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The relationship between Montana science teachers self-efficacy and the integration of Web 2.0 elements in the classroom in schools with a student population over 900

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The Relationship between Montana Science Teachers Self-Efficacy and the Integration of Web 2.0 Elements in the Classroom in Schools With a Student Population Over 900.

by
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Abstract

Web 2.0 tools are part of the 21st century school, and are essential elements to teachers in the classroom as our students today are part of the digital generation (Prensky, 2001). Web 2.0 tools offer the instructor the ability to design the learning environment to focus on collaboration and a facilitation of content knowledge (Solomon & Schrum, 2007). This study investigated the use of web 2.0 tools in the largest 14 high schools in Montana with a student population of 900 or more, and identified relationships that influenced the integration of the tools into the science classroom. Montana science teachers use diverse web 2.0 tools for teaching and learning in the classroom, blogs, wikis, podcasts, social media, and electronic learning management systems.

A quantitative research design was implemented and the survey instruments were replicated with permissions from previous similar research of Pan, (2011). A statewide survey of science teachers in the 14 largest high schools in Montana with a student population of 900 or more was conducted. Thirty-five teachers responded to the research inquiry and of the 35 participants, 31 completed the surveys completely. All of the completed surveys were used in the multiple regression analysis between the dependent variable *The Web 2.0 Tools Integration* survey and the independent variable in *The Web 2.0 Tools Self-Efficacy* survey instrument. Within *The Web 2.0 Tools Self-Efficacy* instrument, six independent variables were explored for their correlation to the dependent variable: age, years teaching in the classroom, access to web 2.0 tools at school and home, using computers for teaching, and average hours of computer use for teaching per week. The results indicated that science teachers in the 14 largest high schools in Montana with a student population of 900 or more rarely use web 2.0 elements in the classroom for teaching. Although, this study identified the importance of professional development, and school administrative support with teacher's self-efficacy for integration of web 2.0 elements into the classroom.

Keywords: web 2.0, web 2.0 tools, blog, wiki, social media, content and learning management systems, science teachers, Montana public schools.

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Chapter One
Introduction

Throughout the 19th and 20th centuries in the United States industrialized corporations relied upon public education to provide students with basic skills to prepare them for the world of work, and to become contributing members of society (Fullan, 2001). Public schools resembled assembly line production of the 1920's where students went from class to class and instructors imparted knowledge upon them resembling the assembly line production for automobiles in the 1920's (Fullan, 1991). This model for public education was refined, and perfected over the last 100 years; however, some public schools still practice this model today. Over the last two decades, educators have begun to identify problems with educating 21st century students under a 20th century paradigm (Prensky, 2001). The 21st century has redefined what expertise corporate and business personnel need to compete due to globalization and the speed of 21st century technology (Friedman, 2006). Our public educational institutions need to redefine public education and embrace the technological revolution while preparing students for jobs/careers that do not exist yet, and still teaching them with technology that will become outdated in a decade (Wilmore & Betz, 2000). Engaging students in relevant content material, redefining the role of the teacher as facilitator, and continuing integration of 21st century technology into the curriculum will change educational pedagogy and pave the way for stakeholders to begin to transform public education (Jacobsen, 2001).

The school administrative leadership team consisting of the principal, vice, or assistant principals, and curriculum directors provide the necessary leadership through the use of strategic planning in leading, and changing the culture of the organization for a technology rich environment of the 21st century (Fullan, 2001). Today's administrative leadership teams fulfill

many different roles in being prepared to create an environment that is ready for change in school culture while sustaining the vision of the organization for the 21st century. The development and integration of 21st century educational technology is an essential element in creating an environment in which student achievement can increase (Schrum & Levin, 2009).

Best practices in technology integration center on the development and use of web 2.0 tools. Such pedagogy engages students in learning through authentic performance assessments, and multiple modes of expression developing a unique 21st century learning environment (Barnett, Keating, Harwook, & Saam, 2004). According to Mehlinger and Powers (2001) "it is no longer possible for administrators to be both naïve about technology and be good school leaders" (p.218). Moreover, Wilmore and Betz (2000) believe, that the principal's role is an important component to the success of technology integration. They assert "information technology will only be successfully implemented in schools if the principal actively supports it, learns as well, provides adequate professional development, and supports his/her staff through the process of change "(p.15). The International Society for Technology Education or (ISTE) developed a set of guidelines for all stakeholders of an organization and a listing of essential conditions that they identify as necessary for changing the culture of the organization with respect to technology integration into the school environment. Specifically these 14 components guide the essential conditions of the school environment and they are: Shared Vision, Empowered Leaders, Implementation Planning, Consistent and Adequate Funding, Equitable Access, Skilled Personnel, Ongoing Professional Learning, Technical Support, Curriculum Framework, Student-Centered Learning, Assessment and Evaluation, Engaged Communities, Supportive Policies, and Supportive External Context (ISTE, 2011). ISTE also developed a specific set of guidelines/standards for administrators to use in the integration of technology into the curriculum:

Visionary Leadership, Digital-Age Learning Culture, Excellence in Professional Practice, Systemic Improvement, and Digital Citizenship (ISTE, 2011).

The demands of a building principal have evolved over the last two decades since the inception of the Internet and its impact on educational pedagogy within the classroom. Today educational leadership is focused on collaboration and supporting a school culture that encourages communities of learning. Corbett, Firestone, and Rossman (1987) believe that for change in an organization to be sustained the leaders must understand how the culture will accept the change, and where the culture will need to be modified. Schools need leaders that can facilitate the change process use strategic planning, change the role of an educator to that of facilitator of content knowledge and continue to integrate technology into the classroom for enhancing students' experiences with the educational experience.

Administrative teams and their dedication to the use of strategic planning, hold the keys to creating change at the building level in addition to the development of teacher leadership and its impact on the culture of the organization. Teacher leadership and involvement in the change process can have an impact on program and instructional practice within the building (Fullan, 2001). In the 21st century educational leaders need to be able to integrate information technology into their daily practice and provide consistent and positive leadership for technology use in the teaching and learning process. "Leaping into the knowledge-age appears to be less about technology integration per se, and more about the fundamental changes to teaching and learning that are enabled and required by the new medium" (Jacobson, 2001, p.14). Twenty-first century technology has now permeated society and schools need to use and integrate the technology to increase student engagement in content material (Daggett, 2005).

The target population for this quantitative study incorporated a purposeful random sample of high school science teachers in the fourteen largest schools in Montana with a student population of 900 or more. The data instrument was adapted from the previous studies of (Baylor & Ritchie, 2002; Davis, 1989; Taylor & Todd, 1995). The instrument focused on items exploring a comfort level with Web 2.0 technologies (blogs, wikis, social networking software, and social bookmarking), actual usage of specific web 2.0 technologies in the classroom, and attitudes toward specific web 2.0 technologies (Ajjan & Hartshorne, 2008; Pan 2011). This research study used the results of the data to determine the levels of technology integration into the classroom through an assessment of the instructors use of such technology in the classroom.

Technology and Pedagogy

Essential to the success of technology integration into the public school is the redesign of educational pedagogy where the teacher becomes the facilitator of content knowledge while committed to continued professional development in using web 2.0 elements within the classroom environment. An essential element to the success of the pedagogical redesign is the support of the building administration. No successful large-scale change or school reform effort has advanced very far without the support of the leadership in the system that is most closely connected to those that need to change (Fullan, 2003). Historically, the building principal has taken on the role of the manager of the organization. Although recently the role of educational leader has transformed the need to incorporate leadership skills into the development of a successful organization; the connectivity and interrelatedness between educational leadership and management is essential for the 21st century educational leader. The leader needs to be able to communicate the vision and mission for the school while the manager tends to the daily activities involved in keeping the organization focused on the mission, and vision.

Research has shown that for the pedagogical redesign, teacher as facilitator and (leader), to take place in connection with that of integrated technology into the daily routines of teachers, the role of the principal needs to encompass that of technology leader (Daggett, 2005). The utilization of technology in the classroom will create the need for change in both teaching practices and learning environments. These changes too will demand new leadership styles to help teachers cope with the demands of these technological and pedagogical changes. Some of the changes in pedagogy were as a result of the literature/programs established in the state.

The Competitive Technology Grants Providing Professional Development for High School Districts in Montana attempted to use a peer-coaching model for providing 21st century professional development for teachers, administrators, and leadership teams. The purposes of the peer-coaching in organizations was to enhance an understanding of needed requirements to effectively integrate technology into the curriculum (Gibson, 2002). Research using a constructivist approach to teaching for participants, as well as the integration of information technology as a transformational element, helped to provide a well-rounded approach for preparing tomorrow's school leaders for their role in the integration of technology into teaching and learning (Gibson, 2002). There appears to be a gap in the research on leadership staff development for technology integration and the methods and strategies that a principal uses for technology leadership. Fewer research studies have paid close attention to factors that might impact the context for, or degree of technology integration. According to related research on this topic, aligning the vision of technology integration and the role of schools and districts in shaping teacher use of technology through leadership has received little attention (Creighton, 2003; Ertmer et al., 2002; Mehilinger & Powers, 2002; O'Dwyer, Russell & Bebell, 2004).

This quantitative research study focused upon the roles of Montana's science teachers in the largest 14 schools with a student population of 900 or more, and their ability to guide the implementation of 21st century pedagogy including teacher as facilitator, and the use of web 2.0 tools into the science classroom (Creighton, 2003; Ertmer et al., 2002; Mehilinger & Powers, 2002; O'Dwyer, Russell & Bebell, 2004). Student motivation, and interest in coursework have changed because of the 20th century paradigm from which instruction is currently being delivered (Jacobsen, 2001). The survey instrument gauged the integration of web 2.0 tools in (blogs, wikis, social networking software, and social bookmarking), actual usage of specific Web 2.0 technologies in the classroom, and attitudes toward specific Web 2.0 technologies into the classroom environment by the science teachers. Data collected from the integration of web 2.0 tools were compared to that of the studies conducted by (Ajjan, Haya, Hartshorne & Richard, 2008; Franklin, 2007; Pan, 2011) that examined pre-service teachers. The data were then compared to that of the integration of web 2.0 tools into the science classrooms of Montana's largest high schools.

Problem Statement

The 20th century industrialization educational paradigm is outdated and reform is necessary to keep students engaged and motivated in a globalized environment of the 21st century. Public education in the United States needs to adapt to the pedagogical and technological revolutions that have swept the country such as the use of social media, blogs, wikis, and podcasts in the classroom environment. In an effort to prepare students for the 21st century educational technological tools, need to be implemented within the classroom lead by the building administrative team to ensure students are receiving enhanced science content material presented by educators in the classroom. The changing roles of educators need to reflect that of teacher as

facilitator and leader (Prensky, 2001). Legault, Green-Demers, and Pelletier (2006) explain how student motivation decreases as students' progress through grades, citing that student motivation indicates a complete lack of engagement, which peaks at the high school level. Students' engagement in content material will increase when they feel that their learning serves a purpose and they can see the reason for learning content material (Prensky, 2001). With the transformation of educational pedagogy and educators serving as facilitators of content knowledge, the use of web 2.0 tools in the classroom, schools should use such means to reform education (Collins & Halverson, 2009).

Purpose of the Study

The purpose of this quantitative study was to examine the leadership roles of Montana science teachers and their ability to serve as facilitators of content knowledge while using web 2.0 tools to enhance science course instruction. One hundred and fifty two science teachers were purposefully selected that are currently teaching science in one of the 14 largest high schools in Montana. The survey centered on the science teachers and their integration of web 2.0 tools into their classrooms. This study sought to explore the strength of the correlations/relationships that existed between the data collected from science teachers, in the 14 largest high schools in Montana; as compared to that of the aggregate national data collected by previous research and that data gathered through two studies using *The Web 2.0 Tools Integration*, and *The Web 2.0 Tools* Self-*Efficacy* questionnaires.

