highly accomplished practice for the competencies often associated with the intent to teach students higher-order thinking skills" (p. 10).

2.9 Technology and Learning

Modern digital technology may be defined as the refinement and application of software to serve a specific purpose. Digital learning technologies are used to enhance

pedagogical practice and the self-directed learning activities. Within the modern context, technology includes computers, printers and other digital devices; specially designed software; and digital communication systems created to serve instructional applications. Digital applications have revolutionized most facets of modern culture with the exception of school-based instruction. This is because digital technology does not become digital education technology until it is integrated into both instructional practice and student learning.

Classroom-based digital learning applications traditionally serve two distinct purposes: computer literacy and fluency. The State Education Technology Directors Association, SETDA (2008) defines computer literacy as: "the ability to use a computer and its software to accomplish practical tasks" (p. 1). Computer literacy alone represents the dominant emphasis for K-12 instruction as currently formulated. Computer fluency is best achieved when digital assets are used to extend learning. The International Society for Technology and Education (ISTE, 2007) suggests: "Simply being able to use technology is no longer enough. Today's students need to be able to use technology to analyze, learn and explore. Digital age skills are vital for preparing students to contribute to the social and civic fabric of their communities" (para 2). Away from most classrooms, "fluent users of technology can move beyond the knowledge-teacher centric environment that serves an old age to access the full range of cognitive abilities necessary to manage the emerging, fast-paced learner environment" (Magnar, as referenced by Trotter, 2009). Like reading, students are expected to learn to use technology so that they can use technology to learn. However, unlike reading, students are rarely afforded the opportunity and freedom to apply technology to relevant, student-directed learning activities while at school. And too often the digital interests of students run contrary to what is considered acceptable by school administrators.

Lessons learned from efforts to integrate technology into education over the last fifty years have provided relevant information related to best practice. Both the euphoric prophecies that computers would soon replace teachers and the predictions that DLT would fade into technological obscurity have given way to a more realistic assessment, a

deeper understanding of the contributions DLT can make in support of learning. In 2007, the International Society for Technology in Education (ISTE) developed National Education Technology Standards (NETS) to guide the effective integration of DLT into teaching and learning (ISTE-NETS, 2011). In *Figure 8*, these standards are divided into six areas of focus.

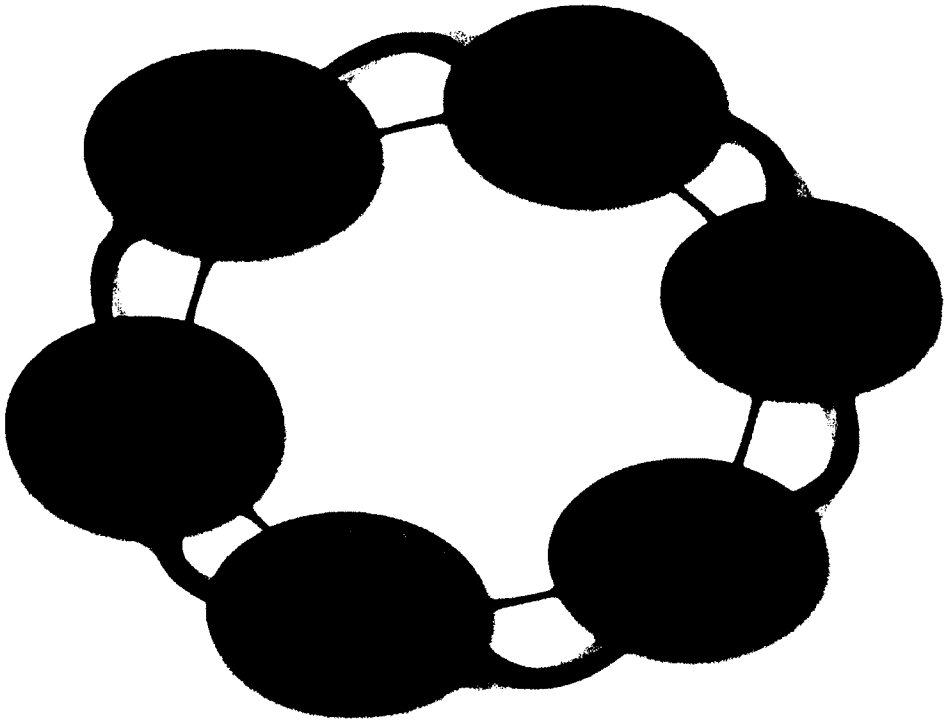

Figure 8. ISTE National Technology Standards for the next century. (adapted from ISTE, 2011, p. 11).

> ISTE suggests that the benefits of following the NETS include:
>
> (a) Improving higher-order thinking skills, such as problem solving, critical thinking, and creativity, (b) Preparing students for their future in a competitive global job market, (c) Designing student-centered, project-based, and online learning environments, (d) Guiding systemic change in our schools to create digital places of learning, and (e) Inspiring digital age professional models for working, collaborating, and decision making (ISTE, 2011, para. 2).

While NETS provided a clear framework for technology integration, two relevant questions remain. Is DLT an instructional tool to create student-centric, constructivist classrooms? Is DLT a tool to serve the learning outcomes of a new age? Researchers have noted several fundamental conclusions regarding the use of education technology. First, education technologies do not alter the basic processes of learning; they enhance them. Digital learning technologies, like culture, affect the "way" people learn, not "how" they learn. Moursund (2002) notes how the human mind and technology work together: "In the past few decades, computers have contributed substantially to mind/brain processes by providing improved access to information, improved communication, and aids to automating certain types of human 'thinking' processes" (p. 7). Teachers should be attentive and respond to the digitally influenced learning styles that children bring to school.

Secondly, computers and other digital applications are machines; sophisticated arrays of on/off switches, animated by software that was originally designed for a specific purpose to accomplish a specific task or to switch between multiple purposes and accomplish multiple tasks. Recent software innovations have transformed the possibilities so significantly that they appear to be magic. Cuban (2011) suggests that the computer has been given too much credit: "Technological enthusiasts overestimate the importance of students' access to technology in schools and underestimate teachers' influence on students' learning" (para. 9). The efficiency of a machine is dependent on the design limitations of the tool, the expertise and talent of the user, the type of application, and the desired outcome. The same is true about DLT; the ultimate success of any technology-based application is primarily determined by a teacher's instructional purpose, philosophy, style and technological acumen (Cuban, 2006; Fisher & McQuinn, 2006). The teacher in this relationship provokes, encourages and facilitates student learning by using effective, research-based practices in a technologically rich environment. Software that afforded students with the flexibility to set and control operational parameters has given way to artificial intelligence software (SIRI) that can adjust to the capability, style and interests of the user.

Finally, the advent of the Internet and the ready availability of portable communication (IT) devices are fundamentally changing virtually all social interactions, not to mention teacher-student relationships. Teachers no longer solely hold control over the content presented to students; learners now carry the capability to acquire knowledge by using a hand-held IT device. Students today, at least those equipped with these devices, have the freedom to ask and answer questions in real-time according to any schedule and get instant results. Lenhart (2012) noted that 63% of all teens send daily text messages as compared to 39% who use cell phones to talk or the 35% who rely on face-to-face communication for after school social communication. B. Barron (2011) articulated the challenge presented to educators:

> Instead of wondering whether teenagers are too easily distracted by computers in the classroom, we should be figuring out how educators, designers and researchers can use digital media to nurture interest and the desire to learn and to tap the social environments online that can help build pathways to sustained learning in and out of school. (p. 1)

Consequently, teachers must shift from a primary emphasis on content to methods that help students make sense of their digitally acquired knowledge. Further, students are bringing digitally enhanced learning styles to school that promise to challenge traditional forms of education that restrict the freedom for students to participate in learning activities.

The classroom teacher remains the primary gatekeeper to technology-enhanced education reform. Zhao, Pugh, Sheldon and Byers (2002) wrote: "We found out when a teacher's pedagogical approach to teaching was inconsistent with the technology they were attempting to incorporate into their classroom, they struggled to successfully accomplish the goals of their proposed project" (p. 492). Teachers must have the skills to hold students instructionally focused and accountable to rigorous standards while creating classroom atmospheres that provide the freedom to explore. Weston and Bain (2010) have concluded: "When technology enables, empowers, and accelerates a profession's core transactions, the distinctions between computers and professional practice

evaporate" (p. 10). Education technology is most effective when embedded within a student-centric learning environment that affords students the opportunity to move beyond computer literacy to become fluent users of technology (Bebell & Kay, 2010; Bebell & O'Dwyer, 2010; Becker et al., 2000; Gulek & Demirtas, 2005; Penuel, 2006; Shapley et al., 2006; Suhr, Hernandex, Grimes, & Warschauer, 2010; Swan et al., 2006).

The digital toolbox of a 21st century teacher may include simulations that allow students to learn through informed trial and error. These simulations leave the traditional classroom behind as students are invited to participate in a virtual environment. Modern interactive games have evolved into entertaining complex simulations that encourage the development of every learner outcome suggested by the Partnership for 21st Century Learning (Trilling & Fadel, 2009). It is significant that the skills required to effectively interact with computer games mimic the processes identified by MBE research, indigenous education practices and the skill sets deemed necessary for the 21st century. Other applications that facilitate learning include texting, social networking websites, interest blogs, and software designed to accomplish specific learning purposes. One of goals of instruction is to ensure that DLT application become resident, invisible tools used by students to enhance learning.

2.10 The Evolution of Education Technology

Formal school-based computer applications available during the late seventies and early eighties were primarily related to instruction in career technical education: accounting, word processing, drafting and programming. Disciplinary applications in select mainstream classrooms included multimedia presentations (*Hypercard*), simple learning games and simulations (*Oregon Trail*), and content driven drill and practice applications (*FlashCard*). The initial steps to integrate information technology (IT) into learning were taken by a few pioneer teachers from every discipline who held the vision that DLT could enhance learning for youth. Early classroom applications were often constructed around the advocacy of an individual teacher and operationally compromised. While these programs worked for a time, fueled by the extraordinary enthusiasm of both teachers and students, they were most often unable to penetrate

traditional instruction. These early efforts represent the first attempt by teachers to use technology to facilitate student-centric, constructivist instruction. Moursund (2002) writes:

> During the past three decades, ICT [Information and Communications Technology] has had some limited effect on curriculum content, instructional processes, assessment, and the professional lives of educators. But, for the most part our educational system has been 'business as usual,' with many small (incremental) changes. In total, our educational system has not changed much during this time. (p. 6)

The failure of these early initiatives is related to a common mistake in reform: trying to solve major problems by addressing the symptoms rather than attending to the root causes. Fullan (2001) writes: "The big problems of the day are complex, rife with paradoxes and dilemmas. For these problems, there are no once and for all answers" (p. 73).

The rapid development of the internet, sophisticated software and the availability of low cost computer technology has transformed the world. In education, computers were offered as a systemic antidote to the increasingly strident national calls (National Commission on Excellence in Education, 1983; "No Child Left Behind Act of 2001 (NCLB)," 2002) for education reform. Overnight, computers became the superstars of education reform demanding ever-increasing slices of budgets, professional development and instructional time. Questions related to education technology as an instrument of reform were set aside as districts pursued creative and innovative strategies to acquire this "cure-all" solution. Soon DLT began to show up in classrooms, labs and eventually full time into the hands of students. Technology was a tool masquerading as a solution.

First and second-order change barriers stand to oppose the rising tide of technology-based reforms and innovations. First order changes are described by Marzano, Waters, & McNulty (2005) as "gradual, subtle, usually obvious, logical, incremental and relatively easy to implement" (p. 66). First order changes evoke first-order barriers. The introduction of DLT into schools was initially challenged due to the

costs associated with the human and physical resources necessary to implement it. The cost of acquiring the hardware, software, bandwidth, technical support and physical infrastructure challenged all districts. Professional development activities competed with other equally necessary school improvements. However, these efforts had limited success. The National Center for Education Statistics reports that by 2008, 100% (Institute of Education Sciences, 2010) of the nations classrooms had one or more computers connected to the Internet. However, while education technology has a resident presence in classrooms, it has not delivered on the promise to transform education into an effective a 21st century model (Cuban, 2010). Overcoming first order barriers brought reform face-to-face with second-order change barriers.

Systemic transformations that dramatically affect the foundational beliefs guiding pedagogy are referred to as second-order changes. Second-order changes are transformative, long-term adjustments in behavior, attitudes and beliefs due to new knowledge, experience or shifting conditions. Initiating and managing second-order changes in education is challenging, because the complex mixture of subjective conceptions that contribute to an instructors beliefs or teaching style are resistant to change (Ertmer, 1999; Fullan, 2001; Marzano et al., 2005; Moursund, 2002).

The barriers erected to oppose secondary changes are difficult to identify because they are internal and often masked by first order barriers. The teacher's option to close the classroom door is powerful, especially when instructional attitude and morale play such a powerful role in the application of technology. Weston & Bain (2010) suggest that the failure of technology to transform teaching and learning is related to the "autonomous, idiosyncratic, non-collaborative and non-differentiated teaching practices that largely remain uninformed by research about what it takes to significantly improve student learning and achievement" (p. 8). Buckenmeyer and Freitas, (2005) found that teacher attitudes toward technology represented a more significant barrier than access to technology resources or professional development.

The urgent call for education to reform to achieve high order learner outcomes has initiated a reevaluation of the limited role DLT has heretofore played in systemic

transformation. Creating an environment for change is a primary responsibility of school leadership. Marzano et al. (2005) write: "leadership supporting an innovation must be consistent with the order of magnitude of the change represented by that innovation. If leadership techniques do not match the order of change required by an innovation, the innovation will probably fail regardless of its merits" (p. 66). The Center for Education Leadership suggests that the quality of leadership to integrate a collaborative vision for technology-assisted education will determine the success of reform strategies: "Technology will not transform schools; rather schools must be comprehensively and systematically transformed in order to improve student learning and make effective use of technology" (Education Leadership, 2012, p. 5).

2.11 Change and Education Reform

Change is complex, particularly so when it is driven by the inertia of major shifts in the norms of society. Paradigm level transformation events are usually bound by extensive periods of uncertainty (Kuhn, 1996). Reforms are often buried under the weight of past practice. This discord describes the situation as education theories, formulated to serve a faded industrial society, are transformed to achieve the high-order cognitive outcomes required for an emergent global society.

The uncertainty regarding the purpose of digital learning assets reflects the broader societal conflicts related to education reform. Planck (1949) suggests that: "new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it" (p. 33). The arrival of a new generation of teachers and students, who are according to Prensky (2006) "Digital Natives" may resolve this conflict. These teachers and learners, practiced and fluent in the new digital technologies, may supply the leadership and courage to transform schools into digital learning environments presenting students with the most exciting options to learn and the technology necessary to pursue and achieve it.

Waldrop (1993) suggested that the turmoil generated by change created opportunities to discover newer order within the disorder. The chaos associated with

change sweeps aside the anchors to past practice and other systemic barriers, leaving room for the new order to emerge, laden with innovative ideas that will lead to new partnerships and new opportunities for further collaborative change (R. Barnhardt & Kawagley, 2006). Waldrop (1993) explained:

> This balance point—often called the edge of chaos—is where the components of a system never quite lock into place, and yet never quite dissolve into turbulence, either. The edge of chaos is where new ideas and innovative genotypes are forever nibbling away at the edges of the status quo, and where even the most entrenched old guard will eventually be overthrown. The edge of chaos is the constantly shifting battle zone between stagnation and anarchy, the one place where a complex system can be spontaneous, adaptive and alive. (p. 12)

The true challenge for educational leadership is not to reform education into a new limited model that reflects the needs of the 21st century; rather it is to create an education system that nurtures the full potential of the mind to learn. Thousands of years of history show the cognitive potential of the human mind to efficiently adapt to change; to find a new order in chaos. Educational reform must nurture this potential rather than building another artificial construct designed to meet the needs of a new era, again anchoring educational practice to the past while the world moves on.

2.12 One-to-One Initiatives

Educators have learned a number of lessons related to the successful integration of DLT into education. These were summarized by ISTE into thirteen "*Essential Conditions to Effectively Leverage Technology for Learning*" (ISTE, 2011). The conditions provide a framework to design first- and second-order strategies that will establish DLT as integral tools for teachers to carry out student-centric instruction and for students to enhance learning. Each condition reflects a critical element of effective technology integration. Table 6 provides a list of conditions necessary to effectively integrate technology into instruction.

Table 6

Essential Conditions for Technology Integration

Shared Vision	Proactive leadership in developing a shared vision for educational technology among teachers students, parents, and the community
Empowered Leaders	Stakeholders at every level empowered to be leaders in effecting change
Implementation Planning	A systematic plan aligned with a shared vision for school effectiveness and student learning.
Consistent and Adequate Funding	Ongoing funding to support technology infrastructure and staff development
Equitable Access	Robust and reliable access to current and emerging technologies.
Skilled Personnel	Educators, support staff, and other leaders skilled in the selection and effective use of appropriate ICT resources
Ongoing Professional Learning	Technology-related professional learning plans and opportunities with dedicated time to practice and share ideas
Technical Support	Consistent and reliable assistance for maintaining, renewing, and using ICT and digital learning resources
Curriculum Framework	Content standards and related digital curriculum resources that are aligned with and support digital age learning and work
Student-Centered Learning	Planning, teaching, and assessment centered around the needs and abilities of students
Assessment and Evaluation	Continuous assessment of teaching, learning, and leadership, and evaluation of the use of ICT and digital resources
Engaged Communities	Partnerships and collaboration within communities to support and fund the use of ICT and digital resources
Support Policies	Policies, financial plans, accountability measures, and incentive structures to support the use of ICT and digital learning resources

Note: Adapted from International Society for Technology in Education (ISTE, 2011).

One-to-one laptop initiatives were specifically designed to address the primary and secondary barriers that opposed the integration of technology into schools. While specific 1:1 programs may differ in purpose and operational policies, they share several fundamental characteristics: (a) students are provided ubiquitous access to a laptop computer; (b) teachers receive improved access to hardware, software and technical support; (c) teachers are engaged in a continuous process of staff development and (d) parents, students, teachers are focused collectively on the success of youth.

Distributing ubiquitous laptops to students is one step of many that must be considered; effective programs must be responsive to the full range of ISTE's essential conditions.

One-to-one programs contribute to learning in several important ways. First, ubiquitous computer use creates an intimate relationship between the user and the tool. Weiser (1993) provides a purpose and goal for 1:1 laptop programs: "Ubiquitous computing is the method of enhancing computer use by making many computers available throughout the physical environment, but making them effectively invisible to the user" (p. 75). Weston and Bain (2010) agree: "When technology enables, empowers, and accelerates a profession's core transactions, the distinctions between computers and professional practice evaporate" (p. 10). Students become fluent technology users when digital learning tools become seamless extensions of cognitive processes (Howland et al., 2012). This digital bond connecting computer and user cannot be shared (Bebell & Kay, 2010). When students have full-time access it is no longer important to climb to the mountain because the mountain is online.

Secondly, one-to-one programs attenuate the first-order barriers that have opposed the integration of technology into instruction, i.e., access to hardware, software, bandwidth, staff development and technical support. Removing these barriers provides an opportunity to identify instructional behaviors that may co-opt the integration of DLT into instruction. Teacher beliefs and teaching styles become visible and subject to intervention when the instructional resources are present but the instruction necessary to support student-centric use is missing.

Thirdly, the distribution of laptops provides all students with equal access to technology while creating a learning community focused on learning. One-to-one initiatives are collaboratively constructed to stimulate teachers and school leadership into discussing instruction and learning. This interactive relationship facilitates real-time growth, learning and commitment.

One-to-one programs have generated a significant research record over the last ten years. Data produced by 1:1 programs is diverse, perhaps reflecting differences in program purposes, implementation strategies, and myriad other factors. Proponents of

education technology have been quick to use research data to argue the criticality of 1:1 programs as agents of reform (Weston & Bain, 2010). Those opposed to 1:1 initiatives are just as swift to use the same data to label 1:1 initiatives as expensive fads that have not lived up to promises of improved student achievement (Cuban, 2006, 2011; Cuban, Kirkpatrick, & Peck, 2001; Toyama, 2011). Sorting the data into relevant information requires careful attention to the intended purpose and outcomes of each 1:1 initiative; the fidelity to essential conditions of technology integration (ISTE, 2011) and evaluation benchmarks.

One-to-one programs vary in purpose and evaluative measures. One-to-one programs designed to reduce the cost of textbooks may use simple cost/benefit algorithms to evaluate the achievement of program goals. Initiatives designed to improve student performance on standards based assessments will track student performance. Strategies to improve assessment performance may include the amplification of traditional teacher-centric practices using digital tools to enhance, reinforce and motivate students. Initiatives to further systemic efforts to create a digitally assisted, constructivist learning environment may use multiple measures to evaluate change in performance. However, public dialogue related to the effectiveness of 1:1 programs rarely differentiates between the programs distinctly separated by purpose; they are virtually all judged by changes in student achievement.

The outcomes of 1:1 program are classified into three areas of effect: student achievement, student attitudes, and teacher styles. Overall, student achievement attributed to 1:1 programs is mixed with assessment scores described as flat, statically insignificant or slightly elevated. While writing often shows marginal growth, reading, math and science remain a matter of concern as 1:1 programs are expensive and implemented with enthusiastic hopes for growth in student achievement. However, the failure to lift assessment scores does not necessarily falsify on the positive link between DLT and student learning. Rather, the failure to achieve program goals may be attributed to other factors. Further, assessments are designed to measure the acquisition of skills and knowledge, while technology integration is tuned to go beyond knowledge to include

application and meaning. More research needs to be conducted to answer questions related to teaching and the type of technology used to support instruction.

Over the last fifteen years, 1:1 programs that achieved significantly improved performance targets were rare and usually embedded within other broad-based reform initiatives designed to create student-centric learning environments (Bebell & Kay, 2010; Goodwin, 2011; Holcomb, 2009). Penuel (2006) suggests that gains in student achievement in "one-to-one initiatives would need to be part of a larger, more comprehensive effort to improve instruction" (p. 341). Improvements in student performance will take time as everyone involved must first learn to become learners.

Positive growth in student motivation was almost universally noted by all (Argueta, Huff, Tingen, & Corn, 2011; Bebell & Kay, 2010). While primarily anecdotal, this information validated the comfort students have in using technology (Bebell, 2005; Bebell & Kay, 2010; Mouza, 2008). Most students, even those just entering school, are proficient users of the same technology that schools are trying to introduce into education to achieve 21st century outcomes. The first step in this process is to create classrooms that invite students to become motivated learners. Academic success begins with students who are engaged. One-to-one programs invite students back to school.