Research Question

Teachers need to serve, as the facilitators of content knowledge within the classroom and such instructional practices need to be rooted in a solid philosophical pedagogy (Prensky, 2001). Additionally, 21st century technological integration into the classroom serves as the vehicle for

facilitation. The established existential pedagogical philosophy needs to be aligned with the integration models being utilized. Ultimately, the driving force behind the teacher serving as facilitator of content knowledge lies in their ability to engage students within the classroom environment (Prensky, 2001). For the purposes of this quantitative study, the interest in technology integration within the classroom lies in the research questions that are stated below:

1. What type of correlation exists between the role of the teacher acting as a facilitator of content knowledge, using web 2.0 tools for instruction and that of the traditional approach to teaching science?
2. What can we learn from the results of the Web 2.0 Tools Integration Self-efficacy questionnaire when given to science teachers in Montana; and compared to the data collected from previous studies in this area of research?
3. How do high school science teachers in Montana use web 2.0 tools in the classroom?
4. How do high school science teachers in Montana use web 2.0 elements to guide science instruction?

Definition of Terms

Educational technology. tools help in the advancement of student learning. The tools can be material products such as machines, hardware, or software. The tools can include systems, methods of organization, and techniques (Schrum & Levin, 2009).

Blog. is a personal website or web page on which an individual records opinions, links to other sites, and information on a regular basis (Schrum & Levin, 2009).

Wiki. is a website that allows collaborative editing of its content structure by users (Schrum & Levin, 2009).

Podcasts. are similar to a radio or TV show, however podcasts are not tied to a specific time usually streamed or downloaded. (Apple Inc., 2007).

Social Media. is the use of social networking in dedicated spaces on the internet in websites and applications to communicate informally with groups of other people with similar interests (Solomon & Schrum, 2007).

*RSS Really Simple Syndication.*is a web tool used to automatically update information on websites via a web feed, or channel. (Solomon & Schrum, 2007).

Facebook. is a free international social website where users present their personal profile, maintain friendships, and share interests and experiences (Facebook Resources, 2010).

MySpace. is a social media platform hosted in the United States and launched in 2004. It offers users to maintain friendships and stay in communication with others (Myspace.com Terms, 2009).

Twitter. is a real-time information network that connects you to the latest stories, ideas, opinions and news about what you find interesting in a 140 character format. Tweets can include links to other content on the internet, video, and pictures (https://twitter.com/about 2011).

Instructional strategies. describe external events to be used by the instructor or facilitator to support learners' internal learning processes in order to achieve learning goals (Zook, 2001, p. 18).

Flickr. is a free open source photo sharing website, it allows users to post images, photo albums, and slideshow presentations to share online with the users friends or through e-mail. Users are able to add tags, maps, post comments, and edit images (Buffington, 2008; Solomon & Schrum, 2007).

Web 2.0. refers to the view of the internet as a medium in which interactive experience, in the form of blogs, wikis, forums, podcasts, etc., plays a more important role than simply accessing information (Dictionary.com, 2011).

Web 2.0 tools. are the use of (blogs, wikis, podcasts, social media software, and social bookmarking) within the classroom environment, and used as a means of classroom instruction (Ajjan & Hartshorne, 2008).

Student engagement/motivation. refers to the level of student participation and engagement within the course content during class time as well as their commitment and motivation in completing the required materials for the course (Marks, 2000).

Best Practices. the practice that can be described as those teaching and learning practices that help to facilitate engaged student learning (Marks, 2000).

Technology integration. is using computers effectively and efficiently in the general content areas to allow students to learn how to apply computer skills in meaningful ways. Discrete computer skills take on new meaning when they are integrated within the curriculum. Integration is incorporating technology in a manner that enhances student learning. Technology integration is using software supported by the business world for real-world applications so students learn to use computers flexibly, purposefully and creatively. Technology integration is having the curriculum drive technology usage, not having technology drive the curriculum. Finally, technology integration is organizing the goals of curriculum and technology into a coordinated, harmonious whole (Dockstader, 1999).

Technological Literacy. is the understanding of the role and impact of technology upon society, accepting of the responsibility associated with living in a technologically oriented information age, and using technology as a tool for obtaining, organizing, manipulating information for communication and creative expression. (Uchida, Cetron & McKenzie, 1996).

Delimitations

The delimitations of this quantitative study included science teachers in Montana that were working in the largest 14 high schools in Montana with a student population of 900 or more. The correlation portion of the study included a purposeful random sample of teachers in the 14 public schools in Montana in grades 9-12. Specific web 2.0 tools that were used within the study and there are numerous emerging web 2.0 tools that are used every day. Appropriate documentation from the institutional review board at The University of Montana was secured before any surveys were distributed or statistics were run on teacher data.

Limitations

The participants from this study were from the state of Montana located in The United States of America. This study explored the correlation between science teachers acting as a facilitator of content material and teacher leadership while, using web 2.0 tools as a vehicle for content presentation in the high school science classroom. This study focused upon the 14 largest high schools in Montana and therefore may have a bias due to the uniqueness's of the Montana culture and demographic structure within the state. A purposeful random sample of eligible science teachers in the largest 14 public schools in Montana took place through the use of purposefully sampling.

Construct of Generalizability/Transferability

Generalizability and transferability give the researcher the ability to generalize to a population through purposefully sampling or other quantitative measures. Through these abilities, the researcher can predict and draw upon conclusions found in the data. The construct of generalizability and transferability for this quantitative research study will be both purposeful as

well as following a strict interpretation of quantitative measures in ensuring that a purposeful sample of eligible science teachers employed in all 14 high schools in Montana is achieved.

Significance of the Study

Education in the 21st century needs to transform its paradigm and begin to engage students within the classroom environment. Today's students need technology to learn to their full potential. Twenty-first century students, who are digital natives, enjoy learning at a higher appreciation level when technology plays a role in the learning process, as seen in multiple studies by (Morgan, 2008). Educational pedagogy relies upon the teacher acting as the facilitator-leader of content knowledge and the use of web 2.0 tools in delivery of course content. *The Web 2.0 Tools Integration Self-efficacy* survey was given to high school science teachers in the largest 14 schools in Montana and served as the guide to gauge web 2.0 tools integration into classrooms. The findings may now be compared to that of a similar populations to help inform the educational leaders of Montana as they integrate web 2.0 tools into the classroom environment.

Summary

Integration of 21st century technology into curriculum will change pedagogy of the future and pave the way for stakeholders to begin to transform public education. The aim and focus of this quantitative study was to examine teacher delivery of content material, enhancement of curriculum through the use of web 2.0 tools in science classes in the largest 14 high schools in Montana. The potential use of Web 2.0 tools used within the classroom setting serves as a guide for facilitation of content knowledge and give this study legitimacy (Taylor & Todd, 1995). An examination of the major contributions of research to the field is one way of examining the theoretical perspectives. A detailed analysis of the relevant research to this study was examined in the review of the literature in chapter two.

Chapter Two

Review of the Literature

The review of the literature is necessary to examine the body of scholarly work related to the topic of the dissertation. This review gave the researcher insight into the needs and implications for further research. Through an exhaustive literature review, the researcher was able to narrow the topic while making a scholarly contribution to the body of research through a five-chapter research study. According to Boote and Beile (2005), the focus of a review of literature is to synthesize and advance the collective understanding of existing studies as well as identifying the strengths and weaknesses within the body of work. This key element within a dissertation places the research study within the scholarly contributions and gave the work legitimacy.

Chapter two examined educational paradigms at the end of the 20th century, and the beginning of the 21st century, associated with the development of educational pedagogy and the ever changing roles of teachers in the classrooms, in-addition to examining the evolution of web 2.0 tools and their uses within the high school classroom environment. This chapter synthesized, and presented information that gave the study a place within the body of research on web 2.0 tools and their integration into the high school science curriculums of Montana's public high schools with a student population of 900 or more. Every attempt has been made to identify relevant research.

Educational Reform and Technology

The 20th century in education in the United States saw the development of the formalized free public education systems and the assembly line production model of preparing students to go to college. The technological revolution that began at the end of the 20th century had a profound

impact for paving the way for educational technology reform of the 21st century (Honey, Culp & Carrigg, 2000).

> Technology is a part of our children's everyday lives. They don't know a time without space travel, pagers, cell phones and the Internet. While most educators concur that technology is important to student learning, many are finding that integrating technology into the education systems and using it in ways that increase student learning and achievement are far more complex tasks than expected. The digital age is literally knocking on the schoolhouse door. Despite the fact that recent public opinion polls indicate communities are strongly supportive of technology in schools, there remains a lack of sophistication among the majority of schools across the United States. The unique combination of what is known today about brain research and cognitive learning theory, combined with the high-speed, networked computers that are slowly making their way into schools, presents educators with opportunities never before possible. The question is whether or not educators and the education system will act strategically enough to capitalize on this unique opportunity. (Lemke & Coughlin, 2009, p. 8)

Now in the second decade of the 21st century our organizations need to prepare for the changing educational pedagogy and in doing so the newly adopted philosophies that are adopted by educational organizations need to impact multiple groups of stakeholders within the organization to fully change the organizational culture (Ellsworth, 2002). Alan November (2000) believes that educational organizations when creating changes need to follow a systems approach to integrating technology into the educational culture.

The notion of organizational reform continues to be promoted through the most recent report on educational technology within the National Education Technology Plan (United States Department of Education, Office of Educational Technology, 2004). The report states that change and innovation are necessary in order for our nation to succeed globally and it states that changes are taking place in education,

> a new excitement in the vast possibilities of the digital age for changing how we learn, how we teach, and how the various segments of our educational system fit together – a ferment for reform that is bringing changes undreamt of even five years ago and unparalleled in our nation's history. (United States Department of Education, Office of Educational Technology, 2004, p. 9)

One of the most effective tools to facilitate the changes needed is the use of technology (Busch et al., 2007; Lemke et al., 2009). Educators note that the implementation of classroom technologies enables students to easily comprehend 21st Century skills (Busch et al.; Lemke et al.). The change in educational pedagogy, at the turn of the 21st century, evolved from the teacher as content expert imparting knowledge to students, to that of facilitator-leader of content knowledge. The era of inquiry and discovery have taken root within the first decade of the 21st century with the educator acting as the guide along the journey. Along with the changing educational pedagogy the skills that students need to learn to be part of the 21st century have also changed and evolved from that of the 20th century. According to the (Partnership for 21st Century Skills, 2008) students need to have a solid foundation in

> critical thinking and problem solving, communication and collaboration, global awareness, creativity and innovation, flexibly and adaptability, initiative and self-direction, social and cross-cultural, initiative and self-direction, productivity and

> accountability, leadership and responsibility, and literacy of civic, health, information, media, and information and communications technology. (p. 13)

The report indicated that educators need to "develop proficiency in 21st century skills, support innovative teaching and learning, and create robust education support systems" (p. 3), thus encouraging educators to use cutting edge technology within the classroom setting, while expecting and teaching students how to use such technology. The United States educational system is on the cusp of a major paradigm shift with the emerging uses of web 2.0 elements in the classroom environment. Thomas Friedman in (2006) identified the trends of globalization and its impact on the economy of the United States and ultimately on the educational institutions of the United States in his book *The World is Flat*.

Thomas Friedman illustrated the changing nature of the global society, economy, and politics of world governments in response to the globalization of our environment, the speed and efficiency of communication with which we all live. The other industrialized countries of the world including China, Taiwan, and India, are using the global market to reform their societies and compete with the other industrialized nations. Friedman argued that within the emerging new global paradigm, our workforce is not prepared nor do they have the appropriate skills to function within the new environment. Friedman (2006) defended the new workforce that will be needed in the globalized environment of the 21st century as: "great collaborators and orchestrators, synthesizers, explainers, leveragers, adapters, passionate personalizers, green people, and localizers" (p. 276). Since 2006, the United States has witnessed the competing industrialized nations expand their economy and compete on a world stage for jobs, using United States-based companies. General Electric has retooled their entire operation to meet the needs of a world economic system and as Friedman (2006) argued that, our educational institutions specifically our

public schools need to reform to meet the changing economic structure of the world economy (Partnership for 21st Century Skills, 2008; Solomon & Schrum, 2007).

The Partnership for 21st Century Skills (2008) believes that fundamental changes in the "economy, job and business… demands of new and different skills… [and to] bridge the achievement gaps in between the lowest- and highest-performing students" (pp. 2-9). Moreover the partnership illustrates this fact when they highlight the U.S. service jobs reaching 56% of the total in 1997 as compared to 36% in 1967 (Partnership for 21st Century Skills, 2008). Furthermore, they identify specific proficiency standards for students in that the:

> skills, knowledge and expertise students must master to succeed in college, work and life—should be the outcome of a 21st century education. To be "educated" today requires mastery of core subjects, 21st century themes and 21st century skills. To help students achieve proficiency in 21st century skills, teachers and administrators need education support systems that strengthen their instructional, leadership and management capacity. And both students and educators need learning environments that are conducive to results. (Partnership for 21st Century Skills, p.14)

In Tony Wagner's The Global Achievement Gap (2008) he illustrated the concept of maintaining 21st century skills for students and educators, through the establishment of seven survival skills. For the purposes of this literature review, an examination of six of the seven will take place. The skills include:

1. Critical Thinking and Problem Solving
2. Collaboration Across Networks and Leading by Influence
3. Agility and Adaptability
4. Initiative and Entrepreneurialism
5. Accessing and Analyzing Information
6. Curiosity and Imagination (Wagner, 2008).

It is Wagner's contention that critical thinking and problem solving skills, in today's public education system is not competing with that of the business world. Educator's according to Wagner are paying lip service to true critical thinking while the 21st century business model has evolved into a teaming atmosphere with all facets of the business organization working together to accomplish a task (Wagner, 2008). Critical thinking as defined by Wagner associated with education is as follows: "Taking issues and situations and problems and going to root components: understanding how the problem evolved – looking at it from a systemic perspective and not accepting things at face value" (Wagner, 2008, p.16). Critical thinking by educators and students is an essential component in the ever-consistent quest for teaching problem solving skills, applying abstract knowledge and executing solutions. The other key component that Wagner discusses is the importance of surrounding yourself with people who have differing opinions other than yours who can help you come to the best solution, using the team-based leadership philosophy (Wagner, 2008).

Wagner's second assertion centers on collaboration across networks and leading by influence. The 21st century is full of mobile technologies and one result is the ability to work or learn in any medium. Students can take 21st century educational technology into the field and collect data in real time, store it on a cloud-based server and then begin to analyze data on the trip home. Wagner focused upon this issue in the exploration of collaboration leadership giving employees the freedom to work from anywhere they had mobile or wireless internet connections. Our schools need to produce graduates that know how to "ask good questions, think critically, solve problems, work effectively in teams, or lead by influence" (Wagner, 2008, p.29). For the purposes of this study, educators need to embrace the 21st century educational technology and begin to learn how to use it and teach students the educational components of such technologies. Wagner

also begins to explain the acquisition of such content knowledge through using such tools with the ability of educators, business industry, and students' adaptability and agility of using the newly acquired 21st century tools. Wagner's third point centers on the agility and adaptation of stakeholders within an organization and their ability to adapt to a changing paradigm for education and business. Wagner argued that businesses and the education world need to be comfortable with the new economy and environment, where we live in an environment where there is not just one right answer, or if there is, it is only right for a nanosecond (Wagner, 2008).

Wagner's fourth point centered on the idea of initiative and entrepreneurialism. In education our initiative comes from the idea of change and its associated challenges that come with the ever adjustments of changing landscapes and associated paradigms in education. The dedicated true educational leader is able to take the elements of many different change agents and put them into place with a unifying structure that all stakeholders can get behind (Fullan, 2007). Wagner explored this concept with respect to educational technology in his fourth point centered on initiative and entrepreneurialism. Dedicated proactive leadership is needed in times when employees, students, or parents are looking for the organization to move in a specific direction (Wagner, 2008). Educational leaders today want to see people take more initiative and be more entrepreneurial in terms of ways to seek out new opportunities with respect to educational technology and changing the organization, moving it forward (Wagner, 2008). The way that teachers and educational leaders access and analyze information will move the educational institution forward, especially in the area of changing the culture of the organization (Wagner, 2008).

Wagner explains the notion of accessing and analyzing information in that we need to be prepared and have the tools necessary to read and evaluate the vast amount of information that is

received by the organization and those stakeholders within the organization. Wagner described the flow of information and the critical thinking skills that are necessary to evaluate the information as a trait that is beneficial to the organization, and those members of the organization that are able to analyze and synthesize the information are valuable to the organization (Wagner, 2008). In accessing and synthesizing information, Wagner believed that curiosity and imagination are also very important points. The curiosity and imagination of an organization keep it focused on the elements of change and on the cusp of innovation. Educational technology and its uses in the classroom are always on the practitioners' minds and a good sense of curiosity and imagination is essential to the constant pursuit of reaching students and using web 2.0 elements as the vehicle to deliver or facilitate content knowledge (Wagner, 2008). The survival skills that Wagner outlined are the new "basic skills" for the world of work and learning, just as the 3 R's were for education under the 20th century paradigm (Wagner, 2008). As the new leaders and teachers of the 21st century and operating in a changing new paradigm for education it is the educators' responsibility to ensure that students of the 21st century are equipped for a business world that has upgraded to the philosophies of the 21st century (Wagner, 2008). The New Media Consortium in partnership with the EDUCAUSE Learning Initiative has developed a partnership where they focus on the emerging technologies and their uses within the educational environment. The partnership began in 2005, and as part of their collaboration, they publish annually the Horizon Report. Within this report, the authors examine emerging new technologies and the likelihood of their relationship with education.

The 2011 Horizon Report examined the elements of electronic books, and continued reliance upon mobile technology. The increased use of electronic books continues to give educators access to digital information changing teaching pedagogy within the classroom. The Horizon Report

focused in on the use of electronic books and their uses for teaching, learning, and creative inquiry (Smith, Willis, Levine, & Haywood, 2011). Science educators in Montana have the ability to use electronic books to reinforce the content both at school and at home. The future of electronic books will continue to grow and develop and impact the classroom in a dynamic manner creating an electronic environment that is conducive to using web 2.0 elements as the tool for content delivery changing educational pedagogy and creating an environment for the teacher to become the facilitator-leader of content knowledge. Biology textbooks have been published in an electronic format giving students detailed illustrations and animations within the text while creating formative and summative assessment quizzes that are embedded within each chapter (Smith, Willis, Levine, & Haywood, 2011). The use and development of mobile technology along with the development of electronic texts have given all stakeholders within an organization the ability to have and develop curriculum that is more meaningful and engaging to students. Using 4G wireless technology students can create and gather real time data while in the field for a science experiment, save the data to the cloud based computing systems in Google documents, and then begin to examine and analyze the data on the bus ride home. All can be done with the technological revolutions that web 2.0 elements, and mobile technologies give to educators, changing educational pedagogy for the future (Smith, Willis, Levine, & Haywood, 2011).

Evolution of the Internet Web 1.0 and 2.0

The development of the internet in the early 1990's required an understanding and writing of HTML code for production (Anderson, 2007; Richardson, 2006; Rosen & Nelson, 2008; Solomon & Schrum, 2007). The development of the original world wide web became a device used to gain information from multiple sources where the information flowed only one way where the websites were listed to collect information and not to interact with (Albion, 2008; Rosen &

Nelson; Solomon & Schrum). This process continued to refine itself and develop over the next 15 years where educators and members of all organizations would post information on the World Wide Web for other people to examine and digest. The interactive portion of the internet did not come about until the advent of web 2.0 elements in the first decade of the 21st century. Web 2.0 is often defined as the conceptual framework for a web-based platform where participants use the collection of technology tools to create and post content, interact in social networking, collaborate on tasks with other human agents, rework existing content, and share data or work results (Buffington, 2008; Jonassen et al., 2008; Solomon & Schrum, 2007). In the new web 2.0 world all members of an organization are able to participate and control information at all times and boundaries are nonexistent (O'Reilly, 2005; Solomon & Schrum, 2007).

Tim O'Reilly, (2005) a leading technology author, gave mainstream public exposure to the term web 2.0 and its associated elements. According to O'Reilly, web 2.0 should be a set of principles and practices that tie together a veritable solar system of sites that demonstrate some or all of those principles, at a varying distance from that core" (http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html, para. 7). Within the web 2.0 environment, users can control their content and share that content with certain individuals or groups of people with similar interests. An example of this would be the Google web 2.0 elements in the applications that they offer users, calendar, documents, and web searching. The users of these platforms have the ability to share information to all pertinent individuals and those that receive the information have the ability to subscribe to the updates that are launched from the cooperative website programs (O'Reilly, 2005).

Another key element of the web 2.0 environment is the network of collaborators that freely share open source information for all organizations. This freely shared information is the

backbone of the continued development of the web 2.0 environment (Solomon & Schrum, 2007). Creators of open source software have the mindset that their contributions need to be free and open for all to use and make better. There are many learning management systems (LMS) that educators use to host their web 2.0 elements some of them being, Moodle, Blackboard, and Joomla. Within these LMS, the individual web 2.0 elements give the users the ability to collaborate on projects and share information. The list of available web 2.0 elements that can be used within the content management software is ever developing and getting better each day (Solomon & Schrum, 2007).

School districts have recently turned to using web 2.0 elements for classroom use because they are free, and thus free up large portions of the budget to be used for other needs. The use of the cloud-based software also helps classroom teachers, as the software can be used from any workstation that has internet connectivity and creates an environment where all students have access all the time. With the development and access to free software for all stakeholders, the ability for students to collaborate on projects and increase the capacity of learning takes place. For the educator, the use of web 2.0 elements gives them the tools to create a collaborative digital environment where students can see connections between content and will have an easier time of taking control of their learning.

The features of participatory Web 2.0 are affecting both education and daily life (Bull, Hammond, & Ferster, 2008). Teachers and students each day use the internet to complete work on a daily basis. The evolution of the internet and associated tentacles throughout the last 21 years have changed the landscape of how human beings communicate and share information. With this change in societal structure, our schools needed to adapt to the changing landscape and embrace

the technological revolution of the 21st century and begin to use web 2.0 elements to engage and challenge the thinking of our future generations (Solomon & Schrum, 2007).

Web 2.0 Tools in Teaching

The use of web 2.0 tools within the classroom gave the teacher and the students the ability to have exposure to content information at a high level of relevance and rigor, meeting the needs of students and teacher (Lemke et al., 2009). Web 2.0 tools facilitates classroom discussion and can give stakeholders immediate formative assessment feedback in a collaborative environment without direct costs (Anderson, 2007; Buffington, 2008; Imperatore, 2009; Jonassen et al., 2008; Liu, 2008; Norton & Hathaway, 2008; Solomon, & Schrum, 2007).

Alan November, in his essay "Why More Schools Aren't Teaching Web Literacy – and How They Can Start", felt that schools needed to teach web literacy. Part of the process November explored was the integration of web 2.0 tools, while reforming the research process to examine effective organization of information, and sharing information with all stakeholders (November, 2004). Districts that integrated web 2.0 tools into the fabric of their organizations for all stakeholders created an environment of collaboration, and "attracted students to school work, meet individual learning needs, develop students' critical thinking skills, provided an alternative learning environment, expanded learning outside school, and prepared students for lifelong learning" (Lemke et al., 2009, p. 7). Blogs offered educators the ability to create electronic dialogue with students where they could weigh in on certain issues. Blogs that were used in the classroom for an online discussion board extended learning from the classroom and students' were able to apply knowledge obtained outside of the classroom environment (Solomon, & Schrum, 2007).

Blogs.