One-to-one initiatives across the country noted the crucial role teachers play in the success or failure of any school improvement initiatives. Bebell and Kay (2010), based on an analysis of the Berkshire 1:1 initiative, concluded that it "is impossible to overstate the power of individual teachers in the success or failure of 1:1 computing" (p. 47). A number of researchers agreed with this conclusion, (Cuban et al., 2001; M. Grant, Ross, Wang, Potter, & Wilson, 2004; Lei & Zhao, 2010; Palak & Walls, 2009) noting the important role that beliefs have in determining instructional actions. Teachers make the final decision regarding the purpose of technology based on beliefs and ultimately by teaching style (Drayton, Falk, Stroud, Hobbs & Hammerman, 2010; Ertmer, 2005; Palak & Walls, 2009).

Several researchers have concluded that teaching in a technology-rich environment does not modify teaching style or result in a student-centric constructivist

environment (Bauer & Kenton, 2005; Cuban et al., 2001; Judson, 2006; Keengwe & Onchwari, 2009; Keengwe & Onchwari, 2011). Palak and Walls (2009) concluded: "teacher use of technology is most frequent for preparation, administration, and management purposes, but rare when it comes to facilitating student-centered pedagogy even among those teachers who work in technology-rich schools and are comfortable with technology" (p. 436). Goodwin (2011) writes: "Rather than being a cure-all or silver bullet, one-to-one laptop programs may simply amplify what's already occurring—for better or worse—in classrooms, schools, and districts" (para. 14). This is a significant conclusion because the majority of teachers deliver instruction based on the teacher-centric style found in most classrooms. If true in practice, 1:1 programs that were designed to shift teachers from teacher-centric to learner-centric models will have little effect.

"Not so," according to a number of researchers (Becker & Ravitz, 1999; Becker & Riel, 1999; Holcomb, 2009; Matzen & Edmunds, 2007) who assert that teaching styles are malleable and subject to change as a result of participation in technology rich classrooms. Silvernail and Gritter (2007); Drayton, Falk, Stroud, Hobbs, and Hammerman (2010); Norris and Soloway (2004); Zucker & McGhee (2005) and Holcomb (2009) have all validated changes in teacher behavior that reflect emerging student-centric beliefs. Silvernail, et al. (2011) noted that participation the Maine statewide 1:1 initiative had demonstrated measurable increases in student-centric practices. Argueta et. al. (2011), after reviewing six major statewide 1:1 initiatives write: "In several of the 1:1 initiatives, teachers shifted away from traditional pedagogical approaches and became facilitators and coaches" (p. 12). Teachers in the 1:1 programs reported an increased confidence and willingness to use student-centric teaching practices (Bebell & Kay, 2010).

Research clearly identified staff development as a key process in achieving the goals defined in 1:1 programs. The key to influencing teacher behaviors to reflect a student-centric, digitally active teaching style is "job embedded, student-centered, collegial, ongoing, and metacognitive" professional development (Holcomb, 2009, p. 50).

Successful initiatives share well-developed professional development programs that lead to student-centric, constructivist teaching styles (Bebell & Kay, 2010; Russell, Bebell, O'Dwyer, & O'Connor, 2010; Shapley et al., 2006). Moeller and Reitzes (2011) state that "only 23 percent of teachers surveyed felt prepared to integrate technology into their instruction. Those who used technology did so primarily to present information rather than to provide hands-on learning for students" (p.7).

In 2005, Association of Alaska School Boards (AASB) sponsored the Consortium for Digital Learning (CDL) "as a means to help students develop 21st century skills, improve achievement and prepare for success in the global economy" (CDL, 2011, para 1). The application process required significant commitment by participants to follow the research-based implementation plan and sustain the initiative. Schools were provided laptops, wireless access, instructional software, technical support and ongoing professional development to help integrate DLT into instruction (CDL, 2011). Since 2005, over 12,000 students in twenty-eight of Alaska districts have participated in the Consortium for Digital Learning (CDL, 2011).

Ohler (2009, 2011), based on a comprehensive final evaluation of the CDL project, concluded that CDL-sponsored initiatives had achieved several program goals.

- Achievement data showed only marginal effects on student achievement on state assessments (Ohler, 2009). However, all sites reported improved attitudes and increased student engagement. These are encouraging indicators, given that student attitudes and engagement have been identified as causal agents of school failure, especially among Alaska Native students (Demmert, 2001).
- Teachers, students and parents are committed to continuance of the laptop program even in the face of a competitive budgetary environment. The learning community valued the effect DLT has had on creating a student-centric learning environment and in preparing youth for the future.
- Improvements in student engagement and attitudes regarding learning are valued by the community as important indicators of success.

- Teachers must be engaged in continuous professional development.

These findings are consistent with research related to 1:1 initiatives across the United States. Ohler (2011) provides the challenge and the solution for 21st century education.

> Our schools and communities have embraced the shift to digital age teaching and learning. We have done so in order to reinvigorate K-12 education and better prepare our students for the world they encounter beyond high school, regardless of whether they go to college or enter the work force. (p. 4)

Digital technology, and especially DLT, is well suited to mediate between the challenges of the present and the opportunities of the future. DLT supports a constructivist learning environment that mimics Alaska Native educational practices, reflects MBE best practice research and prepares students for an unpredictable future. The teacher is the key to unlock the power of digital learning assets that can unite Western and Alaska Native styles into an educational system that works for all kids. Understanding the relationship between teaching style and the application of digital technology to create a student-centric learning environment will inform the strategies necessary to affect change.

Chapter 3: Methodology

This embedded, mixed-methods study will address the relationship between teaching style and the level of technology used in Alaska's 1:1 digital high school classrooms. In this strategy, the qualitative data provides a supportive, secondary role to quantifiable data (Creswell, 2009). The study will use data solicited through survey to test the hypothesis that teaching style (independent variable) will influence the levels of technology usage (dependent variable) for teachers working in 1:1 digital classrooms. A secondary purpose will be to gather qualitative data that will explore changes in teaching style as a result of participation in a 1:1 program and help to validate the quantitative data (Greene, Caracelli, & Graham, 1989).

Chapter Three will review and document the process of inquiry as it evolved through the following stages: (a) theory, (b) context of the researcher, (c) population parameters, (d) delimitation of the study, (e) survey development and administration, (f) analysis of quantitative data, (g) analysis of qualitative data, (h) triangulation of data and (i) summary.

3.1 Study Questions

Three study questions guided the design and conduct of the study.

Question 1: "What is the relationship between instructional philosophy and the way teachers use technology to support learning within Alaskan high school 1:1 laptop programs?"

- Null Hypothesis H_0: There is no relationship between a teacher's instructional philosophy and way teachers use technology to support learning within Alaskan high school 1:1 laptop programs.
- Alternative Hypothesis H_1: There is a relationship between a teacher's instructional philosophy and way teachers use technology to support learning within Alaskan high school 1:1 laptop programs.

Study Question #2: "How does access to a 1:1 classroom affect a teacher's instructional philosophy or its practice?"

Study Question #3: "Does access to a 1:1 digitally enhanced teaching environment

facilitate the use of instructional practices that are consistent with Alaska Native and 21st century learner outcomes?"

3.2 Theory

Research is a search for knowledge guided by the researcher's epistemological assumptions about the nature of the universe. Research must begin with a review of the basic philosophical beliefs that define the researcher's worldview; those assumptions that provide both a philosophical foundation to construct the study and a template to ensure that the design, conduct and analysis of the study is philosophically coherent. Creswell (2009) describes worldview as "a general orientation about the world and the nature of research that a researcher holds" (p. 6). The researcher has a responsibility to articulate a succinct philosophical prescription that allows the study to be interpreted by others using the philosophical perspectives of the researcher.

Four epistemological worldviews are typically defined in the literature: post-positivism, constructivism, advocacy/participatory and pragmatism (Creswell, 2003). Four brief comparisons are included in Table 7.

Table 7

Four Major Worldviews of Scientific Inquiry

Postpositivism	**Constructivism**
Determination	Understanding
Reductionism	Multiple participant meanings
Empirical observation and measurement	Social and historical construction
Theory verification	Theory generation
Advocacy/Participatory	**Pragmatism**
Political	Consequences of actions
Empowerment and issue-oriented	Problem-centered
Collaborative	Pluralistic
Change-oriented	Real-world practice oriented

Note: Adapted from Creswell 2009, p. 6.

Each worldview includes qualities that differentiate them from another. Post-positivists view knowledge as rational, deterministic and subject to scientific verification (Creswell, 2009). Constructionists view knowledge as socially constructed, relative and

subject to individual interpretation (Masadeh, 2012). Advocacy/participatory worldviews are concerned with the need "intertwine politics and a political agenda" in the conduct of the study (Creswell, 2009, p. 9).

This study is founded on the researchers acceptance of pragmatism, a philosophical worldview focused on problem solving and solutions (Tashakkori and Teddlie, 2003). Sleeper (1986) defines pragmatism as a "philosophy rooted in common sense and dedicated to the resolution of conflicts that divide us" (p. 8). Pragmatism allows for multiple *a priori* assumptions, as well as different forms of both data collection and analysis (Creswell, 2003 p. 15). Pragmatism provides flexibility to construct a methodology suited to the unique challenges of Alaska's rural schools.

The mixed-method approach derived from pragmatism provides the philosophical articulation required to reach a deeper understanding of 'why' behavior occurs. Strategies for mixed method research draw from both quantitative and qualitative models, and require fluency in both. The mixed-method approach was of particular interest in this study because teacher attitudes related to digital learning are difficult to measure quantitatively, while data related to the use of technology are more difficult to gather qualitatively.

The nature of the study questions had a critical influence on the design of both the research methodology and the methods. The selection of an embedded, concurrent mixed method was based on similarities to research methodologies that prioritized quantitative survey research data with qualitative data playing an embedded, ancillary role. The concurrent collection of qualitative and quantitative data and the intent to merge data during the analysis fit the ECMM strategy of research (Creswell, 2007, 2009; Terrell, 2012). *Figure 9* provides a portrait of ECMM research design.

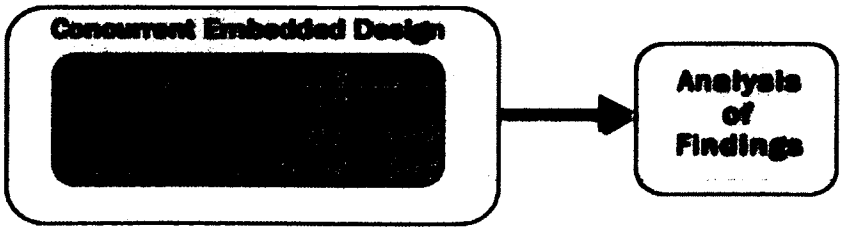

Figure 9. Mixed methods research design.

Terrell (2012) suggests that concurrent, embedded mixed method-strategies have two primary purposes: (a) to gain a broader perspective than could be gained from using only the predominant data collection method and (b) to address different research questions. Considerations related to pedagogical style, technology integration and the researcher's own experiences with Alaska's rural schools were also integrated into the decision matrix. In the final analysis, Howe and Eisenhart (1990) conclude:

> First, a methodology must be judged by how well it informs research purposes, at least as much as by how well it matches a set of conventions. What counts as good educational research will not necessarily match what counts, at any given point in time, as orthodox methodology; for methodology must respond to the different purposes and contexts of research methodology must be judged by how well it informs research purposes, more than how well it matches a set of conventions. What counts for good research will not necessarily match what counts as orthodox methodology. (p. 4-5)

3.3 Controls for Bias

Research bias, whether covert or overt, affects every facet of research from the selection of a study design to the conclusions. Scientific inquiry, as any human endeavor, is subject to the philosophy, experience and professional knowledge of the researcher. For both qualitative and quantitative scientists "their ultimate tasks are the same, to describe their data, construct explanatory arguments from their data and speculate about why the outcomes they observed happened as they did" (Sechrest and Sidana 1995, p. 78). Steps to minimize research bias begin with the acceptance that, to some degree, bias is a resident influence in every study. The research cohort engaged in frequent discourse on the nature of bias and how to control for it during the course of the study. These discourses led to the identification of both overt and covert biases intendant on this research. The cohort recognized that researchers must take explicit steps to identify and reduce bias (R. Johnson & Onwuegbuzie, 2005; Sandelowski, 1986). See Appendix A.

Qualitative, mixed-methods and quantitative researchers are concerned with bias for different reasons. Quantitative researchers seek to minimize bias that may interfere

with efforts to replicate the study results by other independent researchers. In qualitative and mixed-method studies, the validity of conclusions is determined by the degree that bias has been identified, understood and controlled as part of that research. Once an attempt has been made to identify and document bias, it becomes a prescription for others to see, evaluate and discover meaning in the research data as done by the researchers. In both research designs it is critical that bias be identified.

3.4 Context of the Researcher

The research described here has been conducted by an educator in Alaska's urban and rural school districts with 35 years experience as a teacher, principal, superintendent and State Commissioner of Education. The perspectives drawn through these experiences have animated both personal beliefs and educational philosophy. In general terms, philosophical assumptions can be categorized as positivistic; the complex nature of human behavior precludes simplifying into causal judgments. Until this is revealed, pragmatism affords a balanced perspective from which to explore the world and enjoy the diversity of human fellowship.

Pedagogically speaking, years of educational practice have led to the realization that constructivism most closely matches the researcher's teaching style. Watching the twinkle of curiosity in the eyes of kindergartners disappear as the freedom to explore was replaced with rigid content and process that stratified these beginning learners into "those who can" and "those who cannot" suggested a conflict between how students want to learn and how they are taught. Constructivism creates a learning environment that respects the individual while ensuring that the skills necessary for life are nurtured in every child. The opportunity to work in diverse situations has encouraged a deeper understanding of the many worldviews and belief systems resident in Alaska's student populations.

3.5 Parameters of the Research Population

In 2005, the Alaska Legislature allocated $5,000,000 to the Association of Alaska School Boards (AASB) to create one-to-one digital learning classrooms throughout the 660,000 square miles of the state. A new AASB-sponsored initiative, the "Consortium for

Digital Learning" (CDL), was challenged to design, implement and evaluate 1:1 learning classrooms throughout Alaska. Districts applying to participate in the CDL program had to fully commit to four key conditions of district readiness in order to apply for funding: leadership, learning, technical infrastructure and community engagement (CDL, 2006).

- Leadership: There is clear, shared leadership with demonstrated vision and goals and a commitment toward excellence that can be articulated by all stakeholders (CDL, 2006, p. 1).
- Learning: Present project school(s) curriculum and instruction are models for project-based learning with authentic and multiple assessments used to guide instruction. There is a comprehensive professional development plan that supports and validates student learning. The belief that technology supports the total learning environment with 24/7 access to digital content and tools is generally accepted (CDL, 2006, p. 1).
- Technical Infrastructure: The technical infrastructure provides 24/7 access to teachers and students through network-based and web-based tools and a pervasive wireless network is available at the project school(s). The goal is for all project students and teachers to have a dedicated laptop. A tiered-model of support provides timely assistance for software or hardware issues. A system is in place to make sure that project students and teachers always have the best available tools by planning for repairs and replacement in a timeline based on teaching and learning (CDL, 2006, p. 1).
- Community Engagement: The project community(ies) understands and supports the vision and mission of the district. The project school(s) is seen as a natural extension of the community. There is a comprehensive public relations and community outreach from the project school(s) with pervasive community support and sponsorship of project school(s) initiatives from all stakeholder groups. There is a clear link between community vision and improvement (CDL, 2006, p. 1).

These standards were used to define the study populations. Those programs that did not

meet these minimum standards were not included in the study.

3.5.1 Population sample. The study population included teachers in rural Alaska who were in 1:1 classrooms during the 2010-2011 school year. Using information provided by the Consortium for Digital Learning, the Alaska Department of Education and Early Development and through purposeful contacts with district superintendents, the cohort of researchers established that there were twenty-two school districts in the state that met the criteria to be included in this research study. This included two districts that were not in a CDL project but that still met the criteria for inclusion. Additionally, two new requirements were added to the criteria for participation. First, classrooms that were only in the first year of implementing a 1:1 program were excluded from the study. Second, the Institutional Review Board (IRB) required written permissions from district superintendents before the survey was administered. Without this permission, the districts were excluded. Of the twenty-two districts identified as having 1:1 programs, ultimately thirteen participated in this study. Based on data from the Alaska Department of Education and Early Development, this represented a potential population of 236 teachers. Table 8 provides specific information relative to the participation of each of the districts involved in the study.

Table 8

School Districts Participating in Study

District	Grad Level Implementation	Population HS Teachers	Survey Permission	School Conflict	Participation in Survey
AEBSD	9-12	16			Yes
BBSD	9-12	6			Yes
Cordova	7-9	4			Yes
Craig	9-12	13		X	
Denali	6-12	10		X	
Dillingham	9-12	12		X	
Haines	9-12	7			Yes
Iditarod	8-12	8	No		
Juneau	9-12	31			Yes
Klawock	9-12	8			Yes
Kashunamiut	9-12	9	No		
Kuspuk	9-12	13			Yes
Lake and Pen	9-12	3	No		

(Table 8 continued)

LKSD	8-10, 9-12	83			Yes
NSBSD	1-12	50			Yes
NWABSD	9-12	30			Yes
Petersburg	3-12	12			Yes
Pribilof	9-12	4	No		
SEISD	6-12	12	No		
SWRSD	6-12	17			Yes
Wrangell	9-12	14			Yes
Yukon Flats	6-12	4	No		
Total Population		366	2639		
Total Sample Population		236	2142		

Note: School Districts with 1:1 High School Programs 2010-2011 School Year. Population number provided by Alaska Department of Education and Early Development.

3.6 Research Methods

Three of the cohort members identified survey research as the primary method to collect data from teachers while one member elected to conduct a qualitative study based on data collected from student focus groups. The time spent jointly planning, developing, and administering a common survey instrument created a "community of learners and researchers" committed to a common research goal. Instead of four researchers working alone, each of the four profited from the wisdom, insight and knowledge of the other three.

The decision to utilize surveys for collecting data included the following considerations:

- An e-mail survey efficiently solicits study data without the expense of travel.
- A single survey allowed the cohort to access the research group at a single moment in time without disrupting instruction or afflicting teachers with multiple time-consuming and repetitive questionnaires.
- A single survey would provide all the quantitative and qualitative data.
- The online survey tool "Survey Monkey" was used to deliver and manage the survey efficiently.
- The survey allowed data to be collected from a cross-section of Alaska.
- A survey instrument is an efficient method to collect data.

- One-to-one teachers are proficient users of e-mail.
- Both surveys allowed the respondents to remain anonymous.

Two surveys were used to collect data for this study. The first cohort survey collected a wide range of quantitative and qualitative information. A second, four question open-ended form, was e-mailed to the respondents of the first survey to generate further qualitative information specific to this study. Focus group data collected from four student focus groups, each led by a cohort member, was shared with other members of the cohort. One focus group question from each of the cohort members was included in the focus group discussions. All teachers were provided with "Informed Consent" documentation prior to the survey.

3.7 Expert Review

The research methodology underwent a number of revisions as a result of external, expert reviews. Besides the advice offered by dissertation committee members, the cohort solicited advice from several researchers who examined the data collection and analysis plan. Cohort members also sought critical review of the survey from classroom teachers, district technology coordinators and building principals to ensure that the survey questions were clear and comprehensible. The state technology coordinator for Alaska conducted the final review (R. Mourant, cohort interview, January 23, 2011).

The final survey tool included professionally created questions specific to the data needs of each study. Permissions was granted to use modified *Professional Technology Profile* and the *Teaching, Learning and Computing—1998* survey instruments.

3.8 IRB Approval

IRB approval was initially granted by the University of Alaska, Fairbanks Institutional Review Board in December, 2010. An extension was granted in January, 2012. Approval to send a second survey, "Technology and Teaching Style Survey" (TTSS), was granted by the UAF - IRB in September, 2011. See Appendix "D".

3.9 Alaska Native Code of Research Ethics

The Alaska Native Science Commission has defined a code of ethics to guide researchers exploring Alaska Native culture. As this study asked questions relevant to the

interests of Alaska's Native community, it was considered prudent to evaluate the study design to ensure that it conformed to both the letter and the spirit of the code. The data-collection methodology was designed so as not to collect cultural knowledge either by interview or by survey. All Alaska Native historical and cultural knowledge collated by the study was derived from previously published sources. Under the Alaska Native Science Commission's code of research ethics, it was not necessary to seek a memorandum of research for this project. However, in the spirit of respect, Alaska Native Elders and educators have been consulted prior to the release of this study's research findings. It is hoped that this will minimize any cultural misunderstandings caused by researcher bias or cultural dissonance.

3.10 Web-Based Survey Development

The research cohort used the stages of survey research suggested by Rea and Parker (2005) as a framework to ensure that the survey process was professionally constructed and administered. The primary goal was to create an instrument that would collect a sufficient quantity of reliable data in a timely manner while addressing the study questions. Working together as a cohort presented significant challenges regarding the development of the survey. Designing a single survey to meet the data needs of four separate studies while remaining time efficient and logical in format was a difficult challenge. However, patient discussion and compromise fostered the development of a quality survey.

The research cohort created a matrix to map data onto common and divergent elements. This matrix identified previously validated instruments for data collection and the construction of new survey questions. The cohort determined that available survey instruments, with minor modifications, were sufficient to meet the data collection goals of each cohort member. Permissions were granted to embed the professionally developed instruments into the final survey. While ultimately, the final teacher survey included items from different sources, it was seen as a logical and coherent request for information. See Table 9 for list of surveys used by the cohort.

Table 9

Survey Instruments Used in Cohort Study

Name of Instrument	Authoring Citation	Measurement
Concerns Based Adoption Model*~	Newhouse, 2001	Reaction to change or innovation over time.
Apple Classrooms of Tomorrow (ACOT) Evolution of Thought and Practice*~	Dwyer, 1995	Levels of Technology Integration: Entry, Adoption, Adaptation, Appropriation, Innovation
SAMR Technology Adoption Cycle	Puentedura, 2008	Levels of Technology Use: Substitution, Augmentation, Modification, Redefinition
Roger's Diffusion and Innovation ~	Rogers, 2003	Levels of Adoption of Innovation: Innovators, Early Adopters, Early Majority, Late Majority and Laggards
Professional Technology Profile*+	Lemke, 2009	Level of Personal, Professional and Classroom Use of Technology
Teaching, Learning, and Computing—1998*+	Becker and Anderson, 1998 Becker et al., 2000	Teaching Style

Note: * Permission granted by developer. ~ Used by Technology Cohort. + used by this study.

The final cohort survey instrument was composed of 219 closed-item questions and nine opened-ended questions. Following pilot study revisions and IRB approval, the survey was sent to qualifying schools. The window for the Technology Frameworks Survey was from April 15 through June 1, 2011. The framework for the survey is represented by Table 10.

The Technology Frameworks Survey (TFS) included two professional survey instruments specific to this study: Teaching, Learning and Computing—1998 (TLC) Survey (Becker & Anderson, 1998) and the Professional Technology Profile (PTP) (Lemke, 2009). The TLC survey was designed to measure teaching style and the PTP was constructed to measure levels of technology use.

In 1998, the National Survey of Computer Technology and Instructional Reform (Becker & Anderson, 1998) surveyed over 4,000 teachers, investigating the relationship between teacher beliefs, instruction and the application of DLT in the classroom. A section of this study specifically evaluated teacher beliefs on a linear scale from Traditional Transmission Instruction to Constructivist-Compatible Instruction, or

Table 10

Technology Frameworks Survey

Section	Section Title	Questions	Question Focus
1	Demographic	10	Name, gender, age, ethnicity, years teaching, years teaching in Alaska, awareness of Alaska Native culture and history, years at current school, years in laptop program, level of technology proficiency
2	Internet Access	10	Internet access at home and school, broadband capacity, time using internet for home and school
3	Professional Development	3	Professional development programs in support of the 1:1 initiative
4	Personal Use	25	Application and frequency of use to support personal interests.
5	Professional Practice	58	Application and frequency of use to support professional practices. Leadership in technology
6.	Teaching Style and Philosophy	39	Questions designed to measure teaching style by asking teachers to choose a position on teaching scenarios.
7.	Classroom Use	68	Application and frequency of use to support professional practices. Does access to a 1:1 change instruction?
8.	Open Ended Questions	8	Relationship between teaching style and the use of technology. Awareness of Alaska Native and 21st century teaching styles and outcomes.
• How has your participation in the laptop program affected your teaching style? • How does your teaching style affect the depth of student technology usage in your classrooms? • How does your use of classroom-based technology contribute to increased academic performance among your Alaska Native Students?			
Follow-up Survey: Technology and Teaching Style Survey (TTSS)			
1	Follow-Up Questions	4	Relationship between teaching style and the use of technology. Awareness of Alaska Native and 21st century teaching styles and outcomes.
• Given your experience and observations as a teacher and technology user, describe the relationship between a teacher's basic instructional philosophy and the way he or she uses technology to support student learning? • Describe any changes to your philosophy or beliefs as a result of your experiences teaching in a 1:1 classroom? • How has access to a 1:1 digital classroom influenced your pedagogical practice? • How has access to a 1:1 classroom increased the congruence between your instructional practice and traditional ways of passing on knowledge used by Alaska Native cultures?			
Focus Group Question			
Focus Group Question	How does a teacher's use of technology affect your motivation as a learner?		

more simply, from teacher-centric to constructivist beliefs. Becker et al. (2000) differentiated between these two major instructional traditions:

> Traditional Transmission Instruction is based on a theory of learning that suggests that students will learn facts, concepts, and understandings by absorbing the content of their teacher's explanations or by reading explanations from a text and answering related questions. Skills (procedural knowledge) are mastered through guided and repetitive practice of each skill in sequence, in a systematic and highly prescribed fashion, and done largely independent of complex applications in which those skills might play some role (p. 3).
>
> Constructivist-Compatible Instruction is based on a theory of learning that suggests that understanding arises only through prolonged engagement of the learner in relating new ideas and explanations to the learner's own prior beliefs. A corollary of that assertion is that the capacity to employ procedural knowledge (skills) comes only from experience in working with concrete problems that provide experience in deciding how and when to call upon each of a diverse set of skills (p.3).

Becker and Anderson's (1998) Teaching, Learning and Computing survey (TLC) was selected for several reasons:

- The TLC has extensive documentation and has been subject to peer review.
- The TLC is compatible with the present study interests - differentiating between teacher-centric and student-centric practices.
- The TLC is specially designed to validate the link between self-reported beliefs and actual classroom practice. Using an index score, the TLC survey development group achieved a correlation of (+0.85) between beliefs and observed classroom practice (Becker et al., 2000)
- The TLC produces a simple scale score. The scale score is the mean of thirteen questions or prompts that asked teachers to differentiate between transmission and constructivist practices.

The thirteen questions used to calculate the scale score or index were selected by

factor analysis to generate a reliability alpha of .81 (Becker et al., 2000). Each question differentiates along a continuum between transmission and constructivist beliefs. The same group of 13 questions using SPSS 19 produced a Chronbach alpha for the 2011 TFS of (a = .80). Table 11 lists the questions included in the belief index.

Table 11

Teacher Teaching Style Index

No.	Question Prompt	Index
1	Jones' inquiry approach produces more student knowledge than Hill's direct instruction.	1
2	Jones' inquiry approach produces more student skills than Hill's direct instruction	1
3	Believes in being a facilitator rather than explainer.	3
4	Student interest and effort is more important than textbook content.	3
5	Sense-making and thinking are more important than the specific curriculum content.	3
6	Different students engaged in different project-type activities is better than the whole class working at the same time on a series of short-duration assignments.	3
7	Students will take more initiative if they are free to move around the room.	2
8	Students should help establish the criteria on which their work is assessed.	2
9	Instruction should be built around problems with clear, correct answers (R).	2
10	Teachers know more than students and shouldn't let students muddle around (R).	2
11	Student learning depends on background knowledge--that's why teaching facts is so necessary (R).	2
12	It is better for the teacher, not students, to decide what activities are to be done.	2
13	A quiet classroom is generally needed for effective learning (R).	2

Note: Permission to use survey granted by author (Becker & Anderson, 1998). R = reversed

The Professional Technology Profile (PTP) shown in Table 12, evaluates levels of technology use in three categories: personal, professional and classroom (Lemke, 2009). The PTP uses a series of multiple answer, single answer and Likert scale questions tied to one of the three categories of use that probe frequency and complexity of application. Each category is further subdivided into six roles that describe the current level of use: (a) change agent, (b) communicator/connector, (c) producer, (d) implementer, (e)

contributor and (f) consumer. Weighting is based on complexity and frequency of

Table 12

Roles Teachers Assume When Using Technology

Personal Use (TPU)	**Questions Regarding Each Role**
Change Agent (CA)	6.2.1, 6.2.2, 6.2.3
Connector/Communicator (CC)	6.1.1, 6.1.5, 6.1.11, 6.2.4, 6.2.5, 6.2.11
Contributor (C)	6.1.2, 6.1.3, 6.1.4, 6.1.8, 6.2.6, 6.2.7
Producer (P)	6.1.6, 6.1.7, 6.1.10
Consumer (CO)	6.1.9, 6.1.12, 6.1.13, 6.2.9, 6.2.12
Professional Practice (TPP)	**Questions Regarding Each Role**
Change Agent (CA)	7.4.1, 7.4.2, 7.4.3, 7.4.4, 7.4.16, 7.4.19, 7.4.20, 7.4.21, 7.5.1, 7.5.5, 7.5.8
Connector/Communicator (CC)	7.1.1, 7.1.4, 7.4.11, 7.4.5, 7.4.6, 7.4.7, 7.4.8, 7.4.9, 7.5.6
Contributor (C)	7.1.2, 7.1.3, 7.1.8, 7.4.10, 7.4.11, 7.4.12
Implementer (I)	7.3.1, 7.3.2, 7.3.3, 7.3.4, 7.3.5, 7.4.17, 7.4.18
Producer (P)	7.1.6, 7.1.7, 7.1.10, 7.4.13, 7.4.14, 7.5.2, 7.5.3, 7.5.4, 7.5.7
Consumer (CO)	7.1.9, 7.1.12, 7.1.13, 7.2.1, 7.2.2, 7.2.3, 7.4.15
Classroom Use (TCU)	**Questions Regarding Each Role**
Change Agent (CA)	9.1.12, 9.1.13, 9.1.20,9.1.23
Connector/Communicator (CC)	9.1.9, 9.1.10, 9.1.19
Contributor (C)	9.1.16, 9.1.17, 9.1.18
Implementer (I)	9.1.4, 9.1.5, 9.1.6, 9.1.11
Producer (P)	9.1.7, 9.1.8, 9.1.14, 9.1.15, 9.1.21, 9.1.22
Consumer (CO)	9.1.1, 9.1.2, 9.1.3

Note: Permission to use survey granted by author (Lemke, 2009).

application. Averaging the percent scores for each role created a summative index for professional, personal and classroom use.

Several factors contributed to the selection of the PTP.

- PTP reflects an up-to-date milieu of the evolving technology resources that teachers and students are using for instruction and learning.
- The PTP indices represent a comprehensive evaluation of the three primary applications of technology.
- The PTP questions evaluate both the frequency and depth of technology used to support learning.

- The PTP was used successfully in two national studies supported by the Consortium of School Networking Leadership Initiative.

3.11 Pilot Study

The TFS was subjected to a usability analysis to test for readability, wording, accuracy and clarity. A professional proofreader, a state technology specialist and several high school teachers were asked to read through both surveys. Reviewers found grammatical/spelling/punctuation errors, redundancy and questions that were not clear in intent. Based on the input from the usability and readability study, a number of corrections were made to the survey instruments.

The pilot study included two school sites in rural Alaska: Kiana High School in the Northwest Arctic Borough School District and Kuinerrarmiut Elitnaurviat in the Lower Kuskokwim School District. They were selected because they enjoyed: (a) mature 1: 1 programs, (b) strong administrative support, (c) sufficient enrollment, (d) a diverse teaching staff and (e) twenty-four hour student access. An onsite member of the cohort facilitated the pilot study at Kuinerrarmiut Elitnaurviat.

Pertinent information gleaned from the pilot sites included: (a) the survey was long, (b) some questions were redundant, (c) the open-ended questions elicited discerning responses, (d) the flow of the survey was rough. The survey was adjusted to reflect these concerns. (a) questions were condensed and reorganized into topical areas.; (b) logic skip jumps were inserted to allow for a shortened survey for some respondents.; (c) a "% Completed" field was added to each page and (d) an incentive was added to encourage increased participation. Efforts to shorten the survey, while somewhat successful, still left a lengthy survey of over 200 questions. The low response rate and brevity of response to the open-ended questions prompted the decision to conduct a second e-mailed survey composed of four new open-ended questions.

3.12 Survey Administration

The Technology Frameworks Survey invitation was e-mailed to participating schools on April 15, 2011 with a closing date of June 1, 2011. Prior to the invitation, cohort members called district superintendents to provide a reminder of the impending

survey so that school principals would not be surprised. Members monitored participation using SurveyMonkey, Inc., an online survey development tool. A follow-up e-mail to superintendents requesting a reminder directed to principals was sent in May. During the survey window, 121 teachers opened the survey webpage and 94 completed the survey itself. Twenty-seven respondents were disqualified for failure to complete the survey or for not occupying a teaching position.

Focus groups were facilitated by a member of the cohort who was using this qualitative data collection strategy as a vehicle to collect data. The facilitator included one question relevant to the mixed method studies being conducted by the three other members of the research cohort. The research questions for this study included the question: "How does a teacher's use of technology affect your motivation as a learner?"

In October 2011, following IRB and school district approval, a second survey (TTSS) with four open-ended questions was e-mailed to the 94 respondents who completed the first survey. A one-month survey response window attracted 31 respondents out of 94 invitations.

3.13 Validity and Reliability

Validity within a mixed-method study must consider the standards applied to both quantitative and qualitative research designs. The quantitative research used validated instruments that had been subject to critical peer review. The analysis of study data was consistent with accepted statistical procedures for survey research. Establishing the validity of the qualitative data began with the identification of the study problem and proceeded to conclusion. Documenting the process of inquiry is as important as the study outcomes. The research cohort worked diligently to keep the study on a tight philosophical and procedural track. The opportunity to triangulate between quantitative and qualitative data sources produced a deeper understanding of the problem, while contributing to the validity of the study conclusions.

Every effort has been made to document research and cultural bias and to build a logical pathway for reviewers leading to the final conclusions. Bazely (2004) writes:

Mixed methods are inherently neither more nor less valid than specific

> approaches to research. As with any research, validity stems more from the appropriateness, thoroughness and effectiveness with which those methods are applied and the care given to thoughtful weighing of the evidence than from the application of a particular set of rules or adherence to an established tradition. (p. 9)

3.14 Internal Reliability

Chronbach alpha (α) is a statistical measure of internal consistency or reliability that measures the degree of relationship between items in a group. Usually limited to a range between 0 and 1, the higher the value, the greater the relationship between items. The Chronbach alpha calculated for the survey subscales are all within an acceptable range except the alpha for the "contrasting statements of teaching philosophy" index. Chronbach alpha calculations were evaluated using SPSS 19 by IBM.

Gliem and Gliem (2003) suggest the following legend to evaluate Cronbach alpha reliability coefficients: "$\alpha > .9$ – Excellent, $\alpha > .8$ – Good, $\alpha > .7$ – Acceptable, $\alpha > .6$ – Questionable, $\alpha > .5$ – Poor, and $\alpha < .5$ – Unacceptable." (p. 87). The low alpha value, (.537) for the issue of "contrasting statements on teacher philosophy" was not unexpected and is in itself an important element of the study data. While the survey questions are constructed to evaluate teaching philosophy, the questions were designed to identify inconsistencies between belief and action. In this particular case, the Chronbach alpha value identified the conflicts between what teachers believe about DLT and what teachers actually practice. Chronbach alpha values for each question are listed in Table 13.

Table 13

Reliability Index for Teaching Styles and Technology Roles

Personal Use (TPU)	Chronbach Alpha (α)	Professional Practice (TPP)	Chronbach Alpha (α)	Classroom Use (TCU)	Chronbach Alpha (α)
Change Agent	α = .805	Chang Agent	α = .884	Change Agent	α = .782
Connector/ Communicator	α = .730	Connector/ Communicator	α = .855	Connector/ Communicator	α = .750
Contributor	α = .732	Contributor	α = .738	Contributor	α = .956
Producer	α = .708	Implementer	α = .792	Implementer	α = .801
Consumer	α = .335	Producer	α = .811	Producer	α = .879
		Consumer	α = .766	Consumer	α = .629
Teaching Style Indices (Becker & Anderson, 1998)					
Vignettes Describing Contrasting Instructional Styles			α = .830		
Contrasting Statements of Teaching Philosophy			α = .537		
Opinion Statements on Pedagogy			α = .778		

Note: Teaching style indices developed by Becker and Anderson (1998). Teacher roles by Lemke, (2009).

3.15 Response Rate

Using the formula defined by Rea & Parker, 2005 for small sample sizes that include both proportional and interval scale variables, a 95% confidence level was achieved with a +/- .08 margin of error. The relatively high margin of error (+/-.08) in Table 14 is due to the 40% survey response from survey one and will require a close watch over the hypothesis testing in the quantitative component of the study, especially with regard to the possibility of Type I and II errors. See Index C for a review of statistical procedures.

Table 14

Confidence Level for Population Sample

Survey	Total Teacher 1:1 Population	1:1 Study Population	Survey Response	Response Rate	Confidence Level	Margin of Error
1	366	236	94	40%	95%	+/- .08
2	366	236/94	32	14%/34%	NC	NC

Note: Confidence levels for the follow-up qualitative survey were not calculated.

Triangulating between information derived from qualitative and quantitative data sources in a mixed-method study, while not reducing the margin of error, may contribute to increased confidence in the study conclusions. The response rate for the study was lower than anticipated during the design phase. While a number of conditions may have influenced the response rate, the length of the survey and test fatigue cannot be ruled out.

The follow-up survey, designed to collect more qualitative data from first survey respondents, garnered a response rate of only 34%. While this rate is lower than what may have been expected if the questions had been added to the primary survey, the responses to the second survey were more thoughtful. Charmaz (2006) suggests that data to support a grounded theory should "continue until gathering fresh data no longer sparks new theoretical insights, nor reveals new properties of your core theoretical categories" (p. 115). Dey, (as referenced by Charmaz, 2006) contends that data collection should continue until there is a "theoretical sufficiency" (p. 116). A review of the demographic information related to the second survey showed no variation between the initial and the second survey. Further, a demographic review of the respondents to the second survey reflected little variation from the respondents in the initial survey.

The placement of the open-ended questions at the end of a lengthy survey increased the influence of test fatigue. Several superintendents indicated that teachers, continually barraged with surveys, were reluctant to participate in yet another.

Chapter 4: Analysis of Data

In chapter 4, I evaluated the data relative to the relationship between teaching style and the application of technology in Alaska's rural high school laptop programs. A review of the demographic information confirmed the fundamental elements that define 1:1 laptop initiatives: staff development, broadband, leadership, technical support and access to both hardware and software. I explored study question one via quantitative data and triangulated with qualitative data from open-ended survey questions. Study questions two and three were primarily explored with qualitative research methods. Collectively, each study question linked with other research to derive a deeper understanding of the relationship between pedagogical beliefs and the use of digital learning technologies (DLT) in creating learning environments that support both culture based education (CBE) and 21st century learner outcomes.

4.1 Demographics of Population Sample

Descriptive data was collected from an analysis of twelve survey questions. The sample of the population that took the survey was 53% male and 47% female. This ratio is notably different from the gender split among secondary teachers in Alaska, in 2011 at 63% female (Fried & Schultz, 2011). Data for gender is included in Table 15.

Table 15

Gender of 1:1 Teachers in the Study Sample

Gender		Response Percent	Response Count
Male		53%	50
Female		47%	44
n = 94	Total	100%	94

Table 16 provides data collected relative to the race of the 1:1 teachers responding to the surveys. The race of respondents is consistent with the demographics of Alaska's teachers (Hill & Hirshberg, 2006).

Table 16

Racial Make-up of 1:1 Teachers in the Study Sample

Answer Options		Response Percent	Response Count
White		85%	80
Black or African American		1%	1
Hispanic/Latino		1%	1
Asian Pacific Islander		0%	0
Alaska Native/American Indian		4%	4
Other not listed		8%	8
n = 94	Total	99%	94

Note: Percents are rounded. May not total 100%.

The age grouping showed a mature teaching staff with 81 of 94 (86%) staff members reporting ages in excess of 30 years. See Table 17 for specific data.

Table 17

Age Groupings of 1:1 Teachers in the Study Sample

Answer Options		Response Percent	Response Count
20 - 29		14%	13
30 - 39		31%	29
40 - 49		16%	15
50 - 59		31%	29
60 or older		8%	8
n = 94	Total	100%	94

Mean	Standard Deviation	Variance
2.9	1.231	1.515

Note: Data processed using SPSS 19.

Table 18 highlights the experience of teachers working within 1:1 classrooms. Sixty-eight teachers (72%) bring more than five years and 51 teachers (54%) boast more than 11 years of teaching experience.

Table 18

Teaching Experience Among 1:1 Teachers in the Study Sample

Answer Options		Response Percent	Response Count
Less than 1 year		5%	5
1 - 5 years		22%	21
6 - 10 years		18%	17
11 or more years		54%	51
n = 94	Total	99%	94

Mean	Standard Deviation	Variance
3.2	.971	.942

Note: Percents are rounded. Data processed using SPSS 19.

Teachers with Alaskan experience were well represented in the sample. Fifty-three percent (53%) of the responding teachers in Table 19 have more than five years experience teaching in Alaska while 31% have more than 11 years experience.

Table 19

Alaska Teaching Experience Among 1:1 Teachers in the Study Sample.

Answer Options		Response Percent	Response Count
Less than 1 year		6%	6
1 year		11%	10
2 - 5 years		27%	25
6 - 10 years		23%	22
11 or more years		33%	31
n = 94	Total	100%	94

Mean	Standard Deviation	Variance
3.2	1.223	1.496

Note: Data processed using SPSS 19.

The high transiency rate of Alaska's rural teachers was quite apparent. Of the 94 teachers completing the survey only about a third had worked in the same school for five or more years. Teachers commonly move to different schools within their district or to other districts in Alaska (B. Adams & Jordan, 2011). See Table 20 for specific data.

Table 20

Years Spent at Current School by Teachers in the Study Sample

Answer Options		Response Percent	Response Count
Less than 1 year		17%	16
1 year		17%	16
2 - 5 years		30%	28
6 - 10 years		36%	34
n = 94	Total	100%	94

Mean	Standard Deviation	Variance
2.85	1.097	1.203

Note: Data processed using SPSS 19.

Respondents to the survey showed a familiarity with laptop programs and sixty-six percent (66%) reported three or more years of experience working in a 1:1 teaching environment. However, as can be noted in Table 21, a noteworthy number of teachers (15%) had less than one year of 1:1 teaching experience.

Table 21

Years Experience Teaching in a Laptop Classroom in Study Sample

Answer Options		Response Percent	Response Count
Less than 1 year		15%	14
1 - 2 years		17%	16
3 - 4 years		39%	37
5 or more		29%	27
n = 94	Total	100%	94

Mean	Standard Deviation	Variance
2.82	1.015	1.031

Note: Data processed using SPSS 19.

In survey question 10, using the framework developed by Rogers (2003), teachers were asked to select the level that best describes their proficiency in using technology. Overall, a majority of teachers in 1:1 classrooms described themselves as either experienced (48%) or expert (15%) users of DLT. See Table 22.

Table 22

Digital Teaching and Learning Proficiency

Answer Options		Response Percent	Response Count
Non-user		0%	0
Beginner		1%	1
Intermediate		36%	34
Experienced		48%	45
Expert		15%	14
n = 94	Total	100%	94

Mean	Standard Deviation	Variance
3.8	.710	.504

Note: Data processed using SPSS 19.

Three separate Spearman Rho correlation tests were conducted to compare self-reported levels of technological proficiency to each of the indices defined by Lemke (2009). See Appendix "C" for statistical methods. The Spearman's Rho test was selected because the LoA indices are continuous variables whereas the self-reported levels of DLT proficiency constitute ordinal variables. The respective null and alternate hypotheses for each of the three levels of technology adoption indices are listed below.

H_0: There is no relationship between self-reported technology proficiency and the LoA for personal use of technology.

H_1: There is a relationship between self-reported technology proficiency and the LoA for personal use of technology.