Class Blogmeister (http://www.classblogmeister.com) was created by David Warlick especially for classroom use (Solomon & Schrum, 2007). It offers teachers full control of their blog sites for professional publication and classroom management, activities, such as the posting of curricula, comments and students' work (Solomon & Schrum, 2007). This site is available for educators and requires teachers to follow the Children's Online Privacy Protection Act (COPPA) guidelines for participants under 13 years of age in order to not reveal students' personal identification (Terms and Conditions, 2009, http://classblogmeister.com/conditions_sl.php para. 7).

Blogger (https://www.blogger.com) is the most prevalent blogging web 2.0 tool out there. Blogger is a subsidiary of Google and is integrated with all other Google platforms. A teacher can easily create a blog for their classroom using the templates provided for in the blogger maintenance of the site. Another nice feature associated with blogger is the ability for users to comment on blogs they must have an account with a registered e-mail address. Because the users must register their names and associated e-mail, addresses if abuse occurs with postings the owner of the blog can see who is making the remarks.

Wikis.

The first Wiki was "created in 1995 by Ward Cunningham" and named after a short phrase of the native Hawaiian language, "*wiki-wiki*[,] which means quickly" (Jonassen et al., 2008, p. 105). A wiki is actually a modified web page allowing collaborative individual or group users to add, edit or remove online information at any time and from any location (Jonassen et al.; Richardson, 2006; Rosen & Nelson, 2008; Solomon & Schrum, 2007). The use of wiki sites for educators within the past decade has increased and they are a collaborative area for students and teachers to

exchange ideas. PB Wiki is one example of a wiki space where collaboration for educators and students occurs. Wiki sites have also been used as a warehouse of information and information sharing for educators. Numerous educational curriculum consortiums use the collaborative area to refine and update curriculum documents. The wiki platforms integrate other web 2.0 elements within the framework of the wiki, establishing a collaborative environment for teachers and students (Solomon & Schrum, 2007). Wikipedia is the largest online wiki site and has evolved into an online encyclopedia where users can contribute and edit. This collaborative project created a holistic encyclopedia that contained 15 million free articles (Wikipedia, 2011 http://en.wikipedia.org/wiki/Wikipedia) in 282 different languages (List of Wikipedia, 2011, http://meta.wikimedia.org/wiki/List_of_Wikipedias).

The use of wikis in the classroom environment with students gave them an area to collaborate on a project giving students the ability to "join together in a knowledge-building community" (Jonassen et al., 2008, p. 105). The wiki stored all information in the form of revisions to the page. When new information was added to the wiki or information was deleted from the wiki the computer stored the revision of the edited page. Users were able to review previous work, revise or revert to the version they preferred, while comparing thoughts from different members of the group (Hemmi et al., 2009). Research indicated the use of wikis in education improved writing skills and collaborative group work (Jonassen et al., 2008; Mak & Coniam, 2008; Richardson, 2006).

Wikispaces (http://www.wikispaces.com) is free for educators and offers some ad-free sites for K-12. Educators can set personal preferences for security and educational purposes (Wikispaces: Private label, 2011, http://www.wikispaces.com/site/privatelabel). Teachers can set up their wiki sites to be public, allowing everyone to see and edit; to be protected, allowing anyone to see but

only members to edit; and private, allowing only members to review and edit (Wikispaces: Private label, 2011). They can invite people to join their wiki space to view or edit information there. The PB of PBworks(formerly known as Pbwiki) (http://pbworks.com/) stands for 'peanut butter', which promotes the idea that wikis can be used "as easily as a peanut butter sandwich" (Solomon & Schrum, 2007, p. 220). The old name, sites, and function of Pbwiki are still available. The new PBworks includes more Web 2.0 tools, and added access control, document management, and mobile support (PBWorks: Education features, 2010, http://pbworks.com/content/edu+features?utm_campaign=nav-tracking&utm_source=Top%20navigation).

Podcasts.

Podcasting is used to download listen or stream audio and video files that others have uploaded to the internet (Anderson, 2007; Jonassen et al., 2008; Richardson, 2006; Solomon & Schrum, 2007; Williams, 2007). Those that want to listen to podcasts can do so via live streaming through their handheld computer, their desktop, or laptop computer. Podcast web sites commonly offer automatic download by RSS subscription, and is one of the unique features of podcasting (Anderson; Jonassen et al.; Solomon & Schrum; Williams, 2007). Subscribers can regularly receive updated podcasts with a series of episodes from various sources of podcast sites on the internet.

In schools, podcasts are used in many different ways. They can be used as an "ancillary device to enhance, promote programs and activities, research, share school news, professional development, archived lessons, field recording, and study support" (Williams, 2007, p. 30), as well as for library promotion and the sharing of students' learning experience (Eash, 2006). Some teachers have uploaded podcasts for students who are absent from class so that they can review

content (Williams, 2007). An advantage of podcasting for students is their ability to rewind, fast forward or play over and over the podcast so that they receive the content knowledge (Williams, 2007). The collaboration that podcasts give to students is tremendous; students can now contribute their skills and knowledge to all audiences within their organization, while demonstrating their proficiency with the content standards (Jonassen et al., 2008).

Social Media Sites.

Social media sites are web sites that allow people to interact, connect, contact, communicate with others, express themselves and create communities (Franklin & Consulting, 2007). In short, they are the Web 2.0 tools that bring people together through personal conversation and profile presentation for a number of purposes. Examples of social networking sites are Facebook, Twitter, and MySpace. Social media sites have increasingly become used by educational institutions both in the classroom and as a collaborative tool for course content (Gray, Thompson, Clerehan, Sheard, & Hamilton, 2008). Educators should promote the use of social media sites in the school environment for all stakeholders because of the collaborative nature of the tool; while students invest tremendous amounts of time into keeping, their social media sites updated (Maloney, 2007). Social media sites are extremely popular and have become the new way of social connecting and communicating among the digital generation (Lenhart & Madden, 2007; Project Tomorrow, 2008; 2010a). According to a (2007) nationwide phone survey accomplished for a PEW Internet and American Life project, more than half (55%) of American teenagers aged 12 to 17 use social media sites such as Facebook, Twitter, and MySpace for social interaction (Lenhart & Madden, 2007, p. 1). This digital generation uses social media sites to maintain friendships with their current friends or prior schoolmates, schedule plans with friends, or make

new friends online. About one in two (55%) of these teenagers reported creating a personal profile online, but the majority (66%) set profile access limitations (Lenhart & Madden, p. 2).

Youth in the United States use social media sites as their main communication tool today. Lenhart and Madden (2007) reported that nearly half (48%) of these online teenagers visit social media sites daily or even more often, with (28%) visiting once a day, and (22%) visiting several times a day (p. 2). Similar results were found by the NetDay Speak Up (2008) online survey, which reported that in 2008, (40%) of middle school students but the majority (67%) of high school students had their own accounts with Facebook, Twitter, and MySpace (Project Tomorrow, 2008, p. 2). Fifty percent of these high school students routinely used the tools (Project Tomorrow, 2008, p. 2). This survey was conducted online in late (2007) with 319,223 K-12 students from the United States (Project Tomorrow, 2008). In contrast, relatively few teachers have spent the time to learn about the social media sites in Facebook, Twitter, and MySpace. More specifically, with concern to using the social networking software with their classes for educational purposes few educators are integrating social media into their classes (Gray, K., Thompson, C., Clerehan, R., Sheard, J., & Hamilton, M. 2008, p. 12). With the students using social media, sites as the primary vehicle for communication our schools need to embrace the educational value that they have and begin to use them educationally with students (Gray, K., Thompson, C., Clerehan, R., Sheard, J., & Hamilton, M., 2008).

Facebook (www.facebook.com) is a free international social web site where users present their personal profile, maintain friendships, and share interests and experiences (Facebook Resources, 2011, http://www.facebook.com/facebook#!/facebook?v=app_10531514314 . On average, Facebook users have 130 friends on their sites (Statistic Facebook, 2011, http://www.facebook.com/press/info.php?statistics, 2011, para. 1). Traditional typed text, still

images or photos, and multimedia files and videos may all be uploaded and shared online (Facebook About, 2011, http://www.facebook.com/facebook) and mobile access is now available with more than 100 million users (Statistic Facebook, 2011 para. 5). This site claims to have over 800 million active users, and half of them routinely log on at least once daily (Statistic Facebook, 2011 para. 1). Users are able to set privacy level for their sites to control the types of information they would like to share with their friends, friends' friends or general public (Facebook Privacy, 2010, http://www.facebook.com/privacy/explanation.php, para. 1-2)

Twitter (https://twitter.com) is a social media platform hosted in the United States and gives users 140 characters to give updates on information. It is defined by users as the ability to post information between social media postings via Facebook or My Space. Users can attach links, photos, and videos to the tweets giving twitter an added advantage in using it as a gateway to access other content on the internet (https://twitter.com/about, 2011).

MySpace (http://www.myspace.com) is a social networking platform hosted in the United States and launched in 2004 (MySpace.com Fact Sheet, 2010, http://www.myspace.com/pressroom?url=/fact+sheet/, 2011 para. 1). It offers members numerous technology tools; such as personal web sites, instant message service, music and video, and mobile access for communication to help in maintaining friendships (MySpace.com Terms, 2009, http://www.myspace.com/index.cfm?fuseaction=misc.terms, 2011 para. 1). This site claims to have over 100 million monthly active users worldwide; this includes around 70 million users in the United States (MySpace.com Fact Sheet, 2011 para. 1).

Image/Photo Sharing Sites.

The internet and its associated web 2.0 elements have taken the need to draft websites using HTML code to that of point and click. The development of photo sharing sites on the internet

have changed the photo industry like Napster changed the way consumers purchased music (Jonassen et al., 2008). The original photo file sharing software came as a purchased set to be installed on one computer. The development of open-source software gave the users the ability to have the same caliber software free of charge. More importantly, the ability for the photos to be integrated into social media sites gives users the ability to share photos with their social communities (Solomon & Schrum, 2007). One web 2.0 photo sharing site is Flickr. Flickr can be used to share photos with other users but, more importantly for education, Flickr can give students the ability to critique photos challenging students creative thinking, and writing skills.

Flickr is a free open source photo-sharing site http://www.flickr.com it allows users to post images, photo albums, and slideshow presentations to share online with their friends through e-mail (Buffington, 2008; Solomon & Schrum, 2007). Users are able to add notes, tags, maps, post comments, and edit images (Buffington, 2008; Solomon & Schrum, 2007). This site offers a tag search function so users can share their images online with their social networks (Solomon & Schrum, 2007).

Google has within its web 2.0 networks a photo sharing tool in Picasa. The nice feature that Picasa holds over that of Flickr is the seamless integration with other Google tools. Picasa can be found at http://www.picasa.com. Picasa provides the same sharing options that Flickr does and the ability to tag photos and share with social networking sites. Users are able to tag their images on the Google map to indicate the specific location where the photos were taken (About Picasa 3.8, 2011).

Course and Learning Management Systems (CMS, and LMS)

A course or learning management system is used to facilitate the learning of students online in a virtual online course or in a hybrid course model where some student/teacher and

student/student interaction takes place online (Blair & Godsall, 2006; Cavus, 2007; Levy & Stockwell, 2006; Machado & Tao, 2007; Simonson, 2007). Instructors and students are able to use the features of the management systems embedded within its framework such as discussion boards, chat rooms, online exams and quizzes, digital drop box, wikis, blogs, embedded video clip code from sites like YouTube and others, to enrich course content (Levy & Stockwell, 2006). Commercially produced course management systems are sold to educational institutions although there are several open source free management environments in Moodle, and Joomla.

When the educational organization elects to save money and go with free open source course management software for the teaching of online courses or for a hybrid model, the organization needs to allocate resources to set up an in-house management system to solve troubleshooting issues that arise (Kennedy, 2005; Levy & Stockwell, 2006; Watson & Watson, 2007). K-12 environments have begun to teach courses online and provide a hybrid environments for students to collaborate on projects, and this prepares students for the higher education world where most students will take courses online (Blair & Godsall, 2006). Perkins and Pfaffman (2006) reported the integration of Moodle into a high school science courses. The integration of Moodle into the school classrooms improved and enhanced the communication with teachers, students and parents, the academic performance of students, teachers' organization, and curriculum design.