H_0: There is no relationship between self-reported technology proficiency and the LoA for classroom use of technology.

H_2: There is a relationship between self-reported technology proficiency and the LoA for classroom use of technology.

H_0: There is no relationship between self-reported technology proficiency and the LoA for professional practice.

H_3: There is a relationship between self-reported technology proficiency and the LoA for professional practice.

Specific results for each test are listed in Table 23.

Table 23

Spearman Rho Coefficient for Classroom, Professional and Personal Use

Level of Adoption	Spearman Rho (r) Coefficient	Significance	Effect Size Cohen, (1988)	Degrees of Freedom
Classroom Use	$r = .278$	$p = .007$	Small	92
Professional Practice	$r = .458$	$p = .001$	Medium	92
Personal Use	$r = .476$	$p = .001$	Medium	92

Note: Cohen effect sizes: Small $r <= .2$; Medium $.2 < r <= .5$; Large $r > .5$. Sample size (n) = 94. Spearman Rho determines correlation among ordinal variables. Tests conducted using SPSS 19. See Appendix C for information related to significance and effect size. Spearman Rho (r) calculated using a 95% confidence interval-- p values >.05 are not significant at a 95% confidence interval.

A Spearman Rho correlation coefficient was computed to assess the relationship between a teacher's self-report of technology and the LoA for classroom use of digital learning technology. There was a small, (Cohen, 1988) positive correlation between the two variables, $r_s = 0.278, n = 94, p = 0.007$. A significance level of .007 rejects the null hypothesis in favor of the alternative hypothesis that there is a relationship between a teacher's self report of technology and the LoA for classroom use.

A Spearman Rho correlation coefficient was computed to assess the relationship between a teacher's self-report of technology and the LoA of digital learning technology for professional practice. There was a medium, (Cohen, 1988) positive correlation between the two variables, $r_s = 0.458, n = 94, p = 0.001$. A significance level of .001 rejects the null hypothesis in favor of the alternative hypothesis that there is a relationship between a teacher's self-report of technology and the LoA for professional practice.

A Spearman Rho correlation coefficient was computed to assess the relationship between a teacher's self report of technology and the LoA for personal use of digital learning technology. There was a medium, (Cohen, 1988) positive correlation between the two variables, $r_s = 0.476, n = 94, p = 0.001$. A significance level of .001 rejects the null hypothesis in favor of the alternative hypothesis that there is a relationship between a

teacher's self report of technology and the LoA for personal use.

The small Cohen correlation between a teachers' perception of technology use and the level of LoA for classroom use highlights the tension between a teacher's beliefs and the practices of instruction. The strength of Lemke's survey is that it measures technological fluency, including both the complexity of the application and the frequency of use. A low index may reflect a practiced familiarity with instructional technology coupled with a low frequency of use or basic technology applications. This, as a result of operational constraints that limit the use of technology in a classroom.

The strength of correlation between a teacher's self-report of technology use and the LoA for personal and professional use implies that teachers use technology when the barriers have been minimized. While teachers tended to over-estimate their technological proficiency at the high end of technology adoption and to underestimate it at low levels when self reporting, it was clear that generally, teachers are cognizant of their individual levels of proficiency.

Teachers in rural Alaska self-reported a significant fluency with regards to Alaska Native culture and history with over 64% of respondents shown in Table 24 selecting a three or higher on a 5-point scale.

Table 24:

Self-Perception of Alaska Native Knowledge and Culture

Answer Options		**Response Percent**	**Response Count**
1 Limited Knowledge		4%	4
2		16%	15
3		27%	25
4		36%	34
5 Deep Knowledge		17%	16
n = 94	Total	100%	94

Mean	**Standard Deviation**	**Variance**
3.46	1.084	1.176

Figure 10 highlights the significant relationship between Alaska teaching experience and the self-reported knowledge of Alaska Native culture and history.

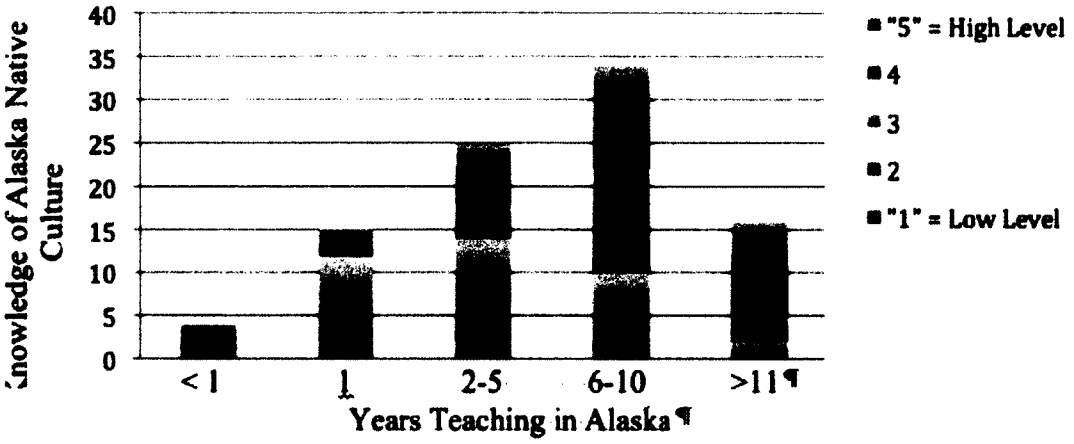

Figure 10. Alaska Native cultural knowledge and teaching experience. (n = 94).

The graph demonstrates a strong relationship between experience and the teacher's awareness of Alaska Native culture. Teachers with 11 or more years of experience selected a 3 or higher on a five point scale. Given the high level of teacher transiency in rural Alaska, Alaska Native students often face teachers who are unfamiliar with Alaska Native culture.

4.2 Quantitative Analysis—Evaluating a Theory

One-to-one programs were specifically designed to address the first-order barriers that traditionally have resisted the use of technology to support instruction and learning: i.e., professional development, technical support, leadership, broadband, software and digital hardware. The initial guidelines for 1:1 programs ensured that the basic elements necessary for effective operation were incorporated into each program. Information from the survey data shows that many of the traditional access-related obstructions to the use of DLT, while not eliminated, have been minimized. *Figure 11* shows teacher responses relative to the operational fidelity of 1:1 programs to design goals.

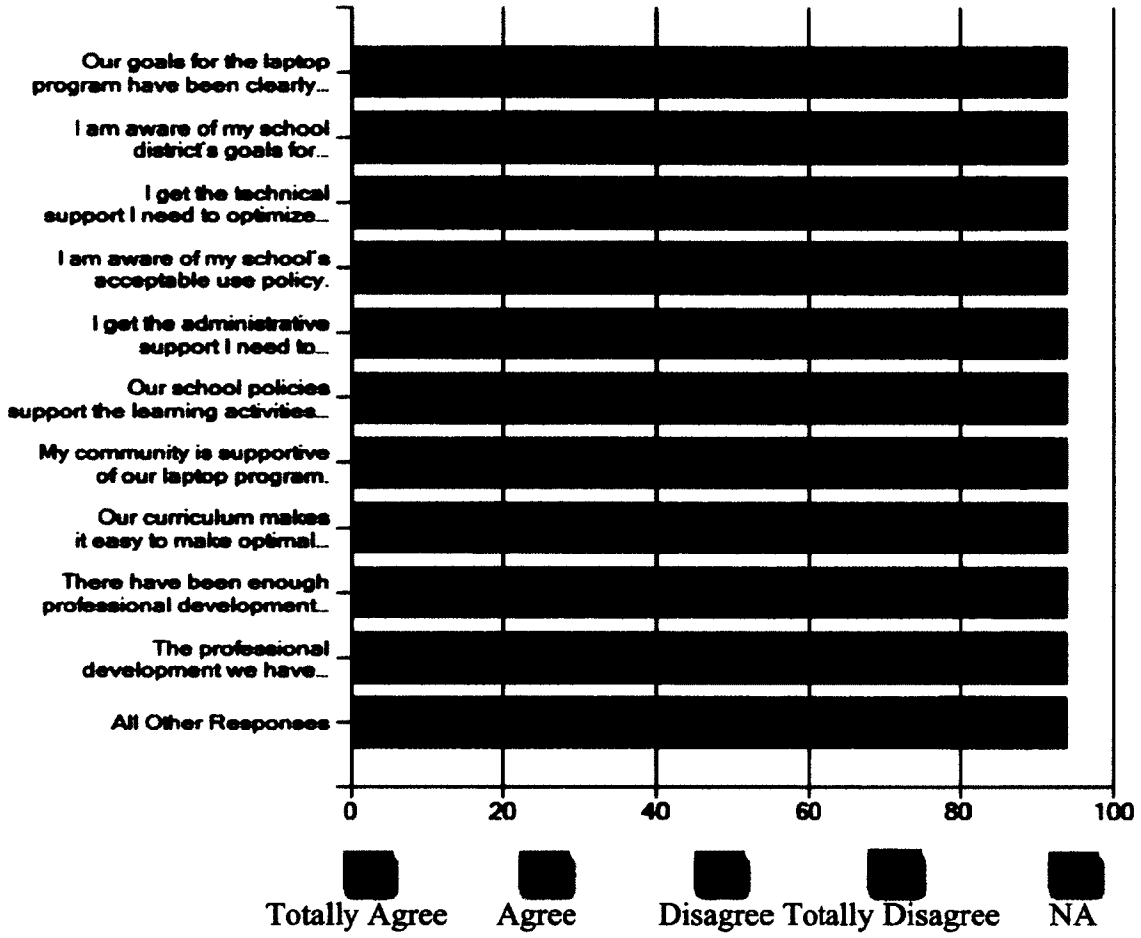

Figure 11. Levels of support for digital learning technology.

An aggregate of nearly seventy percent of the staff agreed (53%) or strongly agreed (16%) that technical support was sufficient to optimize the use of laptops for instruction. Approximately the same number (67%) believed that district administration was providing the leadership necessary for teachers to effectively implement the use of laptop computers. Teachers reported near universal access to 24-hour laptop computers (98%). Two teachers answered "no" when asked if the district provided a laptop to take home (question 12). No comments were offered that suggested access to either hardware or software interfered with the use of DLT in the classroom. While a basic majority agrees that professional development efforts are both available (58%) and relevant (50%), teachers remain interested in further training (question 49: 9 &10). Over one third of the

teachers reported receiving eight hours or less of professional development related to laptop use while ~40% received between 9 and 40 hours. The majority of staff members (>60%) have received less than 24 hours of professional development use of DLT. *Figure 12* illustrates teacher responses relative to professional development.

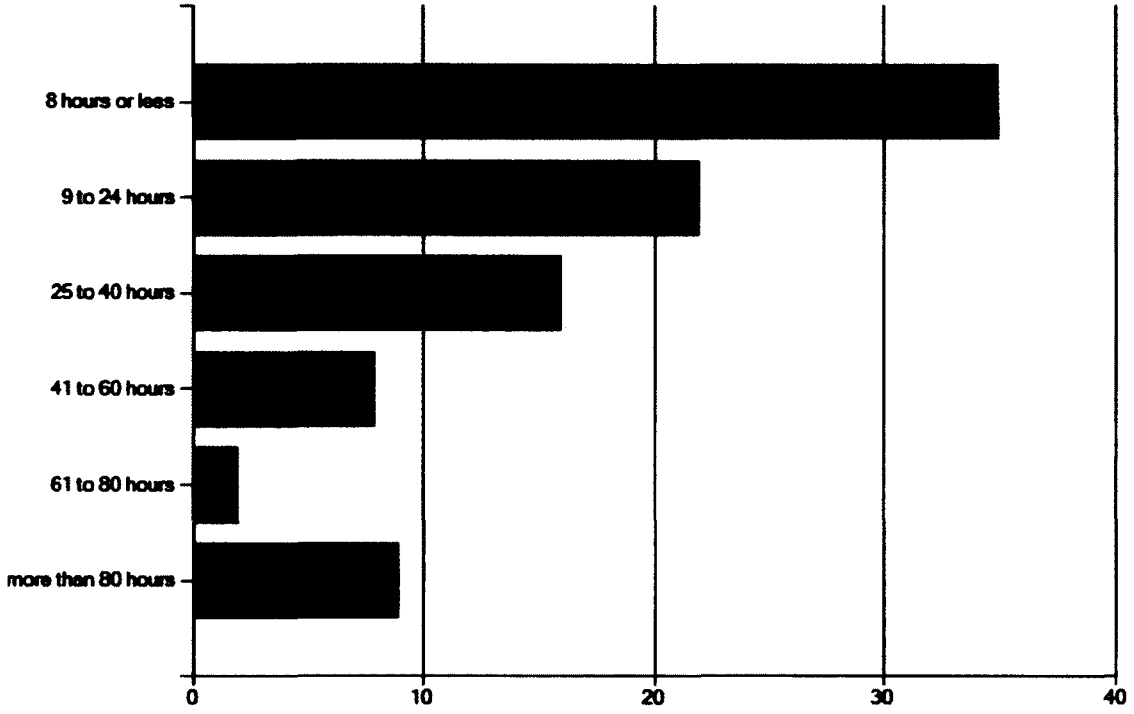

Figure 12. Staff development hours in support of the 1:1 program.

Staff development may be related to teacher concerns relative to the benefits of the laptop program as a tool of education reform. Over 50% of the respondents indicated that the statement "I would like to know how this innovation is better than what we have now or have had before" was "some what" or "exactly like me" (question 48:11). One respondent added: "We need subject specific training and ideas of how to use the laptops" (question 49: answer 2). Almost 80% of teachers were interested in learning more about using laptops (question 48:6).

Yet, survey data revealed significant changes in instructional behavior directly related to the initiation of a 1:1 program. Perhaps the most poignant testimony to the success of 1:1 laptop programs to reduce the barriers to DLT integration was the overall comfort level of teachers using laptops. In *Figure 13*, over 60% of the teachers were

actively committed to or using laptops to maximize the effects on students and instruction.

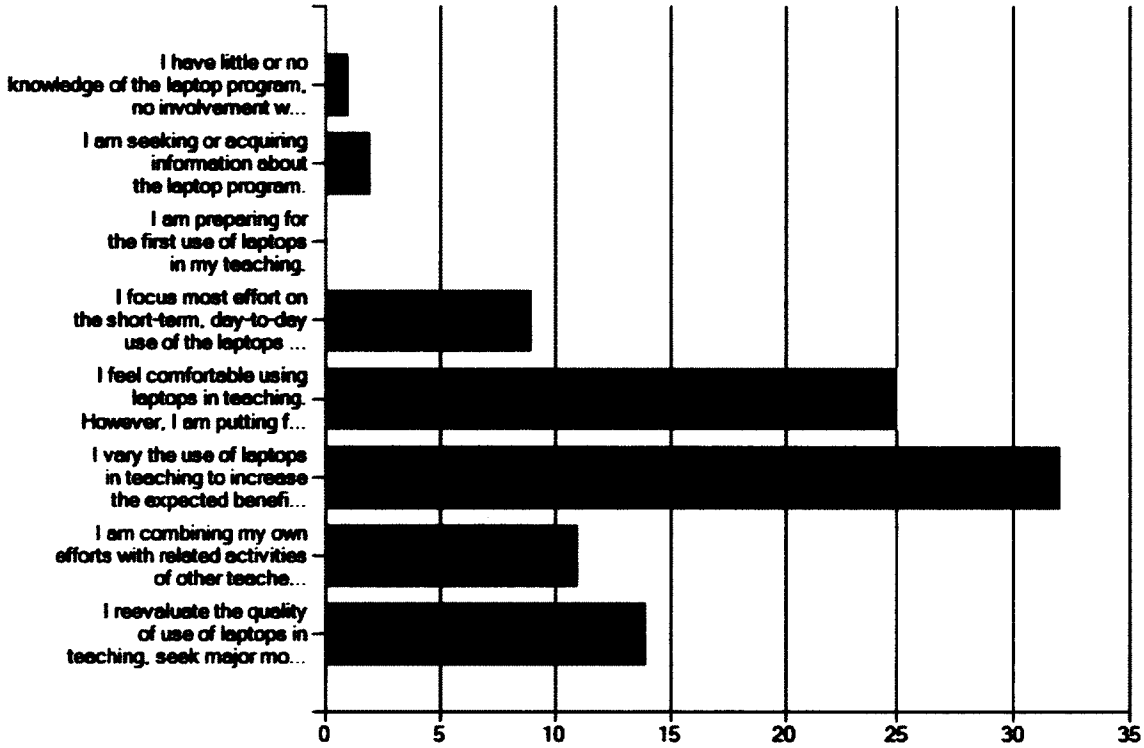

Figure 13. Level of comfort using laptops.

4.3 Teacher Beliefs and Practices

Instructional philosophy was evaluated using three indices developed by Becker and Anderson (1998) for the Teaching, Learning, and Computing: 1998 National Survey (TLC). The first index, "Beliefs and Practices", asked four questions related to a vignette contrasting transmission and constructivist pedagogical styles (Becker et al., 2000). Index two, "Learning Environment", asked teachers to agree or disagree with ten belief statements related to instruction. Finally, in index three, "Teaching Style", teachers were asked to select a position between contrasting beliefs that best represented their pedagogical practice. A summative index for teacher beliefs was calculated from 13 questions or prompts selected from the three indices that accurately placed teachers on a continuum from transmission to constructivist. See Table 25 for summary data.

Table 25

Beliefs and Teaching Style Index

n	Range	Minimum	Maximum	Mean	Standard Deviation	Variance
94	52	38	90	65	10.837	117.440

Note: The "Belief Index" is a mean of the 13 responses to the questions that define the index.

4.3.1 Index 1—beliefs vs. practices. The following vignette was created by Becker et al. (2000) to provide the basis for a series of four questions designed to differentiate teaching styles from traditional teacher-centric instruction to student-centric constructivist instruction.

> Ms. Hill was leading her class in an animated way, asking questions that the students could answer quickly, based on the reading they had done the day before. After this review, Ms. Hill taught the class new material, again using simple questions to keep students attentive and listening to what she said. Mr. Jones' class was also having a discussion, but many of the questions came from the students themselves. Though Mr. Jones could clarify students' questions and suggest where the students could find relevant information, he couldn't really answer most of the questions himself". (p. 11)

Ms. Hill represents traditional styles of instruction while Mr. Jones the student-centric, constructivist style. Each question in Index 1 is designed to identify conflicts between beliefs and practices. Table 26 lists the responses.

Table 26

Survey Response Data for Index 1—Beliefs and Practices

Questions	Hill	Towards Hill	Can't Decide	Towards Jones'	Jones
Which type of class discussion are you more comfortable having in class?	5% (5)	39% (37)	17.% (16)	31% (29)	8% (8)
Descriptive	**Mean**	**Median**	**St. D.**	**Variance**	**Range**
	2.98	3	1.126	1.268	4
Which type of discussion do you think most students prefer to have?	9% (8)	23% (22)	24% (23)	33.% (31)	11% (10)
Descriptive	**Mean**	**Median**	**St. D**	**Variance**	**Range**
	3.14	3	1.151	1.325	4
From which type of class discussion do you think students gain more knowledge?	3% (3)	17% (16)	20% (24)	36% (15)	23% (7)
Descriptive	**Mean**	**Median**	**St. D.**	**Variance**	**Range**
	3.60	4	1.121	1.254	4
From which type of class discussion do you think students gain more skills?	3% (3)	10% (9)	16% (15)	47% (44)	24% (23)
Descriptive	**Mean**	**Median**	**St. D.**	**Variance**	**Range**
	3.78	4	1.022	1.045	4

Note: Descriptive data processed using SPSS 19.

Figure 14, using data from Table 26, reveals the high level of constructivist beliefs among the sample population but lower levels of support for constructivist practices.

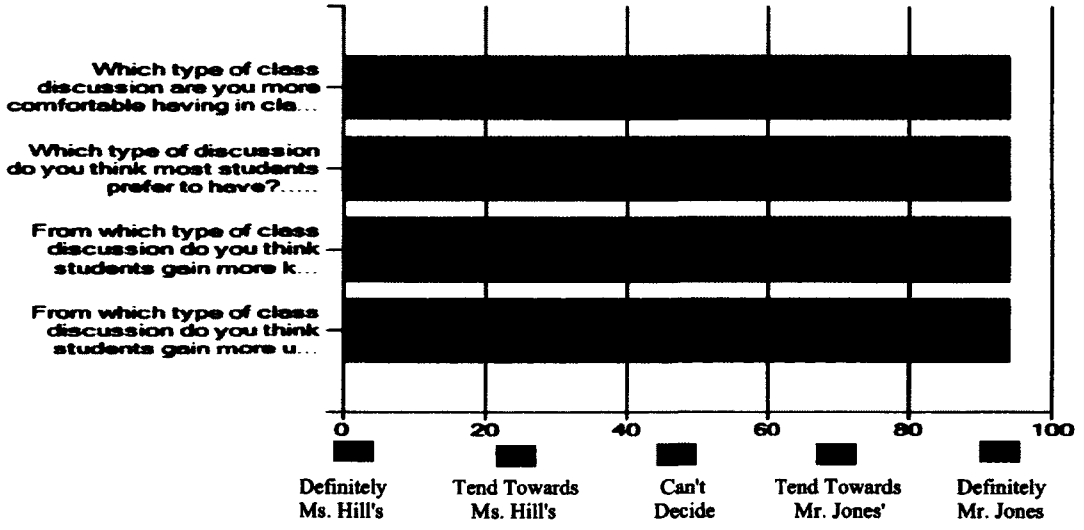

Figure 14. Index 1—contrasting beliefs and practices.

This finding is consistent with other research, reporting wide-spread agreement with the philosophy of constructivism but little evidence among the majority of practitioners that beliefs are being consistently translated into practice (Becker & Ravitz, 1999; Becker et al., 2000; K. Becker, 2002). An analysis of the descriptive data showed the complex relationship between teacher beliefs and practice. Forty-two percent of the teachers were most comfortable with a transmission style of instruction even though a majority believed that students gain more knowledge (60%) and skills (71%) with the constructivist style used by Mr. Jones. Teachers were highly constructivist in beliefs but were either more comfortable or more proficient with transmission practices, or both.

4.3.2 Index 2—learning environment. Questions within Index 2 asked teachers, through a series of ten belief statements, to take a position in support of either a constructivist or a transmission based teaching style. In this Index, respondents choose between a transmission and constructivist belief statement. Table 27 provides a list of the questions and descriptive data relative to each question.

Table 27

Survey Response Data for Index 2—Learning Environment

#	Questions						
1	Teachers know a lot more than students; they shouldn't let students muddle around when they can just explain the answers directly.	**Strongly Disagree**	**Moderately Disagree**	**Slightly Disagree**	**Slightly Agree**	**Moderately Agree**	**Strongly Agree**
		42% (39)	34% (32)	17% (16)	5% (5)	1% (1)	1% (1)
		Range	**Min**	**Max.**	**Mean**	**St. Deviation**	**Variance**
		5.00	1.00	6.00	5.06	1.03496	1.071
2	A quiet classroom is generally needed for effective learning.	**S. Disagree**	**M. Disagree**	**S. Disagree**	**S. Agree**	**M. Agree**	**S. Agree**
		16% (15)	25% (24)	30% (28)	19% (18)	8% (8)	1% (1)
		Range	**Min**	**Max.**	**Mean**	**St. Deviation**	**Variance**
		5.00	1.00	6.00	4.18	1.22661	1.505
3	Students are not ready for meaningful learning until they have acquired basic reading and math skills.	**S. Disagree**	**M. Disagree**	**S. Disagree**	**S. Agree**	**M. Agree**	**S. Agree**
		19% (18)	29% (27)	26% (24)	16% (15)	7% (7)	3% (3)
		Range	**Min**	**Max.**	**Mean**	**St. Deviation**	**Variance**
		5.00	1.00	6.00	4.27	1.32125	1.746
4	It is better when the teacher - not the students decides what activities are to be done.	**S. Disagree**	**M. Disagree**	**S. Disagree**	**S. Agree**	**M. Agree**	**S. Agree**
		8% (8)	21% (20)	24% (23)	26% (24)	16% (15)	4% (4)
		Range	**Min**	**Max.**	**Mean**	**St. Deviation**	**Variance**
		5.00	1.00	6.00	3.68	1.32156	1.747

Table 27 (Continued)

5	Student projects often result in students learning all sorts of wrong knowledge.	**S. Disagree**	**M. Disagree**	**S. Disagree**	**S. Agree**	**M. Agree**	**S. Agree**
		27% (25)	35% (33)	23% (22)	8% (8)	5% (5)	1% (1)
		Range	**Min**	**Max.**	**Mean**	**St. Deviation**	**Variance**
		5.00	1.00	6.00	4.66	1.17824	1.388
6	Homework is a good setting for having students answer questions posed in their textbooks.	**S. Disagree**	**M. Disagree**	**S. Disagree**	**S. Agree**	**M. Agree**	**S. Agree**
		13% (12)	19% (18)	15% (14)	31% (29)	17% (16)	5% (5)
		Range	**Min**	**Max.**	**Mean**	**St. Deviation**	**Variance**
		5.00	1.00	6.00	3.64	1.43573	2.061
7	Students will take more initiative to learn when they feel free to move around the room during class.	**S. Disagree**	**M. Disagree**	**S. Disagree**	**S. Agree**	**M. Agree**	**S. Agree**
		4% (4)	12% (11)	26% (24)	33% (31)	20% (19)	5% (5)
		Range	**Min**	**Max.**	**Mean**	**St. Deviation**	**Variance**
		5.00	1.00	6.00	3.69	1.20060	1.441
8	Students should help establish criteria on which their work will be assessed.	**S. Disagree**	**M. Disagree**	**S. Disagree**	**S. Agree**	**M. Agree**	**S. Agree**
		3% (3)	7% (7)	10% (9)	32% (30)	36% (34)	12% (11)
		Range	**Min**	**Max.**	**Mean**	**St. Deviation**	**Variance**
		5.00	1.00	6.00	4.26	1.20872	1.461
9	Instruction should be built around problems with clear, correct answers, and around ideas that most students can grasp quickly.	**S. Disagree**	**M. Disagree**	**S. Disagree**	**S. Agree**	**M. Agree**	**S. Agree**
		11% (10)	24% (23)	32% (30)	17% (16)	36% (34)	12% (11)
		Range	Min	Max.	Mean	St. Deviation	Variance
		5.00	1.00	6.00	3.94	1.28522	1.652
10	How much students learn depends on how much background knowledge they have— that is why teaching facts is so necessary.	**S. Disagree**	**M. Disagree**	**S. Disagree**	**S. Agree**	**M. Agree**	**S. Agree**
		10% (9)	19 % (18)	35% (33)	26% (24)	8% (8)	2% (2)
		Range	Min	Max.	Mean	St. Deviation	Variance
		5.00	1.00	6.00	3.89	1.16829	1.365

Note: Descriptive data evaluated using SPSS 19. Adapted from Becker et al., (2000).

Agreement with statements 1-6, 9 & 10 reflected a transmission orientation while agreement with statements 7 and 8 represented a constructivist view. The reversal of questions 7 and 8 was intentionally included to ensure that survey respondents were critically evaluating each question (Becker et al., 2000). In *Figure* 15, statements 7 and 8 were inverted to represent a consistent graphical representation.

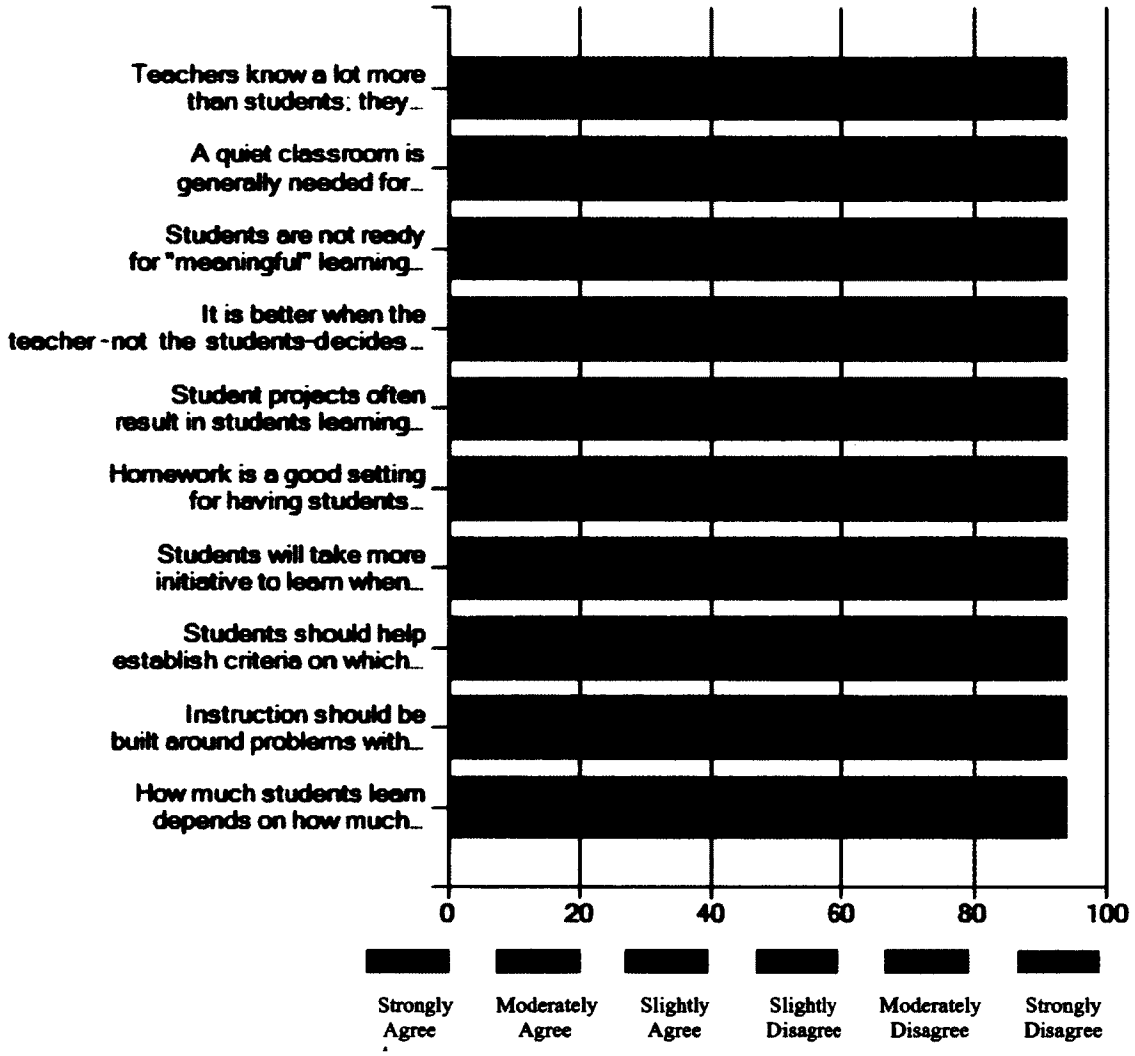

Figure 15. Index 2—learning environment.

The data continued to demonstrate a strong preference for constructivist philosophy, but only limited preference for constructivist teaching practices. Every question confirmed an increase in constructivist perspectives, except the question on student projects with an 8% decrease. Teachers overwhelmingly believed that students benefited from self-exploration (94%), project-based learning (84%) and participation in the development of assessment criteria (80%). Yet, only half of the teachers believed that students should have a say in the selection of learning activities and similarly, half believed that textbook-based homework was an appropriate learning activity.

4.3.3 Index 3—teaching style. Index 3 included five contrasting pairs of of belief statements that asked teachers to place themselves on a five-point scale between a constructivist and a transmission perspective. Table 28 lists the belief statements and descriptive information related to responses to the survey.

Table 28

Survey Response Data for Index 3—Teaching Style

Questions					
Statement A: "I mainly see my role as a facilitator..." **Statement B:** "... students really won't learn the subject unless you go over the material in a structured way."					
Strong "A"	**Somewhat Agree "A"**		**Cannot Decide**	**Somewhat Agree "B"**	**Strong "B"**
42% (39)	34% (32)		17% (16)	5 % (5)	1% (1)
Range	Min	Max	Mean	S. Deviation	Variance
4.00	1	5	3.5106	1.20701	1.457
Statement A: "The most important part of instruction is the content ..." **Statement B:** "The most important part of instruction is that it encourages "sense-making..."					
Strong "A"	**Somewhat Agree "A"**		**Cannot Decide**	**Somewhat agree "B"**	**Strong "B"**
16% (15)	25% (24)		29% (28)	19% (18)	8% (8)
Range	Min	Max	Mean	S. Deviation	Variance
4.00	1	5	3.3830	1.19233	1.422
Statement A: "It is useful for students to become familiar with many different ideas and skills ...." **Statement B:** "It is better for students to master a few complex ideas and skills well..."					
Strong "A"	**Somewhat Agree "A"**		**Cannot Decide**	**Somewhat agree "B"**	**Strong "B"**
19% (18)	29 (27)		26% (24)	16% (15)	7 % (7)
Range	Min	Max	Mean	S. Deviation	Variance
4.00	1	5	3.1702	1.15133	1.326
Statement A: "It is critical for students to become interested in doing academic work..." **Statement B:** "While student motivation is certainly useful, it should not drive what students study...."					
Strong "A"	**Somewhat Agree "A"**		**Cannot Decide**	**Somewhat agree "B"**	**Strong "B"**
8% (8)	21% 20		24% (23)	26% (24)	16% (15)
Range	Min	Max	Mean	S. Deviation	Variance
4.00	1	5	3.7447	1.05684	1.117

(Table 28 continued)

Statement A: "It is a good idea to have all sorts of activities going...." **Statement B:** "It's more practical to give the whole class the same assignment..."					
Strong "A"	**Somewhat Agree "A"**		**Cannot Decide**	**Somewhat agree "B"**	**Strong "B"**
20% (1)	35% (33)		17% (16)	21% (20)	6% (6)
Range	Min	Max	Mean	S. Deviation	Variance
4.00	1	5	3.4149	1.21292	1.471
Note: Descriptive data evaluated using SPSS 19. Survey questions adapted from TLC survey (Becker & Anderson, 1998).					

Teacher responses to the questions in Index 3 reflected robust support for constructivist beliefs. The majority of responses to each of the five questions supported constructivist beliefs, even when the questions were reversed. However, support for transmission-based instruction remained strong, with almost a third of the teachers supporting traditional transmission instruction. Resistance to change may be attributed to a set of core beliefs related to traditional instruction, while transmission-centered instruction itself may be related to the strong emphasis on content standards and assessment driven accountability systems such as those under "NCLB".

4.4 Levels of Technology Use

The fundamental research question asked: "Is there a relationship between teaching style (independent variable) and the way technology is used by teachers to support learning (independent variable)?" The null hypothesis states that there is no linear relationship between teaching style and the LoA of technology by 1:1 teachers.

Lemke's (2009) indices were modified to measure a scale of adoption for personal (TPU), classroom (TCU) and professional use (TPP) of DLT by 1:1 teachers. Table 29 provides descriptive data relative to the LoA for TPU, TPP and TCU.

Table 29

Descriptive Data for TPU, TPP and TCU Index

n	Index	Range	Minimum	Maximum	Mean	SD	Variance
94	TPU	.72	.14	.86	.41	.166	.027
94	TPP	.75	.15	.91	.47	.175	.030
94	TCU	.80	.06	.86	.42	.189	.036

Note: The "Teaching Style Index" is the mean of the 13 responses to the questions that define the index (Becker et al., 2000).

The means of each of the indices for LoA were below .5, showing a central tendency below the .5 midpoint that divided the Likert scale used to collect data. The standard deviation for the LoA for personal use (SD =.166) showed a tighter dispersion compared to the LoA for classroom use (SD =.189) and professional practice (SD= .175). This was consistent with survey data that that showed personal use by respondents to be focused almost exclusively on the daily use of e-mail (98%), web browsing (96%) and the use of search engines (94%). Technology applications reported for classroom and professional practices presented a more diverse but less frequently used set of digital learning applications. Collectively, the measures of dispersion all point to a generally low LoA of technology adoption based on Lemke's indices for personal, professional and classroom use.

4.5 Correlations

A Pearson, two-tailed correlation coefficient (r) was calculated for each of the LoA indices and teaching style index to test the null hypothesis that there was no linear correlation between teaching style and the LoA for TPU, TPP and TCU in Alaska's 1:1 high school classrooms. (See Appendix "C" for descriptions of the statistical formulas and procedures used to process the data.) Table 30 presents the results.

Table 30

Pearson (r) for Teaching Style and the LoA for TPU, TPP and TCU.

Level of Adoption	Pearson (r) Coefficient	Significance
Classroom Use	$r = .234$	$p = .023$*
Professional Practice	$r = .351$	$p = .001$**
Personal Use	$r = .152$	$p = .144$~

Note: * (p is significant at .05); ** (p is significant at .001); ~ (p is not significant at the .05 level). Cohen effect sizes: Small $r <= .2$; Medium $.2 < r <= .5$; Large $r > .5$. Sample size (n) = 94. Pearson (r) correlation tests were conducted using SPSS 19. A significance level of 5% (alpha) was set as the cut point to determine significance. See Appendix "C" for information relative to the application of Pearson's (r) and measures related to effect size and significance

The Pearson (r) coefficient measuring the association between teaching style and the level of adoption of technology for classroom use was calculated using SPSS 19 to test the null hypothesis:

H_0: There is no relationship between teaching style and the LoA for classroom use of technology.

H_1: There is a relationship between teaching style and the LoA for classroom use of technology.

Pearson's (r) showed there was a significant positive relationship between teaching style and the LoA of technology for classroom use ($r = .234, p = .023, n = 94$). Cohen (1988) labels a .234 effect size as small ($r <= .2$ = small; $.2 < r < .5$ = medium; $r => .5$ = large). Pearson (r) coefficient rejected the null hypothesis in favor of the alternative hypothesis. The scatter plot of the relationship in *Figure 16* portrays the weak positive relationship.

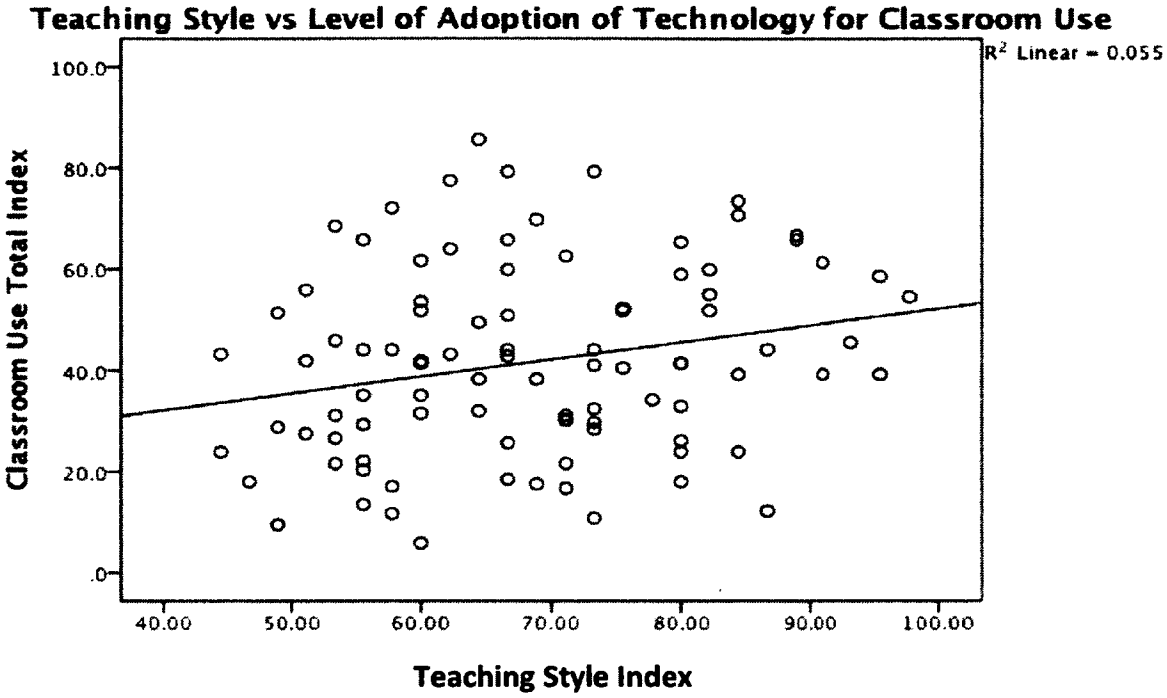

Figure 16. Scatter plot: Teaching style and the LoA for classroom use.

The weak correlation was consistent with descriptive data that demonstrated tension between a teacher's constructivist beliefs and pedagogical practices consistent with those beliefs. The LoA survey measured technological fluency, the complexity of the application and the application's frequency. A low index may have reflected a practiced familiarity with instructional technology yet a limited implementation for instruction.

The Pearson (r) coefficient for teaching style and the level of adoption of technology for professional practice was calculated using SPSS 19 to test the null hypothesis:

H_0: There is no relationship between teaching style and the LoA for professional use of technology.

H_1: There is a relationship between teaching style and the LoA for professional use of technology.

Pearson's (r) showed there was a significant positive relationship between teaching style and the LoA of technology for professional practice ($r = .351$, $p < .001$, $n = 94$). Cohen, (1988) labels a .351 effect size as medium ($r <= .2$ = small; $.2 < r < .5$ = medium; $r =>.5$ = large). A medium, significant Pearson (r) coefficient rejected the null hypothesis in favor of the alternative hypothesis that there is a relationship between teaching style and the level of adoption of technology for professional practice. The scatter plot of the relationship (*Figure 17*) provides visual evidence of the weak, positive correlation between teaching style and the LoA for professional practice.

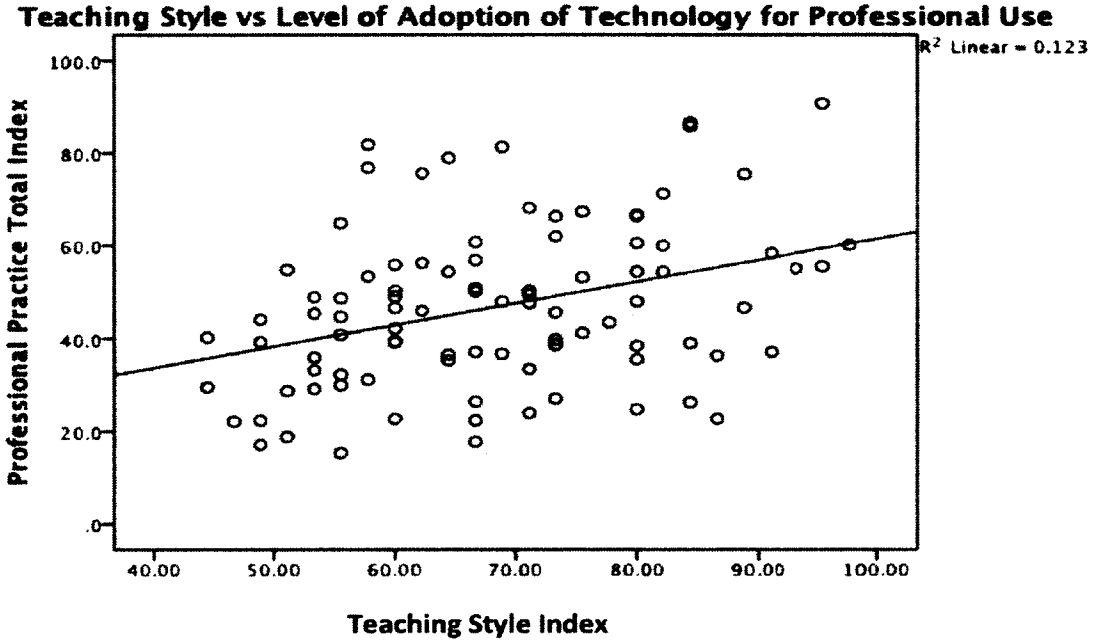

Figure 17. Scatter plot: Teaching style and the LoA for professional practice

The greater relationship between teaching style and the LoA for both professional practice and classroom use suggested that the limited use of DLT by teachers might not have been primarily related to proficiency barriers. Over 98% of the teachers, when asked what proficiency best described their levels of adoption, selected an intermediate to expert proficiency. However, only 40% believed that technology had significantly changed the ways students use technology in the classroom. The differences between professional and classroom use suggested that barriers may have attenuated the LoA of technology in the classroom, regardless of pedagogical beliefs.

The Pearson (r) coefficient for teaching style and the LoA for personal use was calculated using SPSS 19 to test the null hypothesis:

H_0: There is no relationship between teaching style and the LoA for personal use of technology.