Digital Natives

In the 21st century, students learn in incredibly different ways from students in the 20th century. The changes in 21st century technology, where information is a few keystrokes away, and the speed of information forced children to think, and compete in a global environment. Prensky (2001) believed that "Our students have changed radically. Today's students are no longer the people our educational system was designed to teach." (p. 1). Prensky called them "*Digital*

Natives" who "think and process information fundamentally differently from their predecessors" (p. 1), such as parents and teachers. The students of a generation ago were on the cusp of the technology generation, but students of today are wired into the technology and will continue to use 21st century technology in their everyday lives including that of their education.

Current K-12 students are *digital natives* who use information and technologies not only as tools to acquire knowledge and skills for schoolwork but in their everyday social life. According to a nationwide telephone survey conducted in late 2006, teenagers aged 12 to 17 are heavy Internet users; among the 935 teenagers sampled, 93% described the Internet as a platform for social interaction to share their creations, express their feelings or stories, and contact friends (Lenhart, Madden, Macgill, & Smith, 2007, p1). Teenagers set up their own personal social media sites, upload personal information to share with friends, upload and download YouTube videos, write their own blog entries, post comments or feedback to other people's blogs, post photos, and sometimes correspond with friends through e-mail.

This new digital generation is consuming the Internet and Web 2.0 tools much faster than in the past years. Only 73% of American teenagers were reported as Internet users in 2000 (Lenhart, Madden, & Hitlin, 2005, p 1). A few years later Lenhart et al. (2007) reported that more than half (64%) of teens reported active involvement with a variety of online content creation in 2006, compared with 57% in 2004 (p. 2). An even larger increase was observed among teen bloggers, from 19% in 2004; to 28% in 2006 among youth in the same study (p. 3). As of late (2006), more than half (57%) of teen boys reported watching online videos on platforms such as YouTube, and 19% of them had posted videos (Lenhart et al., 2007, pp. 28-29). A similar study conducted by the same organization revealed that by (2007), half (55%) of online teenagers had posted personal profiles online and used social networking site very often, with 48% reporting that they visited

social networking sites daily or more often, and 22% visiting those sites several times a day (Lenhart & Madden, 2007, p. 2).

Today's young students know what they want from technology but their teachers or schools seem to be stuck in the 20th century educational paradigm. According to a report focused on the attitudes, perceptions and behavior toward technology use among K-12 students, "today's high school students are highly tech-savvy" (Farris-Berg, 2005, p. 1) and similar to the *digital natives* described by Prensky. This report, titled *Listening to students' voices on technology: Today's tech-savvy students are stuck in text-dominated schools*, captured the sentiments of today's student. The report reviewed the literature for the attitudes, opinions and voices of students' in grades 6-12. The study ran from 2000-2004, it involved thousands of samples with a variety of research methodologies including web-based surveys, group or class facilitated discussions, focus groups, and individual interviews, and offered a summary of the findings. Based on this 2005 report, students are increasing their Internet use and, "are sophisticated technology users" (p. 2), they believe technology is important and essential to their education. Students' complained about the limited technology access at school, they used computers and the internet as a communication tool mainly from home. Meanwhile, Farris-Berg (2005) reported that students were frustrated by the prominent text-based traditional teaching style of their school systems; teens expected an increased of computer technology and internet access in school, school districts need to adopt diverse ways of using technology in learning activities, and challenging technology-driven instructional exercises for their instructional staff (Farris-Berg, 2005).

Students today are growing up in a technology-rich environment. Prensky coined the term *digital natives,* when describing today's 21st century student. Today's youth are familiar with numerous technology tools, they are technology-savvy, and they know what they want and need

in using web 2.0 tools for fun, and in their social networking circles. They will need help from their teachers in facilitating the integration of technology into their learning, and the school districts need to invest time and resources into training school staff in the use of web 2.0 elements.

Professional Development and Preparation of Teachers for Web 2.0 Elements

The ever-changing landscape of public schools in the Unites States has evolved over the last century and so has the clientele that are served. The school environment with the cells and bells assembly line production model for public school education worked for the majority of the 20th century. With the shrinking of the globe due to emerging technology that gave users the ability to communicate over long distances instantaneously, the dynamic of public schools changed. All information is only a few key strokes away and public school districts need to embrace the technological revolution and give their organizations adequate professional development in the changing nature of educational pedagogy. Numerous investments have been made in beginning to invest in the changing landscape concerning technology and education in the United States and K-12 schools (Lawless & Pellegrino, 2007; Pellegrino, Goldman, & Lawless, 2007). Educational technology standards and benchmarks have been published through national and state education affiliations to give districts the framework for preparing students for a 21st century education (King, 2002; Lawless & Pellegrino; Pellegrino et al; Solomon & Schrum, 2007). Moreover the National Educational Technology Standards (NETS), the International Society for Technology in Education (ISTE) and the No Child Behind Left Act of 2001 (ISTE, 2008; NETS, 2005; U.S. Department of Education, 2001) were guides for educators to integrate and use 21st century educational technology in their classrooms.

The U.S Department of Education (2004) described those of the digital generation as "far ahead of their teachers in computer literacy" (p. 11). Students are more familiar and comfortable with computer technologies than educators, but students need help to apply these web 2.0 elements and associated technologies to academic settings (Heun, 2006; Miners & Pascopella, 2007). Additionally, there is an increased demand for technologically savvy educators with increasing numbers of students that want to take a course online. Unfortunately, there are not enough technology savvy teachers who are using 21st century web 2.0 elements to fill the demand for students that want to take an online course (Project Tomorrow, 2009). In order to meet the need of the increasing numbers of students that want to take a course online or use web 2.0 elements in the hybrid classroom, districts need to continue to invest in ongoing professional development for all teachers to improve the knowledge base (Delacruz, 2004; Guskey, 2000; Project Tomorrow, 2009).

According to a National Center for Education Statistics survey (2000), almost all (99%) of 640 public school teachers surveyed had access to computers and the Internet at school and more than half (66%) indicated that they used computers or the Internet for classroom instruction. The study's findings concluded that teachers who completed at least 32 hours of professional development reported that they were well prepared and willing to create assignments for computer and internet use in contrast to those teachers who received less than 32 hours of professional development in the last three years.

A recent study revealed that an increasing number of districts conducted professional development for classroom technology integration (Wells & Lewis, 2006). Results of their nationwide survey revealed that "the majority (83%) of public schools offered teachers professional development on how to integrate the internet into their curriculum during the

previous academic school year" (Wells & Lewis, p. 10). More than half "(51%) of these public schools offered their teachers online courses" for professional development (Wells & Lewis, p. 10). Project Tomorrow 2009, credited 29 states in the U.S. that have created online or virtual schools, and reported that the majority of teachers within these schools offered online classes for students. Evidence suggested that the more teachers participate in professional development, the more they implement technologies into their instruction changing educational pedagogy for all students (Project Tomorrow, 2009; Wells & Lewis, 2006).

Further research studies indicate that the utilization of Web 2.0 tools for disseminating various subject areas at numerous grade levels has not yet been widely implemented in real classrooms (Lemke et al., 2009; Liu, 2008). In order to implement Web 2.0 tools in the school setting, school systems must undergo restructuring according to the six categories identified by Lemke et al., including "instructional approach; focus on student-centered learning; systemic change to effective use of Web 2.0; time and resources for professional development; accommodations for 24/7 learning; and greater access to technology and the Internet" (p. 41).

To fully integrate web 2.0 tools, teachers need professional development targeted from a 21st century paradigm for delivery of content knowledge (Lemke et al., 2009). Traditional technology professional development will not give educators the tools necessary to implement web 2.0 tools into their classroom (Lemke et al., 2009). Professional development for the 21st century needs to be focused on the development of increasing the teacher's capacity for using web 2.0 tools differently in an engaging manner with students. Just simply starting to use the web 2.0 tools in the current paradigm for education would not be enough change in the nature of educational pedagogy to meet the needs of the 21st century educational student. Educators need access to the

ongoing professional development to reshape the curriculum with increased knowledge of, awareness, competency and implementation of web 2.0 elements (Lemke et al., 2009).

Influences to Teacher Use of Web 2.0 Elements

Several key elements influence teacher acceptance and use of web 2.0 elements within their classrooms. Some of the factors include the following: open source software and its associated technological support, infrastructure within the school environment, and access to the content by way of educational filters that most districts have in place for all users. The open source movement throughout the last decade has created the capacity for the web 2.0 environment to succeed.

Open-Source Software.

Users are welcomed to try products for a free trial or entirely for free. The programmers rely upon the willingness of the users to use the products, try them out and report the problems that need to be fixed. The associated community of users then communicates to other users of the selected element and the process spreads. Elements with the associated open source code and use policy follow the following criteria, it should be freely redistributable and offer the free distribution of the source code. The license should allow users to modify and should not restrict other software; and there should be no discrimination against any person or groups (The open source definition, http://www.opensource.org/docs/osd, para. 1-5).

With the current budget cuts, the use of free, open software is an alternative way for schools to acquire technology applications (Kennedy, 2005). When considering the use of open source software, educators need to investigate the pros and cons for each software application before choosing one for their classrooms (Oliver, 2007). Adopting open source software with an

excellent reputation and many users might be a factor for consideration. Another screening method might be to use educator-friendly sites, such as Google and its host of web 2.0 elements.

Infrastructure.

The evolution of cloud-based computing combined with that of the development of web 2.0 elements has created an environment for students where they have access to information 24 hours a day 7 days a week from anywhere, they can access the internet (Bull & Garofalo, 2006). According to the national report of U.S. public schools, nearly 100 percent had access to the Internet by the fall of 2005, which differs from the mere 35% that had access in 1994 (Wells & Lewis, 2006). In specific classrooms within a school environment only 3% of classrooms had internet access in 1994, by 2005 that percentage had climbed to 94% (Wells & Lewis, 2006) and reached 100% by the fall of 2008 (Gray et al., 2010).

Internet access is available at school to students and an ever-increasing number of students have access to the internet at home. According to a study conducted by the Leichtman Research Group (2009), in the first quarter of 2009, there were up to 69.3 million U.S. households that subscribed to an internet service, a number including 1.6 million new subscribers. These results indicate that 85% of American families have a computer at home and that 80% subscribe to broadband internet service through either a telephone or a cable company.

A similar study conducted in 2002 by the Corporation for Public Broadcasting (CPB), reported that American children had more access to the internet than the previous two years through home, school and library. This report specified that until 2000, 64% of American families with at least one child within the ages of 2 and 17 owned a computer. The percentage of computer ownership increased to 83% by 2002. This trend indicates that an internet connection, either at schools or at home, offers convenient, access for teachers and students to access web 2.0 tools more easily than

ever before. Technology infrastructure within the schools needs to be planned for and work in unison with the professional development plan for the district in planning for the use of web 2.0 elements within the school environment, and access to associated elements within the school environment.

Self-Efficacy and Albert Bandura

The theory of self-efficacy as developed from Albert Bandura will be one of the tools used in the examination of web 2.0 tools and their use in the science classroom's of Montana. The self-efficacy framework is a good predictor of integration of web 2.0 tools in an educational environment (Curts et al., 2008; Faseyitan et al.; Lumpe & Chambers, 2001; Morales, Knezek, & Christensen, 2008; Niederhauser & Perkmen, 2008). Bandura found that when people are provided with the skills and knowledge in coordination with the professional development necessary, efficacy perceptions will influence their decisions with relations to how much effort and time are put into the project (Bandura, 1977; 1982; 1989; 1994; Pajares, 2002). Bandura (1997) described self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments (p. 3)." At times teacher beliefs in the actual practice can differ in relation to implementation of web 2.0 elements in the classroom. As a result, their perceptions of people's behaviors do not equate to their actual capabilities but to their perceptions of self-efficacy that can be measured with the implementation of web 2.0 elements in the classroom (Pajares, para. 15). Teachers use of web 2.0 elements in the science classrooms of Montana's schools and in working with the digital natives that are enrolled in the classes teacher's, self-efficacy is an educational hurdle to cross so that a progressive 21st century learning culture is established so that all students can learn.