H_1: There is a relationship between teaching style and the LoA for personal use of technology.

Pearson's (r) showed there was a small but statistically insignificant ($p > .05$), positive relationship between teaching style and the LoA of technology for personal use ($r = .152$, $p > .05$, $n = 94$). As a result, the null hypothesis that there was no statistically significant relationship between teaching style and the level of adoption for the personal use of technology, was accepted. A scatter plot provides a visual representation of the relationship (See *Figure 18*) between teaching style and the personal use of technology.

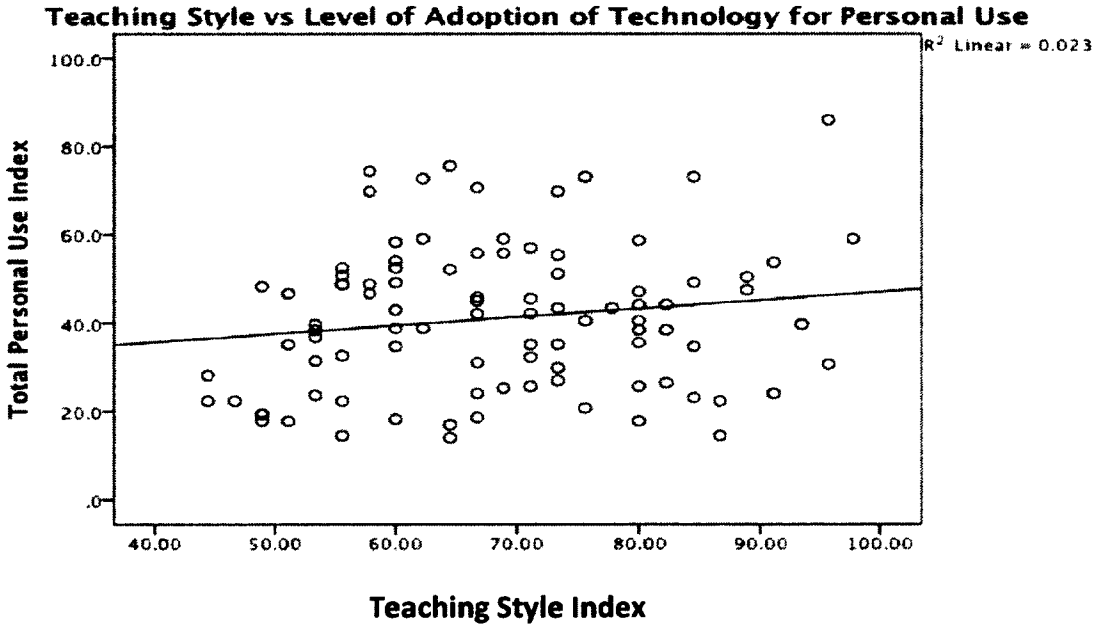

Figure 18. Scatter plot: Teaching style and the LoA for personal use of technology.

The personal use index exposed the limited value technology held for personal use. Only three applications were used more frequently than once a month: e-mail (100%), social networking (46%) and Internet browsing (93%). Any relationship between teaching style and personal use is difficult to evaluate given the limited personal use

reported by survey respondents.

4.6 Survey Comparisons—1998 TLC and 2011 TFS

Data collected from Becker and Anderson's (1998) National Teacher, Learning and Computing Survey (TLC) and the 2011 Technology Frameworks Survey (TFS) showed teacher responses to be strongly congruent across all three belief indices. A chart (*Figure 19*) generated from both surveys for Index 2: Teaching Environment, highlights the parallel responses from teachers separated by 14 years and dramatically different teaching environments.

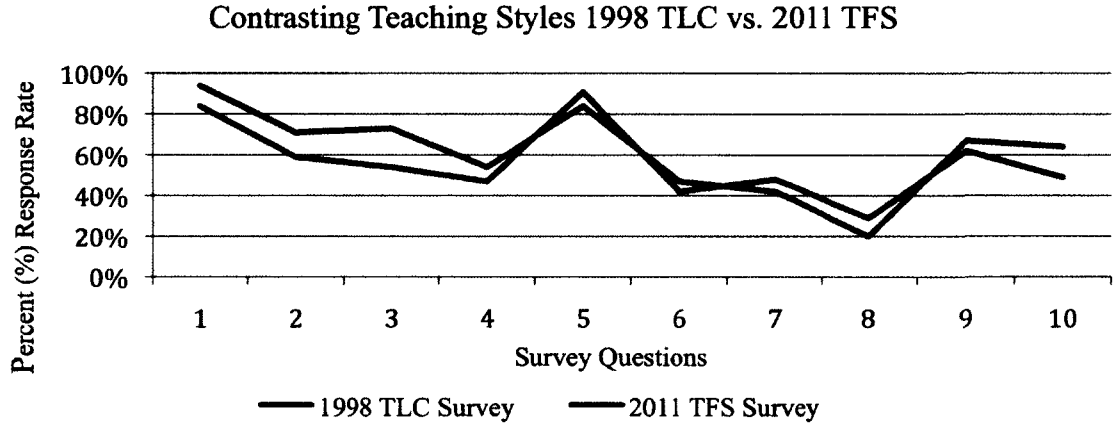

Figure 19. Comparison 1998 TLC and 2011 TFS.

While it would be statistically inappropriate to compare the data from the two samples, the congruence between the 1998 TLC and the 2011 TFS supports the validity and the reliability of Becker and Anderson's (1998) survey to discern teaching style. The data from the other two survey indices for teaching style demonstrate the same pattern of congruence. A notable difference between the two data sets is the higher degree of constructivist beliefs evident in the 2011 TFS as compared to the TLC. The similarity may be random or it may be a reflection of Becker et al.'s (2000) conclusion that access to technology enhances constructivist beliefs and practices among teachers.

4.7 Qualitative Review: Identifying a Grounded Theory

Qualitative data was mined from responses to five open-ended questions from the Technology Frameworks Survey (TFS) as well as responses to four questions included in a brief follow-up "Technology and Teaching Style Survey" (TTSS) sent to the

respondents of the first survey. Questions were designed to collect information relevant to the dynamic interplay between teaching style and the level of adoption of technology in 1:1 learning environments. Information derived from these data may help identify key elements in the development of learning outcomes serving the interests of both Alaska Native and 21st century learners.

The quality of the survey answers to the new questions varied from paragraphical to single word responses. The cohort-level survey provided limited information on these points. The placement of open-ended questions at the end of an hour-long survey may have influenced both the level and quality of response. The depth of information shared in response to the follow-up survey was significantly improved. Collectively, the qualitative data derived from these questions provided a rich exploratory foundation upon which to build the study questions.

The data from open-ended questions was evaluated using thematic analysis; a qualitative method designed to identify, describe and illustrate emerging patterns contained in the data. Braun and Clarke (2006) suggest that thematic analysis should include several key steps: initial coding, illustrative reporting and theme identification and development. Given the overlapping nature of the survey questions and the limited response to them, the coding process was consolidated into seven response sets, and each was evaluated within the context of the three primary study questions.

4.7.1 Question 1—beliefs, teaching style and technology. The qualitative treatment of study question one, previously considered by quantitative measures, provided information that was used to further elucidate the nature of the relationship between teaching style and the use of DLT in 1:1 classrooms. Teachers were asked to consider the relationship between instructional philosophy and the application of technology for learning. A follow-up question inquired if students were using technology themes and the major codes that emerged from the thematic analysis of the open-ended survey data. Table 31 provides the themes and the major codes that emerged from the thematic analysis of the open ended survey data.

Table 31

Relationship Between Philosophy and the Application of Technology

Describe the relationship between a teacher's basic instructional philosophy and the way he or she uses technology to support student learning? (n = 30)												Follow-up question: Are students using technology in your classes in a manner consistent with your beliefs about teaching and learning? Why? (n = 30)					
	Themes	Sum *f*	Codes A	*f*	Codes B	*f*	Codes C	*f*	Codes D	*f*	Codes E	*f*					
1	Instructional Philosophy	18	**Philosophy determines technology**	9	Evolution of teaching philosophy and style		**Conflicted beliefs**	6									
2	Teaching style	38	**Technology as tool of instruction**	12	Strong support for constructivist beliefs	1	**Management of student technology users**	2	Support for 21st century skills	3	**New experience**	2					
3	Obstacles	8	**Basic technology support**	3	Appropriate use of technology		**Integration challenges**	3									
4	Student Learning	10	**Enhance**	4	Engage		Context	3	Choice	2							

Note: *f* = frequency of code notations. Total *f* represents the codes connected to each theme. Data generated was collected by the TTSS survey. Response rate: 30 responses out of 94 invitations. Follow-up responses were included in analysis.

Teachers' responses showed widespread agreement that instructional philosophy was a strong factor in the level of adoption of technology (9). One teacher noted this relationship by writing:

> I think that a teacher's instructional philosophy is directly linked to his or her use of technology. If the philosophy of teaching is as the teacher-centered classroom with a focus on lecture, note-taking and textbook use then the use of technology will be secondary if at all. I think that a paradigm shift needs to occur in older methods of teaching practice in order to better understand the importance of technology use in the classroom for both the educator and the student.

The strength of the relationship was attested to by the fact that 24 out of 31 teachers confirmed that student use of technology was consistent with their teaching philosophy. Concerns related to student misuse of technology were frequently offered as a basis for the variance between philosophy and practice. However, an alternate

perspective suggested that teachers did not "have enough time to figure out ways to integrate it into a lesson before giving it."

While survey responses of teachers supported a positive relationship between their beliefs and the use of technology, the translation from philosophy to practice was made more difficult by concerns over student management, instructional integration and technical support.

Validating a relationship between philosophy and practice did not shed light on either the direction of the relationship or the nature of the pedagogical outcome. However, the second theme "Teaching Style" provided insight into pedagogical practices in 1:1 classrooms. Even though survey questions did not ask for a teacher's philosophy of instruction, a number of teachers (9) noted that access to a technology-rich learning environment supported constructivist teaching styles. One respondent wrote:

> Teachers that believe in a constructivist classroom are more likely to utilize technology in an efficient manner. It seems that teachers who are more inclined to direct instruction have difficulty with the "teacher as facilitator" role and therefore do not like the unpredictability of rich and rigorous technology use.

Other teachers, professionally conflicted over the application of technology, offered the opinion that technology represented a needless distraction that interfered with instruction. However, the responses more commonly suggested that teachers were reexamining practices as a result of working in a 1:1 classroom. A teacher highlighted this struggle: "I embrace technology but I am also an old dog and sometimes it is hard to learn new tricks. My upbringing and old style occasionally gets in the way of teaching".

Teachers often referred to technology as a tool that is used depending on the expertise of the user. One teacher, articulating the feelings of several respondents, wrote:

> Since technology is a tool, each teacher uses it differently. I have a student centered approach so I believe in allowing students choice in which technological tools they use to best get 'the job done'. Other teachers are very prescriptive in when, where, and how technology is to be used. ... All these choices are made in the classroom and reflect the teaching philosophy of the instructor.

The third theme identified the strong belief among teachers regarding the positive effect 1:1 environments have on learning. Enhancement, engagement and reinforcement were common descriptors as outcomes of 1:1 instruction. A teacher writing on the effect of instructional technology noted:

> Technology should be there to enhance a lesson and perhaps involve visual, audio, and even kinesthetic aspects of the lesson that wasn't there before. Technology is a great tool to help students see beyond the page in a book and hear voices that they may never have heard. In the end, it has to be a support system. It's there to enhance the lesson, not be the lesson.

The thematic analysis of answers to the question: "What is the best reason for pursuing a 1:1 laptop program?", provided further insight into the positive effect teachers have observed in 1:1 classrooms relative to student attitude and achievement. See Table 32 for a thematic analysis of the responses.

Table 32

Reasons for Pursuing a Laptop Program

What is the best reason for pursuing a laptop program? *(n = 54)*

#	Themes	Sum *f*	Codes A	*f*	Codes B	*f*	Codes C	*f*	Codes D	*f*
1	Students	35	**Development of 21st century skills and attitudes**	24	Expanded access to cultural information	3	**Communication**	4	Increased engagement, curiosity and attitude	4
		10	**Heightened curiosity and interest in learning**	3	Expanded contact with other cultures	5	**Prepares students for post-secondary training and work**	2		
2	Student Growth	22	**Technology-related growth in achievement**	9	Increased academic confidence	4	**Increased rigor and expectations**	3	Same as non-Native students	6

Note: *f* = frequency of code notations. Total *f* represents the codes connected to each theme. Data generated was collected by the TFS survey.

Teachers commonly noted increases in both student engagement and achievement. Over twenty teachers emphasized the role DLT played in preparing students for the challenges of life in the 21st century. Concerning this role, a teacher noted: "When are the students ever again going to know a day without technology. They

will be immersed in it for the rest of their lives." Another shared: "Being able to productively use technology is crucial for success in our computer-driven society."

4.7.2 Question 2—relationship between teaching and technology. Study question 2 asked: "How does access to a 1:1 classroom affect a teacher's instructional philosophy or practice?" This question was explored using data supplied by three survey questions focused on whether access to a 1:1 environment led to changes in beliefs and/or changes in practice. Is the application of DLT subject to teaching style or does DLT act as an agent of change catalyzing the evolution of student-centric styles? Table 33 provides a summary of the thematic analysis of the question: "How has access to a 1:1 digital classroom influenced your pedagogical practice?"

Table 33

Digital Classrooms and Pedagogical Practices

How has access to a 1:1 digital classroom influenced your pedagogical practice? (n = 30)

#	Themes	Sum *f*	Codes A	*f*	Codes B	*f*	Codes C	*f*	Codes D	*f*
1	No change in instructional practice	15	"NO" No reason given	3	Technology was already integrated	3	Committed to traditional instruction	7	Little change	2
2	Change in instructional practice	18	Increase in constructivist practices	12	"YES" No reason given	2	Changes in instructional emphasis	2	Positive teacher attitudes	2
3	Administrative challenges and benefits	12	Instructional management	6	Infrastructure	6				

Note: *f* = frequency of code notations. Total *f* represents the codes connected to each theme. Data generated was collected by the TTSS survey.

Of the 30 teachers responding to the follow-up survey, fifteen reported no change in their pedagogical practice while seven continued to use DLT as a tool supporting traditional methods. Several teachers felt that technology did not change their style because they were already using DLT in support of student-centric instruction. Twelve respondents noted a shift toward constructivist practices. This change may not be related to a philosophical swing as much as it is an adjustment increasing coherence between belief and practice made possible by DLT. This was expressed by a teacher who wrote: "Access to a 1:1 classroom has influenced my practice by providing me with the tools

necessary to guide students in authentic learning experiences." Once again, teachers reported instructional management concerns related to the misuse of DLT resources by students and that the misuse interfered with the full application of the technology. Survey respondents also noted changes in pedagogical philosophy attributed to instruction within a 1:1 environment. Table 34 provides information relevant to the survey request for teachers to "Describe any changes to your philosophy or beliefs as a result of your experiences teaching in a 1:1 classroom."

Table 34

Changes in Philosophy and Beliefs in 1:1 Classrooms

Describe any changes to your philosophy or beliefs because of your experiences in a 1:1 laptop program. (n = 30)

#	Themes	Sum *f*	Codes A	*f*	Codes B	*f*	Codes C	*f*	Codes D	*f*
1	Integration Challenges	8	**Student management interference**	5	Infrastructure	3				
2	Change in instructional practice	23	**Growth in constructivist practices**	12	No change: constructivist beliefs	5	**No change: traditional beliefs**	4	No change	2
3	Changes in beliefs about student learning	7	**Student ownership**	1	Accountability	2	**Creativity**	3	Engagement	1

Note: f = frequency of code notations. Total f represents the codes connected to each theme. Data generated was collected by the TTSS survey.

Eight teachers observed that management problems interfered with the successful integration of technology into their pedagogical portfolio. Their collective voice can be represented by the statement shared by one teacher: "While excited about the potential benefit of the program, I find myself disillusioned about both the management of it and in keeping my students focused on what they are supposed to be doing." However, in spite of logistical challenges, the responses of twelve teachers suggested a move to or validation of constructivist practices. One of the twelve writes:

> I don't know that I have had a change in philosophy due to the 1:1 classroom experience. However, I do feel that the 1:1 experience has allowed me to transform my classroom in a way that would not have been possible previously. I

have students sharing their learning via technology where sharing much more limited in a paper-centered classroom. I have become more of a facilitator giving mini-lectures and using the Internet to visualize this learning to come alive .

Four teachers saw technology as a tool to support traditional instruction. Seven teachers noted the benefits to students brought about by 1:1 classrooms. One teacher acknowledged the overall effect of using technology: "The students were better prepared for their future and were able to learn more than just what the teacher was offering in the classroom." The prompt from the TFS: "Please share a thought about how the laptop program has affected you personally" provided an opportunity for 1:1 teachers to share any personal thoughts related to experience working in a laptop environment. Table 35 analyzes and reports on the responses shared by teachers.

Table 35

Teacher Insights from Participation in the 1:1 Laptop Program

Please share a thought about how the laptop program has affected you personally (n = 60)

#	Themes	Total *f*	Codes A	*f*	Codes B	*f*	Codes C	*f*	Codes D	*f*
1	Changes in beliefs	22	**More student centered**	10	Reflective planning	4	**Increased motivation as teacher**	4	No effect	4
2	Change in instructional practice	45	**Challenges in technology integration**	5	Increased proficiency using technology	15	**Better communication**	8	Increased time spent managing behavior	5
		3	**New ways to use technology**	3	Flexibility with lesson planning	1	**Increased student engagement**	6		

Note: Data generated was collected by the TFS survey.

While 15 teachers noted increased efficiencies as strengths, eighteen others commented on changes in beliefs as strengths of the program. One teacher wrote: "It has changed my role in the classroom, been inspiring to my personal learning of technology and my role as a teacher to students." Another teacher shared: "I've changed how I teach to how my students learn." Ten teachers noted an increase in student-centered practices as a result of the opportunity to teach in a 1:1 classroom. Challenges in integrating technology into instruction continued to be coded as barriers preventing coherence

between philosophy and practice.

4.7.3 Question 3—21st century learning: Old methods—new technologies. Study question three read: "Does access to a 1:1 digitally enhanced teaching environment facilitate the use of instructional practices consistent with Alaska Native and 21st century learner outcomes?" The foundation for linking traditional Alaska Native methods of passing on knowledge and constructivist teaching practices was described in the literature review. The TFS probed awareness of this link by asking teachers working in rural classrooms to answer the question: "How does your use of classroom-based technology contribute to increased academic performance among your Alaska Native students?" Responses to this question are posted in Table 36.

Table 36

Technology and Academic Performance

How does your use of classroom-based technology contribute to increased academic performance among your Alaska Native Students? (n = 54)

#	Themes	Sum *f*	Codes A	*f*	Codes B	*f*	Codes C	*f*	Codes D	*f*
1	Cultural support	11	**Safe arena for individual and artistic expression**	3	Expanded access to cultural information	5	**Curious and interesting learning environment**	2	Creates environment hat nurtures a love of learning	1
2	Learning support	22	**The same as non-Native students**	4	Expanded contact with other cultures	3	**Provides opportunity for increased academic rigor**	3	Not sure	12
3	Technology	16	**Communication**	1	Increased academic confidence	7	**Access to information**	1	Increases academic achievement	7

Note: *f* = frequency of code notations. Total *f* represents the codes connected to each theme. Data generated was collected by the TFS survey.

The responses did not show a strong comprehension of the role technology can play in developing constructivist learning environments consistent with Alaska Native ways of teaching. Five respondents linked technology to increased opportunities for access to cultural resources. One teacher suggested that 1:1 classrooms "have more to do with helping students develop a love for learning and a desire to succeed than using traditional bells and whistles to entice them." Only three teachers out of 54 respondents

to this questions noted the potential to create learning environments that nurture curiosity, a love of learning and student interest. The majority of responses viewed technology as general support for academic growth and as a tool of instruction.

The survey question: "How has access to a 1:1 classroom increased the congruence between your instructional practice and traditional ways of passing on knowledge used by Alaska Native cultures?" produced more thoughtful and balanced understandings of the potential of technology to enhance culture-based instruction. The question's preamble provided a foundation for teachers to reflect on the relationships between their teaching methods, the use of technology and Alaska Native teaching practices. Table 37 defines several ways teachers are using DLT to enhance instruction for Alaska Native students in 1:1 classrooms.

Table 37

Awareness of Alaska Native Teaching Methods

How has access to a 1:1 classroom increased the congruence between your instructional practice and traditional ways of passing on knowledge used by Alaska Native cultures? (n = 54)

#	Themes	Sum *f*	Codes A	*f*	Codes B	*f*	Codes C	*f*	Codes D	*f*
1	**Culturally enhanced learning**	30	**Online cultural resources: music, dance, language, story telling, art**	4	Expanded access to cultural knowledge	7	**Place-based, contextualized programming**	4	Enhanced visual learning activities	4
			Experience-based learning	3	Project-based learning	5	**Alaska Native language**	2	Student paced	1
2	Learning activities	11	**Enhanced intra- and inter- cultural communication**	4	Access to cross-cultural resources	3	**Cultural preservation**	4		
3	Instruction	13	**Cultural resources for teachers**	4	No change: kids are kids	6	**Concerns with over use of technology**	3		

Note: *f* = frequency of code notations. Total *f* represents the codes connected to each theme. Data generated was collected by the TFS survey.

Teachers overwhelmingly identified technology enhanced teaching and learning strategies (30) that were both constructivist and consistent with the process and outcomes of traditional Alaska Native education. An Alaska Native teacher shared the effect of a 1:1 classroom has had on instruction:

> The 1:1 classroom has allowed more access to digital storytelling and visual learning. It allows me to more effectively run a place-based learning / contextualized learning classroom and without a doubt increases the amount of experiential and applied learning. This is essential to providing a quality instructional program in rural Alaska and I would not be able to provide the rich activities that I do without the 1:1 classroom.

Technology enhanced school-community efforts to preserve culture created new opportunities for students to access on-line cultural resources. It also stimulated the school and the community to build the trust necessary to engage in culture-based educational programming. To this point, a teacher wrote:

> Technology has allowed a level of networking within and between tribes. Students are able to access a combined knowledge from multiple sources to explore their own and other cultures through technology. Technology allows us to record and share stories, interviews, and teachings in new ways. Many of the programs available to my students on computer allow them to demonstrate knowledge in more of a story-telling, visual, or interactive format as well.