Summary

The utilization of web 2.0 tools in K-12 classrooms will benefit digital natives in gaining proficiency in the skills they need to survive in this 21st century. Web 2.0 tools will not only help them in practicing the skills of critical thinking, problem solving, communication, collaboration, creativity, innovation and self-direction, but also lead them to approach a globalized environment (Lemke et al., 2009). Digital natives are surrounded with rich technology and electronic communication devices, such as computers and the internet (Prensky, 2001) both at school and home. Kids are technology savvy consumers whose technological needs may not be understood by the adults in their life. Teens request technology for both learning and entertainment (Farris-Berg, 2005; Project Tomorrow, 2008; 2009) as they enjoy living in the digital world (Farris-Berg; Lenhart et al.; Project Tomorrow, 2008). Still, they believe they already know about the use of technologies. Students may not be able to transfer their technology skills into an academic settings (Heun, 2006). In fact, they need further help from teachers to teach technology skills (Dow, 2007; Heun; Miners & Pascopella, 2007).

Technology infrastructures and internet access has prepared public K-12 schools for the implementation of web 2.0 tools into classrooms (Wells & Lewis, 2006). Teachers and students are able to access the internet easier than ever before. Some digital immigrants (Prensky, 2001), such as administrators, educators, and parents, are still far behind digital natives who, as students, embrace computer technologies (U.S. Department of Education, 2004; Project Tomorrow, 2009). According to Lumpe and Chambers, (2001) there is an urgent need to bridge the gap between these digital immigrants and digital natives. Evidence indicates that teachers need professional development to implement and integrate technology in their teaching, and the more confident teachers are, the more likely they are to apply technologies to their teaching (Lumpe & Chambers,

2001; Project Tomorrow; Wells & Lewis, 2006). Teachers can use web 2.0 tools to participate in online professional communities of practice and demonstrate their professional knowledge and skills, and to practice web 2.0 tools for future classroom use (Drexler et al., 2008; Hanson-Smith, 2006; Hur & Brush, 2009; Meskill et al., 2006; Wisker et al., 2007).

Chapter Three

Methodology

This quantitative research study focused upon the roles of Montana's science teachers in Montana schools with a student population of 900 or more and their ability to guide the implementation of 21st century pedagogy including teacher as facilitator leader, and the use of web 2.0 tools in the science classroom. Student motivation and interest in coursework have changed because of the 20th century paradigm from which instruction was delivered (Jacobsen, 2001). This study examined the 14 largest high schools in Montana with a student population of 900 or more to determine the use of web 2.0 tools in the high school science classroom. The survey instrument gauged the integration of web 2.0 tools in (blogs, wikis, social networking software, and social bookmarking), actual usage of specific web 2.0 technologies in the classroom, and attitudes toward specific web 2.0 technologies in the classroom environment by the science teachers. The data collected from the integration of web 2.0 tools were compared to pre-teachers self-efficacy in the study completed by Ajjan, Hartshorne, & Franklin (2008) Pan, (2011).

Research Design

This study analyzed the implementation of web 2.0 tools in (blogs, wikis, podcasts, social networking software, and social bookmarking). The designed survey was cross-sectional, and collected data at one point in time (Creswell, 2009). The data were collected using a survey adapted from a previous research study that involved the study of web 2.0 elements and their associated predictors of teachers using these elements within the K-12 classroom. This research study took two survey instruments from the previous research study by Pan (2011) and replicated them with a similar population. The two survey instruments entitled: The *Web 2.0 Tools*

Integration and *Web 2.0 Tools Integration Self-efficacy.* In addition to the two survey instruments the researcher collected demographic data from participants in an effort to explore relationships that existed between teacher's self-efficacy and their use of web 2.0 tools in the science classroom. A multiple regression formula was constructed to predict the influential factors in the use of web 2.0 tools. The quantitative data from the survey was collected using a Google form and was e-mailed to the potential participants after required permissions were secured.

Research Questions

Participant self-efficacy of Montana science teachers was measured in the 14 largest high schools in the state of Montana with a student population of 900 or more, using web 2.0 tools as a device for delivery of content material.

1. What type of correlation exists between the role of the teacher acting as a facilitator of content knowledge, using web 2.0 tools for instruction and that of the traditional approach to teaching science?

2. What can we learn from the results of the *Web 2.0 Tools Integration Self-Efficacy* questionnaire when given to science teachers in Montana; and compared to the data collected from previous studies in this area of research?

3. How do high school science teachers in Montana use web 2.0 tools in the classroom?

4. How do high school science teachers in Montana use web 2.0 elements to guide science instruction?

Variables and Hypothesis

This research study used a multiple regression to determine the relationship that existed between the multiple independent variables and the dependent variable. The independent variables for this research study were *The Web 2.0 Tools Integration Self-Efficacy* (Pan, 2011) survey instrument, *the number of hours of professional development each teacher spent on web 2.0 elements for the 2010-2011 school year, teachers access to web 2.0 elements at school, and*

home (Pan, 2011). The dependent variable for the research study was the use of web 2.0 tools in Montana's 14 largest high schools with a student population of 900 or more, and the science teacher's use of web 2.0 tools in the classroom environment.

How did following independent variables: web 2.0 tools integration self-efficacy, professional development, access into web 2.0 tools at school, access to web 2.0 tools at home, predict the dependent variable of: teacher's use of web 2.0 tools in Montana's 14 high school's with a student population of 900 or more students? At least one of the independent variables, web 2.0 tools integration self-efficacy, hours of professional development, availability of accessing web 2.0 tools at schools, availability of accessing web 2.0 tools at home; was a significant predictor of the dependent variable. The dependent variable for the research study was; teacher's use of web 2.0 tools in Montana's 14 largest high schools with a student population of 900 or more.

Null Hypothesis

There will be no experimental importance or statistically reliable relationship between the web 2.0 tools integration self-efficacy, professional development, access into web 2.0 tools at school, access into web 2.0 tools at home, with respect to the integration of web 2.0 tools into the 14 high schools science teachers classrooms'.

Dependent Variable

The *Web 2.0 Tools Integration* survey (Pan, 2011) examined six different areas designed to measure current levels of web 2.0 integration into the science classroom. The levels of integration were obtained to serve as a foundation of which to measure the other variables. The web 2.0 tools integration survey was taken from prior research study by Pan (2011) and was used with Montana science teachers in the 14 largest high schools with a student population of 900 or more. The survey used a five point Likert scale ranging from daily (5), at least once a week (4), at least once

a month (3), at least once a year (2), to never (1) (Pan, 2011). The ratings were identified on a scale ranging from five points to one point so the multiple regression formula could take place. The data collected from the administration of *The Web 2.0 Integration* survey served as the dependent variable (Pan, 2011).

Independent Variables

The *Web 2.0 Tools Self-Efficacy* (Pan, 2011) survey examined six different areas designed to measure the self-efficacy of science teacher's integration of web 2.0 elements into instruction. This instrument measured the participant's levels of comfort in integrating web 2.0 tools instruction. The survey instrument was taken from a prior research study by Pan, (2011) and was used with science teachers in Montana's 14 largest high schools with a student population of 900 or more. The survey used a five point Likert scale ranging from one to five points. The Likert categories ranged from strongly agree (5), agree (4), neutral (3), disagree (2), to strongly disagree (1) (Pan, 2011). The data collected from *The Web 2.0 Tools Self-Efficacy* survey served as one of the independent variables (Pan, 2011).

Demographic data were collected within this research study. Collected demographic data served as multiple independent variables and were measured against the dependent variable in *The Web 2.0 Tools Integration* (Pan, 2011) survey for each participant using a multiple regression formula. The demographic data collected, when compared to the dependent variable, gave the researcher the ability to generalize toward the target population of high school science teachers in Montana's 14 largest public schools.

Population and Sample

The population for the study was purposefully selected and came from the 14 largest high schools in Montana. The total target population was 152. The population from which the sample

was drawn represents the 14 largest high schools in the state of Montana with a student population of 900 or more (Office of Public Instruction, 2011). Schools were contacted via e-mail and telephone beginning with the principal of each school. Invitation letters were sent to all school principals and potential participants. The appropriate permissions required by The University of Montana Institutional Review Board (IRB) were obtained before research was conducted or contact was made with potential schools or participants. Additionally, the IRB required materials were submitted to the IRB for this quantitative research study.

External Validity

External validity was obtained when the study could be replicated and generalized to that of similar populations of science teachers. The use of conceptual replication (Cozby, 2009) was used throughout the research study to attempt to further the understanding of the integration of web 2.0 elements into Montana science classrooms for high schools meeting the threshold of a student enrollment of 900 or more. The use of conceptual replication in this study sought similar methods to better assess relationships that existed between the dependent variable *The Web 2.0 Tools Integration* and the six independent variables within *The Web 2.0 Tools Integration Self-Efficacy* survey instruments replicated from the original research study done by Pan, (2011) with per-service teachers. When conceptual replication between research studies took place, it increased the confidence that generalizations could be made between variables (Cozby, 2009). The study could be replicated with similar science teacher populations across similar demographic areas in the United States.

Data Collection Procedures

The data collected for this study followed quantitative methods and utilized purposeful random sampling of eligible participants in the target population. Conceptual replication took place

concerning the data collection instruments that were used. The surveys used were replicated with permission from the author to our population of high school science teachers in Montana. Initially, the surveys were used in a national study on a similar topic in the measure of web 2.0 integration with that of pre-service teachers (Pan, 2011). The research questions for this study were aligned with the survey instruments from previous research by Pan, (2011). A multiple regression analysis examined the multiple independent variables and that of the dependent variable.

Measurement Instruments and Reliability

The Web 2.0 Tools Integration instrument consisted of six items designed to evaluate the use of web 2.0 tools in the science classroom in Montana. The survey was based on a five-point Likert scale. The scale ranged from daily, at least once a week, at least once a month, at least once a year to never and were coded from five points to one point for statistical coding. The instrument was modified based upon prior research by (Milbrath, 2000; Vannatta & Fordham 2004; Pan, 2011). *The Web 2.0 Tools Integration* instrument held a Cronbach Alpha score of .78 based upon prior research of (Pan, 2011). The Likert data based on a one to five scale collected from the administration of *The Web 2.0 Tools Integration* (Pan, 2011) instrument served as the dependent variable.

The *Web 2.0 Tools Self- Efficacy* (Pan, 2011) instrument consisted of 30 items with a possible selection of five items on a Likert scale for each item. The scale ranged from strongly agree, agree, neutral, disagree, to strongly disagree and ranged from one to five points. The participants took the survey with their rate of agreement in using web 2.0 elements in teaching, an example being the following: When using web 2.0 tools in teaching, I feel confident I can….. The participants then completed the survey in answering the question for each of the remaining 30

items. *The Web 2.0 Tools Integration Self-Efficacy* instrument held a Cronbach Alpha score of .98 based upon prior research of (Pan, 2011). The data collected from the administration of *The Web 2.0 Tools Self-Efficacy* (Pan, 2011) instrument served as one of the independent variables.

Demographic data were collected and served as another independent variable for the research study. Gender, age, education status, grade-level taught, access to web 2.0 tools at school, access to web 2.0 tools at home, access to web 2.0 tools through mobile devices, internet access at school, internet access at home, access internet through mobile devices, hours of professional development, years in education, number of years using technology in the classroom, hours of computer use in the classroom per week, support at school for web 2.0 elements served as independent variables. The variables for the research study are articulated in table 1. The survey for the study can be accessed at the web address located in appendix A.

Internal Validity

Internal validity was measured based upon the likelihood that the independent measures of the *Web 2.0 Tools Self- Efficacy* instrument and that of the demographic information that was collected had a direct relationship with the dependent variable the *Web 2.0 Tools Integration* instrument (Cozby, 2009).