Several teachers were concerned that technology will be used to further disconnect students from their culture by emphasizing virtual learning at the expense of active engagement with real-life experiences. Further, one teacher noted that DLT can be used to create an effective learning environment or it can be used to perpetuate the "vast chasm between traditional Native ways of learning and the educational practices that are part of the modern world." Another shared a similar view: "In short, to learn the traditional way you have to get off your butt and interact with nature, people, and yourself as a physical being. You can't do it sitting behind a computer desk".

A number of teachers questioned the ethics of differentiating instruction between Alaska Native and non-Native students. Given the limited nature of the response and the context of the issue, it has been difficult to determine the meaning they intended. If the response was intended to imply that one instructional method or style meets the needs of all students regardless of their cultural experiences, it may be another facet of the

instructional bias that has marginalized Alaska Native education practices. However, if the statement reflects a belief that quality instruction, centered on the unique learning signature of an individual child is by definition culturally blind, it is a statement of constructivist practice.

Teachers clearly see the potential for using technology to create student-centric learning environments, yet they remain uncertain regarding the relationship between academic achievement, higher standards and constructivist practices. A teacher described the challenge of reuniting culturally appropriate instruction and the broader outcomes for education: "Vast and varied amounts of subject knowledge, coupled with state and federal assessments, and societal career opportunities, make me believe there are difficult choices to make for students, schools and parents in regards to learning styles and modes." Another teacher shared perhaps one of the most poignant and promising outcomes of DLT supported, culturally-based education; that of a teacher reflecting on the beliefs, methods and outcomes of cross-cultural instruction: "Interesting question, I think more, question more, ask for more explanation/reasoning. I look deeper which causes more thinking as I process where is my place as an educator for the Alaska Native."

Chapter 5: Conclusions

The purpose of this research is reflected in the title: "Polishing the Mirror: A Multiple Methods Study of the Relationship between Teaching Style and the Application of Technology in Alaska's Rural One To One Digital Classrooms."

This study explored the links between teacher beliefs and the way digital learning technologies are used to support student learning. Three research questions defined and guided the study:

1. "What is the relationship between instructional philosophy and the way teachers use technology to support learning within Alaskan high school 1:1 laptop programs?"
2. "How does access to a 1:1 classroom affect a teacher's instructional philosophy or practice?"
3. "Does access to a 1:1 digitally enhanced teaching environment facilitate the use of instructional practices consistent with Alaska Native and 21st century learner outcomes?"

Chapter 1 introduced the landscape of opportunities and challenges from which the study problem emerged. The literature review in Chapter 2 formed a comprehensive foundation upon which to build the study within the context of contemporary educational research. Chapter 3 reviewed the statistical research used to conduct this study. The process of transforming the survey data was presented in Chapter 4, while chapter 5 connects the data with conclusions responsive to the study questions.

5.1 Summary of Findings

Each of the three research questions were evaluated based on the analysis of data collected by the study and also from relevant research identified through a comprehensive literature review. Themes identified from open-ended prompts were used in combination with quantitative data to identify a grounded theory relevant to the study questions. Throughout the qualitative phase of the investigation, teachers frequently identified increased access as an opportunity to increase the constructivist tone of instruction. Comments offered in support of the 1:1 initiatives invariably refer to new opportunities to

engage constructivist practices. Twenty-four teachers stated that the best reason for pursuing a laptop program was to arm students with 21st century skills. Seven teachers saw technology as an opportunity for students to increase their academic achievement. While a minority of respondents saw DLTs as a tool to support traditional pedagogy, not one teacher argued that access to technology encouraged teachers to adopt transmission-based practices. While the majority of teachers continue to practice transmission-based instruction, the momentum for education reform is slowly turning toward methods that honor a student's innate desire to acquire purpose through learning.

5.1.1 Research question 1—philosophy, practice and DLT. The following findings provide the basis for conclusions relative to the question: "What is the relationship between instructional philosophy and the way teachers use technology to support learning within Alaskan high school 1:1 laptop programs?"

1. Instructional philosophy was measured using a survey instrument defined by Becker and Anderson (1998) that was specifically designed to differentiate between the transmission and constructivist styles. Teachers showed a significant preference for the constructivist style.
2. The data also highlighted a tension between belief and practice. Teachers, while agreeing with theoretical constructivist beliefs, did not always implement a constructivist pedagogical practice. In response to a small vignette that contrasted constructivist and transmission styles of instruction, over 70% of the teachers agreed that the constructivist model provided students with more useful skills. However, in response to a different question related to practice, only 40% felt comfortable teaching using constructivist practices. Among the survey respondents, verbal support for constructivist beliefs was more widespread than the actual implementation of these in practice.
3. The 2011 Technology Frameworks Survey (TFS) revealed a consistent increase in the level of constructivist beliefs compared with teachers participating in the national 1998 TLC. Except for higher agreement with

constructivist philosophy, responses to the 2011 TFS survey closely paralleled the Becker et al. (2000) data. Whether this increase was related to access to a 1:1 laptop program or representative of an increased adoption of constructivist teaching practices over the past ten years is unknown.

4. The teaching style indices, derived from Lemke's PTP for personal use (.41), professional use (.47) and classroom use (.42) revealed low levels of technology adoption. This was not necessarily surprising given that Lemke's levels of adoption were based upon the frequency, innovation and complexity of the technology application. In the index for personal use, the predominant responses in 21 out of 24 questions about personal use were "never" or "not at all like me". According to the index for personal use, teachers in 1:1 classrooms use DLT primarily for internet browsing, word processing, searching and e-mail. The low LoAs of technology in an 1:1 environment rich in both technological resources and instructional acumen suggests a possible barrier to the use of technology.
5. The Pearson (r) correlation coefficients testing the relationship between teaching style (Becker and Anderson, 1998) and each of the three levels of technology adoption for classroom ($r = .234, p = .023$), personal ($r = .152, p = .144$) and professional ($r = .351, p < .001$) use of digital learning technology showed weak correlations (Cohen, 1988). The correlation between teaching style and personal use was not statistically significant at ($p = .059$). Any p value greater than the usual criterion for significance, which is usually set at 5% in the social sciences, reduces the confidence interval below the accepted level of 95%.

The weak relationship between the level of technology adoption for classroom use and teaching style may be related to several factors. First, the tension between teachers' constructivist beliefs and classroom practices affected the reliability of the index. Secondly, based on Lemke's LoAs, teachers are primarily using more basic software applications rather than more sophisticated

ones. Finally, the expression of philosophy into a coherent teaching style is subject to external constraints inhibiting the expression of philosophy through practice. Themes identified from open-ended questions suggest that barriers related to student management and difficulties with content integration acted to attenuate the use of technology in the classroom.

6. Generally, teachers expressed confidence in their proficiency at using technology. Fifteen percent described themselves as expert, 48% as experienced, and 36% as intermediate users of technology. A correlation study to ascertain the Spearman Rho coefficient between the self-report of technological proficiency and the levels of adoption (LoA) defined by Lemke (2009) showed a marginal correlation (r_s = .275, with p <. 007) for classroom use, but a more substantial correlation for both personal (r_s = .476, p < .001) and professional (r_s = .458, p < .001) use. The marginal correlation between the self-report of technology proficiency and the LoA in the classroom compared to the LoA for personal and professional purposes again suggests the possibility that some unidentified obstructions oppose the full expression of a teacher's technological acumen in support of classroom learning.
7. Several strong themes emerged from an analysis of the open-ended questions included in the TFS and the follow-up TTSS. Nine out of thirty-one teachers noted the strong relationship between instructional philosophy and classroom practices relative to the use of technology. Nine teachers considered technology a tool of instruction and considered it subject to the intent of the user. While information related to the teacher's philosophical beliefs was not solicited in these open-ended questions, eleven teachers noted the potential of DLT for constructivist opportunities. A small number of teachers stated that DLT had actually interfered with instruction. Teachers also noted that the increased use of DLT in 1:1 classrooms enhanced instruction, engaged students and contributed to the development of 21st skills and attitudes. Instructional challenges associated with the integration of technology into the classroom and the misuse of

technology by students were noted by teachers as significant barriers to the effective implementation of DLT.

Given the quantitative data, there was sufficient information to conclude that there was a strong but constrained relationship between instructional style and the use of technology. However, this relationship was strongly influenced by external constraints. Information drawn from a thematic analysis of teacher responses to open-ended questions suggested that teachers believe that there is a stronger relationship between teaching philosophy and practice than was found in this study. The difference may be related to differing definitions and external constraints limiting technology use. Further study will inform these topics.

5.1.2 Research question 2--teaching and technology: emerging relationships. Study question two asked: "How does access to a 1:1 classroom affect a teacher's instructional philosophy or practice? Will access to a 1:1 environment facilitate a shift to constructivist teaching practices; or will access DLT more directly support teacher-centric instruction? Data generated from three open-ended survey questions provided the foundation to investigate this study question.

Responses to the question, "How has access to a 1:1 digital classroom influenced your pedagogical practice?" were coded into three themes: (a) no change in practice, (b) change in practice, and (c) challenges and benefits. Fifteen respondents indicated that access to a 1:1 classroom had either zero or minimal effect on teaching styles. Of these, seven were comfortable with traditional educational practices while three did not express a need to change because they felt they were fully integrating DLT into practice. Twelve of eighteen teachers responding suggested that a teaching style shift to more constructivist practices was, in their opinion, due to increased access to technology. It was unclear if these teachers experienced a change in philosophy or took advantage of the 1:1 environment to align practice with philosophy. Concerns over maintaining the technological infrastructure and managing appropriate student involvement were noted as barriers to the effective use of the 1:1 resources.

The survey prompt, "Describe any changes to your philosophy or beliefs as a

result of your experiences teaching in a 1:1 classroom" generated significant agreement among the seventeen teachers who stated that access to a 1:1 environment shifted their philosophy towards a constructivist approach. Seven teachers noted 1:1 environments afforded students with greater creativity, ownership and engagement. When prompted to share thoughts related to working in a 1:1 laptop environment, ten teachers described themselves as more student-centered, fifteen as more proficient technology users and eight as better communicators.

A thematic analysis of the data leads to the conclusion that access to a 1:1 classroom facilitated a shift from transmission to constructivist beliefs and a commensurate shift in practices to reflect student-centric methods. For some teachers, the changes in practice catalyzed by a 1:1 classroom reflected an opportunity to express previously held constructivist beliefs rather than to adopt a new philosophical system. A small group <25% continued to support traditional teacher-centric instruction as evidenced by the resilience to change noted when comparing the 1998 TLC and the 2011 surveys.

5.1.3 Research question 3—hidden opportunities. Two open-ended survey questions were used to collect data relevant to study question three: "Does access to a 1:1 digitally enhanced teaching environment facilitate the use of instructional practices that are consistent with Alaska Native and 21st century learner outcomes?" Survey questions focused on a teacher's awareness of the potential for 1:1 environments to increase the congruence between traditional Alaska Native teaching styles with those used at school. Teachers asked to self-evaluate knowledge of Alaska Native culture in the survey sample reported a mean of 3.5 out of 5 points on a Likert scale.

Three themes were identified from responses to the question: "How does your use of classroom-based technology contribute to increased academic performance among your Alaska Native students?": (a) cultural support, (b) learning support, and (c) technology outcomes. A minority of the responders noted the potential for DLT to enhance cultural connections by increasing access to cultural information and by creating a safe avenue for artistic expression. The most common theme voiced was that

technology could be used as a learning tool to reinforce the development of basic skills or to enhance rigor. Twelve respondents stated they were not sure.

The second survey question asked: "How has access to a 1:1 classroom increased the congruence between your instructional practice and traditional ways of passing on Alaska Native cultural knowledge?" The analysis of the responses generated three themes: (a) culturally enhanced learning, (b) learning activities, and (c) instruction. Culturally enhanced learning practices coded into the themes included place- and project-based learning, expanded access to cultural knowledge, online cultural resources, Alaska Native languages and increased levels of intra- and inter-cultural communication. Several teachers noted the opportunity to access important online cultural resources as a positive attribute of 1:1 programs.

Responses to the survey question: "How does your use of classroom-based technology contribute to increased academic performance among your Alaska Native students?" showed limited insight into the role DLT played in creating a culturally friendly learning environment. Once prompted by a preamble describing traditional Alaska Native ways of instruction in the second survey, respondents were able to thematically describe many of the components critical to an effective culture-based education program. Given the responses, it was reasonable to conclude that digital learning technologies can play a significant role in education reform. However, to this end, teachers must ensure that instructional beliefs are translated into effective practice rather than being attenuated. Teachers were much more aware of 21st century methods and outcomes than they were of Alaska Native traditions.

5.2 Emerging Themes

One-to-one classrooms were designed to overcome first order change barriers including limited access to broadband, computers, software, technical support; all issues thwarting the integration of technology into instruction. Quantitative and qualitative data collected from this study demonstrated that 1:1 classrooms have clearly stimulated teachers into second order reform challenges: managing student computer use, integrating DLT into instruction, and reconciling beliefs with pedagogical practices preparing

students for 21st century life. The shift from first to second order barriers allowed evaluation of the study questions absent interference due to limited access to DLT. However, teachers, regardless of their pedagogical beliefs, were deeply immersed in second order issues related to the integration of technology and the reconciliation of instruction with the new methods. In a sense, the introduction of ubiquitous DLT into instruction has delivered education to the edge of chaos where new norms must be defined.

One of the most common themes identified addressed the excessive time spent monitoring student use of technology. Clearly, the ways teachers wanted students to use technology and the way students wanted to use it were often at crossed-purpose and represented the most significant barrier for teachers integrating technology into instruction. Expecting students to limit their embrace of this newly acquired autonomy after years of enforced conformity ignores basic aspects of human nature. Clearly the application of methods for accountability to restrain inappropriate student use would be beneficial.

A recurrent theme among respondents was the difficulty in dealing with a student-centric learning environment. If technology has become the servant of teaching style, the teacher must first be fluent in the style's effective expression before technology can be implemented appropriately. The opportunity for challenges related to student misuse is manifestly compounded during any dead time exposed when learning activities are poorly planned. It has often been noted that students who have been freely using digital technology have developed a strikingly brief digital attention span. Creating a constructivist learning environment is a critical step in using technology to successfully support instruction. Teachers need to learn to teach in a constructivist manner, to know how to use technology to facilitate learning. Without a coherent philosophy of use firmly in place, simply knowing how to use the instruments of technology can and will lead to student misuse. If teachers cannot effectively direct the use of technology for learning, the students will continue to use technology as they see fit.

Noted by teachers as continuing challenges were the difficulties in delivering student-centric instruction and how to take advantage of DLT resources. Teachers, who were grounded in constructivist philosophy, continued to use teacher-centric practices and low-level applications of technology because they had only limited time to develop, deliver and assess lessons. It is important to note that the advocacy for a constructivist environment is not centered on a specific instructional style. In fact, a student-centric environment requires teaching that places the student at the focus of each lesson.

5.3 Limitations of the Study

The study conclusions are based on data provided by a sample of 1:1 high school teachers working in rural Alaska's predominantly Alaska Native communities. The unique culture that defines Alaska's rural schools precludes broad generalizations relevant to all 1:1 teachers, Alaska's teachers, or to teachers in general. Yet the characteristics attached to the word "teacher" are the same when considering the learning needs of an individual child. Still, care should be taken when applying the study conclusions beyond the boundaries defined by the study.

The study focused on a new keystone of contemporary education: the technology mediated relationship between teaching and learning. In Alaska, 1:1 classrooms provided an opportunity to study this relationship without the interference of first order barriers that have often inhibited teachers in moving technology from the periphery of instruction to become a centerpiece in the new constructivist relationship between teachers and learners. This study assumed that the elements defining Alaska's 1:1 programs were in place including: ubiquitous access to laptops, high quality staff development, technical support and broadband. While care was taken to confirm the presence of these key elements, community ownership and school leadership all gave individual programs a unique character. The absence of any of these requisites for technology integration could have affected the quality, reliability and validity of the data.

5.4 Implications for Further Study

The conclusions leave many challenges waiting for future researchers. Topics that merit further study include:

- The appropriate balance between the autonomy of the constructivist learner and the rigorous outcomes necessary for a 21st century lifestyle.
- A more clearly defined relationship between the teacher and the technology enhanced autonomy of the 21st century learner.
- The skills necessary to manage, facilitate and support staff through the challenges presented by secondary change; i.e., fundamental changes in philosophy, thought and action.
- The potential of technology to support culture-based educational programming.
- How to manage student performance in a technology-enhanced constructivist classroom.
- The relationships between education research, the process of change and classroom practice.
- Professional development and the malleability of individual teaching philosophies.
- The differences between school and home use of technology by students.
- Gaming and the design of effective, technology enhanced learning activities.

This study could be expanded to include a sample of classrooms throughout Alaska. The opportunity to study the influence of digital learning technologies on teaching philosophy and teaching practice would provide a deeper understanding of the mechanisms catalyzing second order change.

5.5 Conclusions

The relationship between teaching and learning is a key variable in education reform. Youth bring to the learning moment a unique personality, programmed by complex interactions with the ability to acquire and act on knowledge. Teachers seek to direct learning toward specific outcomes. When the methods of formal education facilitate the same learning processes used by the student away from school, teaching and learning can become mirror images. Efforts to align educational practices along student-centric lines are attempts to polish the mirror - to reestablish a natural learning

environment. Life in a technologically accelerated, information-dominated world will require that the full range of cognitive attributes become challenged during formal instruction.

Digital learning technologies are tools that can be used to support a student-centric learning environment affording students the opportunity to use high order cognitive skills that will be required in life after school. To this end, teachers must create a learning environment that invites students to become actively engaged in contextual learning, challenging students to find purpose in schoolwork. Teachers must create learning activities diverse enough to accommodate a child's preference or to discover a new one.

These reform efforts are critical. For Alaska Native students, the change to a constructivist learning environment will link Western and Alaska Native methods. Twenty-first century students must be practiced learners who can respond to changing expectations. However, two factors are critical to this effort. Teachers must adopt practices consistent with the outcomes anticipated for the 21st century. Secondly, technology must move from being prescribed tools used by the teacher to becoming an open set of tools used by students to cognitively extend their innate abilities to live and thrive in a virtual landscape that continues to be created. Constructivist teachers will need to use technology to create a constructivist-learning environment while students will need direction, access and the time to practice.

The study has demonstrated that teaching philosophy and the application of technology can be closely related. Reform initiatives designed to prepare students for 21st century jobs will prove futile when applied with outmoded philosophies and practices. The evidence generated by the study shows that teaching beliefs are malleable and subject to change. Two key barriers must be addressed before effective change can be achieved.

First, both teachers and students need unfettered access to digital learning tools. Teachers cannot be expected to confront second order barriers if they can't easily transit first order barriers. Secondly, once teachers are engaged in second order challenges,

effective staff development time must be made available to help teachers progress through the transitions from one belief system to another.

Patience will be required to facilitate these monumental changes. The learner outcomes of culture based education and 1:1 initiatives have been similar: minimal increases in student achievement but measurable gains in student engagement and attitude. Reform initiatives should not be evaluated based on immediate improvements in student achievement. Rather, effective programs should define the first evaluative benchmark through changes in student engagement and attitude. Purpose follows engagement and academic proficiency follows purpose.

Changes in instructional philosophy will proceed slowly because some teachers adhere to traditional pedagogical beliefs or they wait to see if the change is simply another passing fad. But for others, access to a technology-rich environment provides the opportunity to daily practice their student-centric philosophy in spite of the systemic barriers. Access to DLT did not lead to immediate changes in teaching style for all teachers but it did provide the infrastructure for students to teach the teacher. It became clear that through an increase in attitude and engagement, technology can act as a catalyst reviving students' natural inclination to resolve curiosity through investigation. It is not the technology, rather it is the students who will convince teachers to alter their methodology. To this end, students and teachers must become engaged in a common partnership to ensure that teaching and learning one again reflect mirroring roles.

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Appendices

Appendix A: Cohort Experiences

This dissertation is one of four inter-related studies focusing on the digital landscape in one-to-one laptop environments within classrooms in Alaska's public high schools. Each of the four doctoral students analyzed aspects of teaching and learning in these technological environments; each approaching their individual study from their own individual perspectives. The cohort model provided a professional atmosphere for social learning (Wesson, Holman, Holman, & Cox, 1996). Wesson, et al. analyzed the social processing in a cohort that promotes a learning environment rich in both collaboration and cooperation. This has been true for the model offered to the four cohort members over the three-year duration of the project.

The cohort structure helped to build a common vision of the combined research effort as well as to manage differences of opinion. Experience allows recommendations for a good working structure to include 1) organize a cohort with similar levels of experience, 2) attend to the personal dynamics of the group, 3) create a culture where difference of opinion is respected, valued and open, 4) establish the expectation that feedback will be provided, and 5) present opportunities for informal exchange (Creamer, 2004). In addition, the knowledge of and access to the network of associates each cohort member brought to the table enabled other members to benefit from a much larger range of logistical support in their individual research.

A collaborative structure, positive cohort experiences, specifically in preparing scholarly leaders, and built on each researcher's professional experiences, have been shown to produce higher rates of completion (Barnette & Muth, 2008). The four members making up the technology cohort exemplified this statement. There were many times the cohort did not abandon difficult problems because of the reliable support of each of the members. In addition, the cohort shared common coursework, collected research data through common survey instruments using the same program population, and shared common committee members.

Having similar backgrounds and experiences is beneficial for a cohort (Dorn,

Papalewis, & Brown, 1995 1995). All members of our cohort were well experienced in Alaska education, having individually taught here for many years, and all were recognized as seminal influencers of educational technology and Alaska education in general. Each of the four cohort members came to the research topic with previous experience, at a school, a district or state levels for one-to-one laptop implementations. Each also had experience working in Alaska school districts.

Larry LeDoux is the former Commissioner for the Alaska Department of Education and Early Development. During his 30 years in the Kodiak Island Borough School District, he has served as superintendent, principal, teacher and technology director. Besides serving on a number of state boards and commissions, Larry has served as President of the Alaska Association of Secondary Principals and the Alaska Council of School Administrators. Larry is currently working as a private education consultant.

Pam Lloyd served fifteen years in the Anchorage School District as both an administrator and a classroom teacher. She held the position of K-12 Instructional Technology Coordinator for six years. Pam has held numerous board positions including President of the Alaska Society for Technology in Education and President of Cook Inlet Literacy Council. She currently serves as President of the Alaska Academic Decathlon and is on the U.S. Academic Decathlon board of directors. She currently works for General Communications Incorporated (GCI). GCI is an Alaskan based telecommunications company providing voice, video and data communication services to residential, commercial and government customers. Pam is currently the Director of GCI SchoolAccess, a division within GCI, providing Internet access and distance learning services for schools across Alaska, New Mexico, and Montana.

Mark Standley has served in the capacity of teacher, principal and assistant superintendent across several districts in Alaska, including the Anchorage School District. He was formerly co-chair of the State's Technology Standards group (1990-1991) and is President-elect of the Alaska Society for Technology in Education. He is currently is the CEO for a non-profit, Education 4 Leadership, focused on one-to-one

implementation and supervises/teaches education research to pre-service principals for the University of Alaska Southeast (UAS) Education Leadership Program.

Robert Whicker, a former teacher, principal, and superintendent, ended his K-12 career in the Denali Borough School District, one of Alaska's first one-to-one laptop implementation districts. He worked for Apple, Inc. as a Development Executive, meeting with school districts in their implementation of one-to-one laptop programs across the western U.S. He currently is the Director for the Association of Alaska School Boards, Consortium for Digital Learning program, and serves on the Alaska Broadband Task Force.

Together, the members of this cohort have significant knowledge, experience, and expertise in the field of technology and education. They have all worked with each other over the years in their various capacities, at the national, state and district levels.

Cohort groups in research bring a larger network of resources to the benefit of the group (Miller & Irby, 1999). Time and again, the vast amount of experience of this Tech Cohort benefitted not only the group in its organization but each individual. The differences in experience and perspective of the cohort members enabled each individual to test their theories (Creamer, 2004). Just as with the previous University of Alaska Fairbanks (UAF) Interdisciplinary cohort, (Atwater, 2008; Cope, 2008; Crumley, 2008; McCauley, 2008) this cohort shared a commitment to their common goal, making the research process a true community practice through discourse, mixed methods and models. The cohort shared classes and met outside of class regularly to discuss the overarching topic of one-to-one laptops in the digital landscape of Alaska education.

Each member of the cohort looking through their unique lens, shared interest in an overarching topic of studying teaching and learning in the Alaskan digital landscape. The four cohort members and their dissertation topics were:

Larry LeDoux's research is a mixed methods study, titled: "Polishing the mirror: a multiple methods study that examined the relationship between teaching style and the application of digital learning technologies in Alaska's one-to-one laptop programs." Larry researched the outcome of this relationship as a key determinant in the success of

strategies to create learner environments that are consistent with both Alaska Native and 21st century practices and outcomes.

Pam Lloyd's research is a mixed method study, titled: "Digital dead-ends along Alaska's information highway: home broadband access for teachers and students in Alaska's high school one-to-one laptop programs." Pam researched the Levels of Adoption (LoA) among three categories of bandwidth availability in the community for teachers and students.

Mark Standley's research is a qualitative study, titled: "Kids getting away with learning: student perceptions of a one-to-one laptop program." Mark listened to students views of learning in and outside of formal school structures by conducting focus groups with high school students in five rural schools.

Robert Whicker's research is a mixed method study, titled: "Framing complexity: teachers and students use of technology in Alaska one-to-one laptop high schools." Bob researched the perceptions of teachers and students in the implementation, levels of use, and concerns identified by teachers in Alaska's high school one-to-one laptop program.

The relationship between each cohort members' research topic and questions related to the overarching theme is depicted in Figure 20.

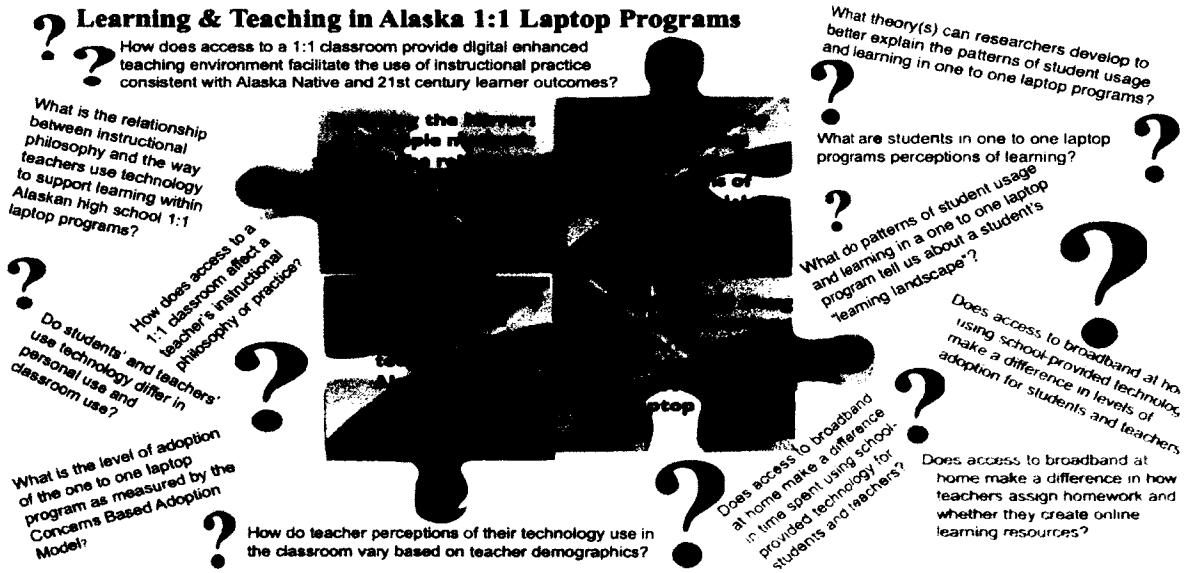

Figure 20. Cohort topic relationships

A 215-item teacher questionnaire, with nine open-ended questions and a 100-item student questionnaire, with three open-ended questions, were collaboratively created by three of the four cohort members. The cohort shared in the dissemination of the surveys to districts identified as having predefined criteria. This led to response rates of 40% for teachers (n = 94), and 43% for students (n = 725). This shared effort led to higher response rates and a much larger dataset than if the cohort had gathered data individually. The fourth cohort member created questions for qualitative focus groups. This was done using input from the three other members to gather student perceptions about questions on the online survey.

In a remote village in northwest Alaska in January of 2011, the cohort organized a pilot study to test the online survey and focus group instruments. This meant that part of the cohort had to be at the school and a separate part had to be online managing the technology involved with our research instruments. This team effort led to better online surveys and improved focus group questions. This shared field-testing and pilot study gave the entire team more confidence in their several tools for conducting the research.

The cohort, by modeling many of the practices and roles of the cohort previous cohort, was able to achieve a community of practice and a vision for shared leadership (Atwater, 2008; Cope, 2008; Crumley, 2008; McCauley, 2008). Both cohorts also functioned as a "knowledge mini-market" as they reviewed literature, created meaning and shared knowledge (Cope, 2008).

For many doctoral students the individualized, independent structure of a traditional doctoral program can lead to frustration and failure. This frustration has led 40% to 70% of the doctoral student population down the path of dropping out and feelings of failure (S. Gardner, 2008). For some traditional doctoral students, the transition from "consumers of knowledge to creators of knowledge" causes much isolation in the doctoral process (S. Gardner, 2008). The cohort model experience did not reflect feelings of isolation or frustration, but rather a feeling of belonging to a group with a common purpose and commitment to four members, sometimes driving simultaneously, and sometimes one at a time.

The cohort developed a corporate personality and voice. While there was not always agreement on individual issues, there was always support for each other throughout the process. The cohort shared a collegiality and a trust that pushed each member toward becoming a more effective researcher. The benefits experienced by each cohort member supported the research findings, and provided a successful learning community for each cohort member. The main reason for doctoral students in an Illinois university to complete their programs was the support and encouragement of their cohort of graduate students (Brien, 1992).This was most certainly true for this more structured cohort. Due to the demands of professional careers combined with the pressure of our doctoral programs, the trust and understanding between cohort members was crucial.

The cohort met regularly over a three-year period. Weekly Monday night classes were common to all members, overlapping schedules during educational conferences, meetings in airport boardrooms and regularly scheduled teleconferences reinforced the cohort's support. The development of a team structure provided the encouragement needed to persist in our research. The experiences of this cohort support the findings of the researchers cited above, that the benefits of a cohort are indeed tangible and worth replicating in other doctoral programs.

Appendix B: Glossary of Terms

1. Aboriginal: An adjective that refers to people originating from a specific area or place.
2. Algaqsruun: According to Ramoth-Sampson (2012) algaqsrum is the "advice" Alaska Native Elders share with children.
3. Analytic tools: Devices and techniques used by analysts to facilitate coding process (Corbin & Strauss, 1998, p. 87).
4. Axial coding: The process of relating categories to their subcategories, termed "axial" because the coding occurs around the axis of a category, linking categories at the level of properties and dimensions (Corbin & Strauss, 1998, p. 123).
5. Broadband: Refers to a telecommunication signal or device of greater bandwidth and is measured in speeds. The FCC has defined broadband speeds as 786 Kbps Download to the customer by 200 Kbps upload to the Internet.
6. Categories: Concepts that stand for phenomena (Corbin & Strauss, 1998, p. 101).
7. Classroom Use of Technology: The use of technology in the classroom with students in learning activities.
8. Coding: The analytic processes through which data are fractured, conceptualized, and integrated to form theory (Corbin & Strauss, 1998, p. 3).
9. Complex Learning: Kirschner and vanMerrienboer, (2008) describe complex learning as "the integration of knowledge, skills and attitudes; coordinating qualitatively different constituent skills; and often transferring what was learned in school or training to daily life and work" p. 244).
10. Concurrent Embedded Design: A mixed-method design where the priority between quantitative and qualitative data "is usually unequal and given to one of the two forms of data—either to the quantitative or qualitative data. The nested, or embedded, forms of data are, in these designs, usually given less priority" (Hanson, Creswell, Plano-Clark, Petska, & Creswell, 2005, p. 229).
11. Culture: "The forms of traditional behavior which are characteristics of a given

society, or of a group of societies, or of a certain race, or of a certain area, or of a certain period of time" (Mead, 1937, p. 17).

12. Culture-Based Education: An education process that uses "the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science and other subjects across the curriculum (Sobel, 2004, p. 7).
13. Digital Learning Technology: Digital applications that "encompasses a wide spectrum of tools and practice, including using online and formative assessment, increasing focus and quality of teaching resources and time, online content and courses, applications of technology in the classroom and school building, adaptive software for students with special needs, learning platforms, participating in professional communities of practice, providing access to high level and challenging content and instruction, and many other advancements that technology provides to teaching and learning" (Schwartzbeck, 2012, p. 1).
14. Elders: Lewis, (2009) suggests that Eldership status is granted to those individuals who have "aged well" as evident by their emotion, spirituality, community engagement and physical health. Lewis (2009) writes: "Elder status is not determined by reaching a certain age (e.g., 65 years), but instead is designated when an individual has demonstrated wisdom because of the experiences he or she has gained throughout life" (para. 3) .
15. First Order Change: "Incremental change that fine-tunes the system through a series of small steps that do not depart radically from the past" (Marzano et al., 2005, p. 66).
16. Grounded Theory: "A method of conducting qualitative research that focuses on creating conceptual frameworks or theories through building inductive analysis from the data" (K. Charmaz, 2006, p. 187).
17. High Order Skills: Those skills necessary to "analyze, synthesize and apply evidence"... critical thinking, communication, problem-solving, collaboration and reasoning (Chun, 2010).

18. Learning Style: "A composite of the cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment" (J. Keefe, 1979).
19. Methodology: A way of thinking about and studying social reality (Corbin & Strauss, 1998, p. 3).
20. Methods: A set of procedures and techniques for gathering and analyzing data (Corbin & Strauss, 1998, p. 3).
21. Mixed Method Design: A mixed-methods evaluation is one that "establishes in advance a design that explicitly lays out a thoughtful, strategic integration of qualitative and quantitative methods to accomplish a critical purpose that either qualitative or quantitative methods alone could not" (Gargani, 2012, p. 1).
22. One-to-one: The ratio of computing device per end user, a tool per learner and teacher.
23. One-to-One Classrooms: Technology rich classrooms that provide students with ubiquitous access to a laptop computers, teachers with necessary professional development and classrooms with sufficient access to the hardware, software, bandwidth and technical support to integrate technology into learning and instruction.
24. One to one laptop program definition for study: a) students and teachers having access to laptops anytime, anywhere, in and out of school, b) access to a wireless infrastructure, c) the use of the laptops included in the curriculum as tools of learning, d) a professional development model including technology integration in the learning process, and e) a policy of at-home use of a school issued laptop at some time during the program.
25. Open coding: The analytic process through which concepts are identified and their properties and dimensions are discovered in data (Corbin & Strauss, 1998, p. 101).
26. Personal Use: The use of technology in personal life for daily functions.
27. Phenomena: Central ideas in the data represented as concepts (Corbin & Strauss,

1998, p. 101).

28. Placed Based Education: "Learning that is rooted in what is local—the unique history, environment, culture, economy, literature, and art of a particular place" (Smith & Sobel, 2010, p. 23).
29. Professional Practice: The use of technology in the professional arena of teaching to include aspects of preparation, planning, administration, organization, assessment and professional development.
30. Second Order Change: "Deep changes that alter the system in fundamental ways, offering a dramatic shift in direction and requiring new ways of thinking and acting" (Marzano et al., 2005, p. 66).
31. Student-Centric Instruction: An approach to learning that places an emphasis on "changes in students' learning and on what students do to achieve this rather than on what the teacher does" (Harden & Crosby, 2000, p. 338) by giving "students greater autonomy and control over choice of subject matter, learning methods and pace of study" (Sparrow, Sparrow, & Swan, 2000, p. 1). Used synonymously with constructivist instruction in study.
32. Superficial vs. Deep Cultural Knowledge: Superficial culture can be described as those components of a culture that can be observed and noted by an individual from another culture; i.e., language, art, dance, storytelling. Deep culture is described by R. Barnhardt, (2005) as "the knowledge and skills derived from thousands of years of careful observation, scrutiny and survival" that inform the relationship between Alaska Native people and land.
33. Teacher-Centric Instruction: Focuses "on the teacher as a transmitter of information, with information passing from the expert teacher to the novice" (Harden & Crosby, 2000, p. 338).
34. Teaching Philosophies: "Written statements of why teachers do what they do—their beliefs and theories about teaching, about students and about learning, all of which underpin what and how they teach" (Fitzmaurice & Coughlin, 2007, p. 3). Used synonymously with beliefs in study.

35. Teaching Style: Represent the practices and behaviors that a teacher uses to facilitate learning. Teaching styles is a compromise between philosophy and internal/external factors that limit the expression of philosophy.
36. Technology Integration: The application technology "to introduce, reinforce, extend, enrich, assess, and remediate student mastery of curricular targets" (Hamilton, 2007, p. 20).
37. Theory: A set of well-developed concepts related through statements of relationship, which together constitute an integrated framework that can be used to explain or predict phenomena (Corbin & Strauss, 1998, p. 15).
38. Traditional Knowledge and Alaska Native Ways of Knowing: "Traditional knowledge (TK) is the information that people in a given community, based on experience and adaptation to a local culture and environment, have developed over time, and continue to develop" (Hansen & VanFleet, 2003, p. 1).
39. Triangulation: A mixed method strategy used to develop a more complete understanding of a phenomena being studied by using multiple research methods that may include the collection and analysis of both qualitative and quantitative data.
40. Twenty-First Century Skills: "The skills, knowledge and expertise students should master to succeed in work and life in the 21st century: core subjects and 21st century themes; learning and innovation skills; Information, media and technology skills and life and career skills" (Partnership for 21st Century Skills, 2011).
41. Worldview: " A means of conceptualizing the principles and beliefs - including the epistemological and ontological underpinnings of those beliefs - which people have acquired to make sense of the world around them" (Kawagley et al., 1998, p. 133).

Appendix C: Statistical Analysis

This study examined the correlation between teacher beliefs and the level of adoption of technology for teachers in 1:1 high school classrooms in rural Alaska. The validity of the study was dependent on the quality of the data collected from survey respondents and the statistical procedures used to analyze the data. Care was taken to ensure that the data ultimately used in the statistical equations was valid and a reliable representation of the study. The Statistical Package for the Social Sciences (SPSS) by IBM was used to process survey data.

The Technology Frameworks Survey (TFS) defined by the research cohort was administered asynchronously April 1 to June 1, 2011. SurveyMonkey, a privately owned internet-based survey host, sent password-protected invites to 1:1 teachers who met the study's participation guidelines. During the survey window, 121 out of a predetermined population of 236 teachers accessed the survey. After a case-by-case review, 27 teachers were removed from the sample. The grounds that merited removal included surveys that were: (a) not filled out, (b) incomplete, (c) purposely random and (d) completed by individuals not currently teaching in a 1:1 classroom. The final sample included 94 teachers for a response rate of 40%.

The equation for population size reported by Rea and Parker (2005) was used to calculate the standard error for a distribution of sample means (p. 152).

$$n = \frac{Z_a^2 s^2}{ME_i^2 + \frac{Z_a^2 s^2}{N-1}}$$

Where ME_i is the confidence interval, Z_a^2 is the Z score for various levels of confidence α, $\sigma_{\bar{x}}$ is the standard error for a distribution of sample means and s is the standard deviation of the sample. Solving for $\sigma_{\bar{x}}$ produced a standard error of ±.08 or ±8%.

Pearson's Coefficient of Correlation (r) in SPSS is a popular test to evaluate the linear relationship between two continuous variables. The Pearson (r) coefficient can be calculated form the following equation:

$$r = \frac{\sum z_x z_y}{N}$$

where z_x is the variable X converted into Z scores and z_y is the variable Y converted into Z scores.

Pearson's test generates an (r) value that informs both the intensity and direction of the relationship between two continuous variables: the absolute value of Pearson's coefficient (-1, 0, +1) is the intensity of the relationship while the sign of the (r) coefficient (-, 0, +) represents the direction of the association. Values become weaker as they approach zero.

However, use of Pearson's (r) coefficient required two considerations be evaluated. First, a Pearson's (r) coefficient value represents a linear relationship between one group of variables paired with another. A review of the scatter plots was necessary to ensure that the relationship between variables was a linear and monotonic: i.e. as one variable increases, so does the other (positive) or as one goes up, the other goes down (negative).

Secondly, Pearson's (r) coefficient is sensitive to the included outliers in the data. Two tests were conducted to ensure that these outliers did not significantly skew the results. The first involved a visual inspection of scatter plots generated by plotting belief scales against the levels of adoption of technology. The scatter plots did not reveal any noteworthy outliers. A second statistical inspection, using SPSS 19 to detect unusual data, identified two outliers. Consequently, after a brief review of both cases unambiguously showed thoughtful response patterns to the survey questions, the cases were retained in the study data.

The interpretation of the effect size of the Pearson coefficient was evaluated using Cohen's (1988) effect scale. Cohen's effect scale is a standard way to report the intensity of relationships between data: Small (< = .2); Moderate (> .2 and <.5); Large (> = .5).

It is important to note that effect size does not measure cause; rather it merely identifies a relationship. The statistical significance (p) of a relationship is a function of the size of the sample, the effect size and the confidence level selected for the particular research. The acceptable probability (p) that the sample was not representative of the population under study was set at <.05 (5%); the general standard for social science research. Smaller values of (p) reflect greater confidence that the results are not the result of chance. Values equal to or greater than .05 support a rejection of the null hypothesis that there was relationship between the variables being compared. A two-tailed test for significance was used because the direction of the relationship between the independent and the dependent variable was not confirmed.

Spearman's Rho is use to evaluate correlation when the data being compared is ranked or ordinal data. The formula for Spearman's Rho is represeted by the equation:

$$\text{rho (p)} = 1 - \frac{6d^2}{n(n^2-1)}$$

where (n) is the number of paired ranks and (d) is the difference between the paired ranks. Like Pearson's (r), Spearman's Rho estimates both the strength and direction of the relationship. Correlation ranges from -1 to +1. Spearman Rho was used to evaluate the relationship between the self-report of technology and the level of adoption of technology by high school 1:1 teachers in rural Alaska. SPSS 19 was used to process the data. The evaluation of Spearman's Rho parallels Pearson's (r) with regard to determinations of significance and effect size.

Appendix D: Institutional Review Board Approval

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Institutional Review Board

909 N Kinyon Dr, Suite 212, PO Box 757270, Fairbanks, Alaska 99775-7270

January 11, 2011

To: John Monahan, Phd
Principal Investigator

From: University of Alaska Fairbanks IRB

Re: [174783-2] Polishing the Mirror: A Multi-Methods Study of the Relationship Between Teaching Style and the Application of Technology in Alaska's Rural 1:1 Digital Classrooms.

Thank you for submitting the New Project referenced below. The submission was handled by Expedited Review under the requirements of 45 CFR 46.110, which identifies the categories of research eligible for expedited review.

Title:	*Polishing the Mirror*: A Multi-Methods Study of the Relationship Between Teaching Style and the Application of Technology in Alaska's Rural 1:1 Digital Classrooms.
Received:	December 27, 2010
Expedited Category:	7
Action:	APPROVED
Effective Date:	January 11, 2011
Expiration Date:	January 11, 2012

This action is included on the January 27, 2011 IRB Agenda.

No changes may be made to this project without the prior review and approval of the IRB. This includes, but is not limited to, changes in research scope, research tools, consent documents, personnel, or record storage location.

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Institutional Review Board

909 N Koyukuk Dr, Suite 212, PO Box 757270, Fairbanks, Alaska 99775-7270

October 7, 2011

To: John Monahan, Phd
Principal Investigator

From: University of Alaska Fairbanks IRB

Re: [174783-3] Polishing the Mirror: A Multi-Methods Study of the Relationship Between Teaching Style and the Application of Technology in Alaska's Rural 1:1 Digital Classrooms.

Thank you for submitting the Amendment/Modification referenced below. The submission was handled by Expedited Review under the requirements of 45 CFR 46.110, which identifies the categories of research eligible for expedited review.

Title:	Polishing the Mirror: A Multi-Methods Study of the Relationship Between Teaching Style and the Application of Technology in Alaska's Rural 1:1 Digital Classrooms.
Received:	August 26, 2011
Expedited Category:	2
Action:	APPROVED
Effective Date:	October 7, 2011
Expiration Date:	January 11, 2012

This action is included on the October 13, 2011 IRB Agenda.

No changes may be made to this project without the prior review and approval of the IRB. This includes, but is not limited to, changes in research scope, research tools, consent documents, personnel, or record storage location.