Data Analysis

Based upon prior research done by Pan, (2011) it is the intent to discover that a direct relationship existed between the multiple independent variables and that of the dependent variable. It is anticipated that a relationship between the variables is consistently found at the $\alpha =$ .05 level, and that the defined relationship meets the experimental importance score of 2.0 for each set of variable interactions. The use of inferential statistics was used to illustrate the relationship between the dependent variable and the demographic data collected. The multiple

regression that were run illustrated the relationship between *The Web 2.0 Tools Integration Survey* (Pan, 2011) and that of the multiple independent variables. The sample size was large enough to meet the central limit theorem and gave an accurate representation of the targeted population of Montana science teachers, teaching science in the 14 largest high schools in Montana with a student population of 900 or more. A multiple regression formula was developed to answer the research questions and determine experimental importance set *a priori* at 2.0 for each variable interaction, and experimental consistency at the and consistency of $\alpha = .05$ level. The multiple regression formula in table 1 was developed to analyze the data.

Table 1

Multiple Regression Formula, Variables, School Enrollments

	Independent Variable	Dependent Variable
1	Age	
2	Years teaching in the classroom	Web 2.0 Tools Integration Survey
3	Access to web 2.0 elements at school	
4	Using technology for teaching in school	
5	Access to web 2.0 tools at home	
6	Average hours of computer use for teaching in classroom per week	

Multiple Regression Formula

Formula
$Y=a + b_1X_1 + b_2X_2 + b_3X_3\, b_4X_4 + b_5X_5 + b_6X_6$
Y= Dependent Variable a= Constant b= Regression coefficient X= Multiple Independent Variables H_0: $R^2=1$, b=1,2,3,4,5,6 H_A: at least on regression coefficient is not zero H_0: $R^2= 1$, the change of R^2 is significant when the independent variable, *Web 2.0 Tools Integration Self-Efficacy is added*

Multiple Regression Formula School Enrollments

	School	Enrollment	Science Teachers
1	Billings Senior	1,708	11
2	Billings Skyview	1,527	10
3	Billings West	1,914	14
4	Bozeman	1,818	13
5	Butte	1,361	11
6	Flathead	1,436	6
7	Glacier	1,259	9
8	Great Falls	1,631	14
9	Great Falls CMR	1,528	13
10	Helena	1,655	11
11	Helena Capital	1,383	11
12	Missoula Big Sky	1,045	10
13	Missoula Hellgate	1,274	9
14	Missoula Sentinel	1,221	10

A priori Assumptions

Experimental consistency for the six independent variables within *The Web 2.0 Tools Self-Efficacy* survey instrument compared to the dependent variable *The Web 2.0 Tools Integration* survey was defined at the $\alpha = .05$ level; which accounted for the statistically reliable relationships between the dependent and independent variables. Experimental importance was defined as a median score of at least 2.0 for each independent variable as measured against *The Web 2.0 Tools Integration Survey* (Pan, 2011). Homogeneity of variance was met by a sufficient sample size.

Summary

The research study used quantitative measures to collect data. A survey using a multiple regression for statistical analysis was used to identify if a relationship existed between six independent variables and one dependent variable for Montana science teachers in the 14 largest high schools in Montana who use web 2.0 elements in their teaching and classrooms. The target population consisted of all science teachers in the 14 largest high schools in Montana. The measurement instruments of the study was the *Web 2.0 Tools Integration* and *Web 2.0 Integration Self-Efficacy* instruments adapted from previous research by Pan (2011) as well as demographic data which served as additional independent variables. The internal reliability of the instruments was obtained based upon previous research by Pan (2011). The Cronbach Alpha score for the *Web 2.0 Integration* instrument was .78, while the *Web 2.0 Self-Efficacy* instrument had a Cronbach alpha score of .98. Data were collected after obtaining the proper permission through the school principal via e-mail and phone calls. Once permission was obtained from the building principals contacts with the potential participants were made via e-mail and personal phone calls.

Chapter Four

Findings

This study, *The Relationship between Montana's Science Teachers Self-Efficacy and the Integration of Web 2.0 Elements in the Classroom in Schools With a Student Population Over 900*, sought to explore the relationships that existed between one dependent variable in the *Web 2.0 Tools Integration Survey* as compared to the 6 dependent variables in age, years teaching in the classroom, access to web 2.0 tools in the classroom and at home, using technology for teaching and average hours of computer use for teaching during the school week. The statistical information was obtained using the data analysis function of Excel. The use of descriptive statistics was used to analyze demographic information, and to illustrate the use of the teacher's use of web 2.0 tools in the classroom and their self- efficacy with using such tools. A multiple regression formula was used to address the research questions. Chapter four includes an analysis of the participants in the research study, the reliability of the instruments that were used, and the multiple regression analysis of the data sets.

Participants in the Research Study

The participants in the research study were purposefully selected from the eligible population of participants that were teaching science in the 14 largest high schools in Montana with a student population of 900 or more. The total eligible population was 152, and surveys were sent out to all participants via e-mail after permissions were secured from the building principals. The request for responses to the survey were sent out to the target population three different times and yielded a response of 35 surveys of which only 31 were complete. The total percentage of completed responses for the target population was 31/152 = 20.4%. A detailed analyses of the response rate

included 13 of the 14 largest high schools in Montana with a student population of 900 or more. Table 2 represents the high schools of participants in the state of Montana.

Table 2

High Schools in Montana Represented in the Sample

	Montana High Schools Student Population of 900 or More	Target Population	Survey Responses	No Response	Response Percentage Rate Per High School
1	Billings Senior	11	7	4	64%
2	Billings Skyview	10	0	10	0%
3	Billings West	14	1	13	7%
4	Bozeman	13	3	10	23%
5	Butte	11	1	10	9%
6	Flathead	6	4	2	67%
7	Glacier	9	1	8	11%
8	Great Falls	14	3	11	21%
9	Great Falls CMR	13	5	8	38%
10	Helena	11	1	10	9%
11	Helena Capital	11	1	10	9%
12	Missoula Big Sky	10	4	6	40%
13	Missoula Hellgate	9	2	7	22%
14	Missoula Sentinel	10	2	8	20%
Totals		152	35	107	23%

Web 2.0 Tools Integration

There were 152 eligible participants for the research study. Of the 152, 35 filled out the survey, and of those 35 surveys only 31 of them were filled out completely. The participants were reminded six different times to fill out the survey either via e-mail or personal telephone

call. The *Web 2.0 Tools Integration* survey was collated and reviewed to examine the differences in integration between the categories identified in the teacher's use of blogs, wikis, podcasts, social media, photo/image sites, and course management software. Figure 3 indicates the levels of integration for each category based upon the Likert scale of daily =5, once a week = 4, once a month = 3, once a year = 2, and never = 1. This information was then compared to the participants responses' and the median was taken for each set of group variables to give an overall median for each variable within the *Web 2.0 Tools Integration* portion of the survey.

Table 3

Web 2.0 Tools Integration Survey

	Blog	Likert Score	Wikis	Likert Score	Podcasts	Likert Score
Daily	1	5	1	5	1	5
Once a Week	4	16	1	4	4	16
Once a Month	2	6	6	18	10	30
Once a Year	4	8	4	8	4	8
Never	21	21	19	19	13	13
No Response	3		4		3	
Total	32	56	31	54	32	72
Medians		8.0		8.0		13.0

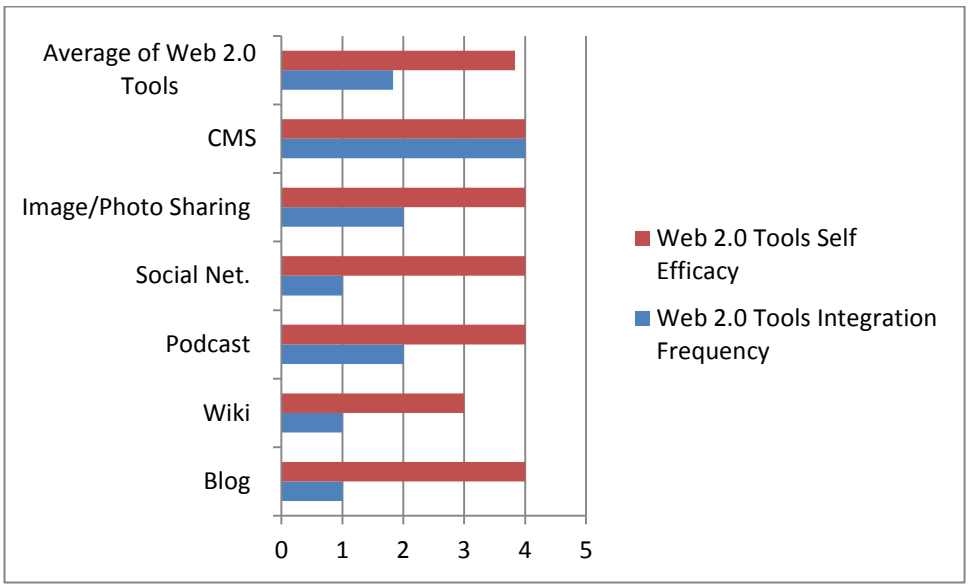
Web 2.0 Tools Integration Survey

	Social Media	Likert Score	Image/ Photo Sharing	Likert Score	Course Management	Likert Score
Daily	1	5			13	65
Once a Week	3	12	4	16	6	24
Once a Month	1	3	7	21	4	12
Once a Year	2	4	5	10	4	8
Never	24	24	15	15	8	8
No Response	4		4			
Total	31	48	31	62	35	117
Medians		5.0		15.0		12.0

The data above indicated that the teachers were confident using the course management web 2.0 elements in the classroom to teach students. The rate of consistent integration from participants was consistent with the category of once a year, for actual use of the web 2.0 elements in the classroom. The only exception was with course management systems. The participants indicated that they on average used these systems daily with students or to teach students, as the median score was 12.0, indicating that they used the tool at least daily. The rate that the participants used the web 2.0 tools in the classroom was not consistent with that of their comfort levels in using them in the classroom. The overall exam of the integration falls between never and once a year for blogs, wikis, podcasts, and social media. Figure 1 illustrated a comparison between elements wherein participants indicated their self-efficacy and comfort with the tools was actually rated higher or equal to the integration of the tools into the classroom environment. Based upon the data collected from the participants, there is a need for more professional development training to transcend their self-efficacy into the application of such tools in the classroom environment. The

course management section of the chart indicated that there was a relationship between the frequency of use and that of the participants' self-efficacy in its uses in the classroom environment.

(Figure 1) The comparison between Web 2.0 Tools Integration- Frequency and Web 2.0 Tools Self-Efficacy



Note: The median of self-efficacy is calculated by the scale of 'Strongly Agree=5, Agree=4, Neutral=3, Disagree=2, Strongly Disagree=1' and the median of frequency of use is calculated by the scale of 'Daily=5, At least once/ week=4, At least once/ month=3, At least once/ year=2, Never=1'.

Demographic Information

The demographic information collected came from the 31 participants completing the survey. The demographic information included 20 (57%) males, 14 (40%) females, and 1 (3%) unknown. The participants ranged in age from 27 to 65 years old with a median age of 44.

Table 4

Demographic Information

	Male	Percentage	Female	Percentage	Unknown	Percentage
Gender	20	57%	14	40%	1	3%

Demographic Information

	Range of Age	Average Age
Age	27-65	43

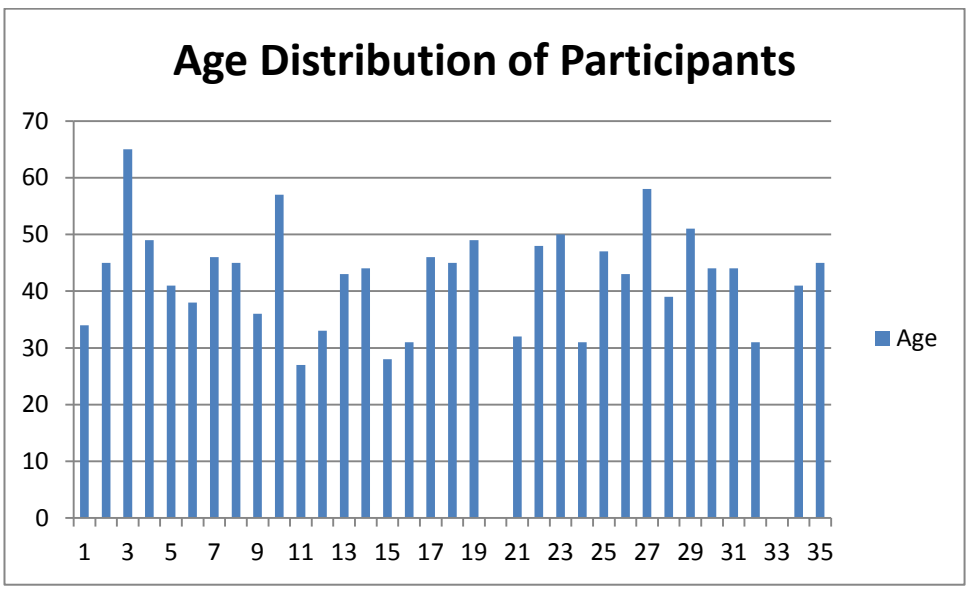
Table 5

Demographic Information Age, Teaching Experience, and Using Technology in the Classroom

	Age	Teaching Experience in years	Using Technology to Teach in the Classroom in years
Mean	43	15.2	12.4
Median	44	15	11
Mode	45	22	8

Table 5 represented the mean, median, and mode for the participants age, teaching experience, and use of technology in the classroom.

(Figure 2) Age Distribution of Participants



The educational status of participants is represented in Table 6. The table illustrated that 11% of the participants received a bachelor's degree, while 30% received a master's degree, and 3% received a doctorate.

Table 6

Educational Status of Participants

	Bachelors	Masters	Doctorate
Frequency	4	30	1
Average	11%	86%	3%

Table 7 indicated grade levels taught by participants in high school. All participants were high school science teachers in Montana. 29% of the sample of the participants in the research study taught either 9^{th}-12^{th} grade or 10^{th}-12^{th} grade which were the largest two categories for grade levels taught based upon the participants responses to the collection of data in the survey instrument.

Table 7

Demographic Information Grade Levels Taught

	Frequency	Percentage
9^{th}	4	11%
9^{th}-12^{th}	10	29%
10^{th} and 12^{th}	2	6%
10^{th}-12^{th}	10	29%
11^{th} and 12^{th}	5	14%
10^{th} and 11^{th}	2	6%
12^{th}	1	3%
9^{th}-11^{th}	1	3%

The research study had 35 participants and only 31 participants that completed the survey in its entirety. 97% of the participants could access web 2.0 elements at home and 94% could access them at school, while only 3% could not access them at home and 6% were able to access them at school. The data indicates that the participants have adequate access to web 2.0 tools but have not integrated them fully into their classroom environments for teaching.

Table 8

Access to Web 2.0 Elements at Home and School

	Home	Percentage	School	Percentage
Yes	34	97%	33	94%
No	1	3%	2	6%

Table 9 and Figure 3 illustrated the mean, median, and mode for the hours of professional development with computers for the participants in the research study. There was not a tremendous range in professional development between participants but the average was 11 hours of professional development associated with computers in one year. This would equate to a little over one working day of professional development with computers in the past school year for the participants.

Table 9

Hours of Professional Development with Computers

	Hours of Professional Development
Mean	11.1 Hours
Median	6 Hours
Mode	0 Hours

(Figure 3) Distribution of Hours of Professional Development for Participants

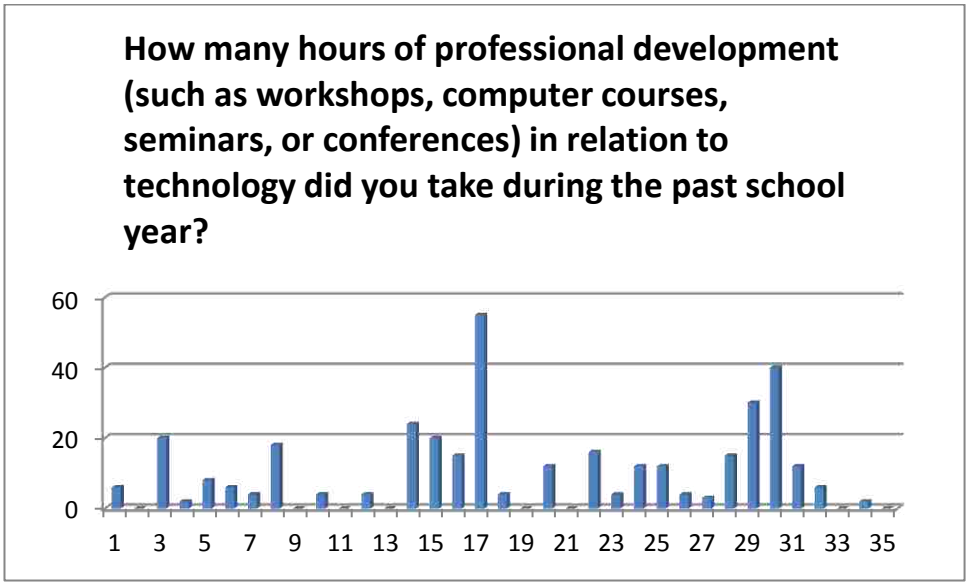


Table 10 depicts administrative support for using web 2.0 tools in the classroom. Among the participants 60% indicated that they have been using web 2.0 tools, but it does not correspond to the integration portion of the study. The data indicated that the participants have been using web 2.0 tools for a while but this data did not reflect the relationship with web 2.0 tools use within the classroom with students based upon the participants responses to their self-efficacy with web 2.0 elements. Based on previous research by Pan (2011), and the participants' self-efficacy responses in this study, administrative support and professional development is essential to the success and integration of web 2.0 elements in the classroom.

Table 10

Administrative Support for using Web 2.0 tools in the classroom

We have been using web 2.0 tools for a while	21	60%
We are starting to use web 2.0 elements	6	17%
We are investigating the use of web 2.0 elements	1	3%
We do not use web 2.0 elements	2	6%
I do not know what you are talking about concerning web 2.0 elements	5	14%
Median	5.0	

Table 11 depicted the different subject areas taught by the participants in the research study. All respondents taught science in Montana's 14 largest high schools with a student population of 900 or more. The majority of the participants taught core science classes in biology, earth science, integrated science, chemistry and physics. A smaller percentage of the participants taught elective science courses in anatomy and physiology, AP/IB courses, wildlife biology, organic chemistry, and astronomy.

Table 11

Demographic Information Subjects Taught by Participants

Subject Taught	Responses	Percentages
Earth Science	6	17%
Integrated Science	7	20%
Biology	15	43%
Chemistry	12	34%
Physics	7	20%
Anatomy & Physiology	4	11%
Biomed Science	2	6%
AP/IB Biology	4	11%
AP/IB Chemistry	1	3%
Wildlife Biology	1	3%
Organic Chemistry	1	3%
Astronomy	1	3%

Multiple Regression Correlation

The correlation within the research study attempted to illuminate the relationship between the dependent variable in the *Web 2.0 Tools Integration* and that of the six independent variables. The first comparison consisted of examining the *Web 2.0 Tools Integration* (dependent variable) and age of the participants. The correlation coefficient within the statistical information from Excel does not demonstrate causality as it only exhibits the relationship that exists between the variables (Creswell, 2009). Age was negatively correlated with the dependent variable in the web 2.0 tools integration as it was represented with a -0.022 relationship. The correlation indicated that age was a significant predictor of web 2.0 tools integration as it yielded an r value of r = 0.151 see table 12. Age was a significant predictor because it was negatively related to *The Web 2.0 Tools*

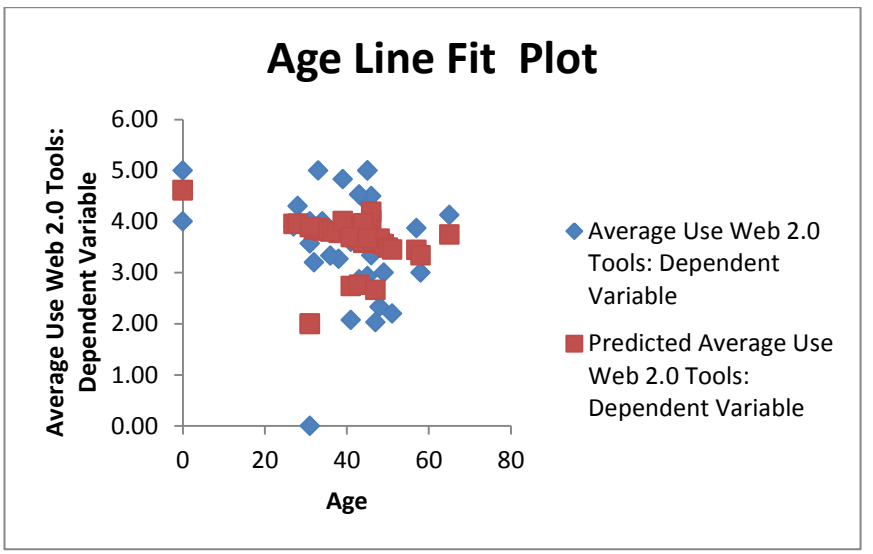
Integration into the classroom environment. As age increased the implementation of web 2.0 tools integration into the classroom decreased. The p-value of 0.149 was found. Therefore, the study failed to reject the null hypothesis.

Table 12

Correlation between Web 2.0 Tools Integration and Age

	Coefficients	
Age	-0.022	
r value	0.152	
p-value	0.149	p<.05

(Figure 4) Average use of Web 2.0 Tools measured against Age of Participants



Age was a negatively significant predictor of the integration of web 2.0 tools in the classroom as it yielded an r-value of r = 0.152, and did so consistently as it corresponded to a p-value of 0.149. 0.149 is a large p-value and the study would benefit from a larger sample size to investigate the relationship age plays with respect to web 2.0 tools integration in the classroom. The reliability of

the instruments and the Cronbach Alpha scores were taken from previous research in the area of integration of web 2.0 elements by Pan (2011) see table 13.

Table 13

Reliability of the Survey Instruments

Reliability of the Instruments	Cronbach Alpha Score
Web 2.0 Tools Integration Survey	0.652
Web 2.0 Tools Integration Self-Efficacy	0.983

The function of the Cronbach Alpha scores near 1.0 gives the study reliability based on a pilot study with a similar population conducted before this research study. The reliability of the survey instruments gave the study legitimacy within the target population so that generalizations and predictions could be made on the results of the study to the participants in the research study and to the population (Creswell, 2009).

A multiple regression analysis was done to examine the relationship that existed between the dependent variable and that of the six independent variables, while answering the following research questions:

1. What type of correlation exists between the role of the teacher acting as a facilitator of content knowledge, using web 2.0 tools for instruction and that of the traditional approach to teaching science?
2. How do high school science teachers in Montana use web 2.0 tools in the classroom?
3. How do high school science teachers in Montana use web 2.0 elements to guide science instruction?

Table 14 identified a very small relationship between integration of web 2.0 tools and that of years of teaching in the classroom. The correlation coefficient when compared to the dependent variable was 0.033 and yielded a p-value of 0.278. This information suggests that there is a very

small positive relationship between the integration of web 2.0 tools and number of years teaching in the classroom; although it is not statistically significant at the p<.05 level. A larger sample size would yield an increased statistical consistency and a smaller p-value between these two variables.

Table 14

Web 2.0 Integration Compared to Years of Teaching

	Coefficients	
Years of Teaching	0.033	regression coefficient
r-value	0.152	correlation coefficient
p-value	0.278	p<.05

(Figure 5) Years of Teaching in the Classroom compared to the Web 2.0 Tools Integration

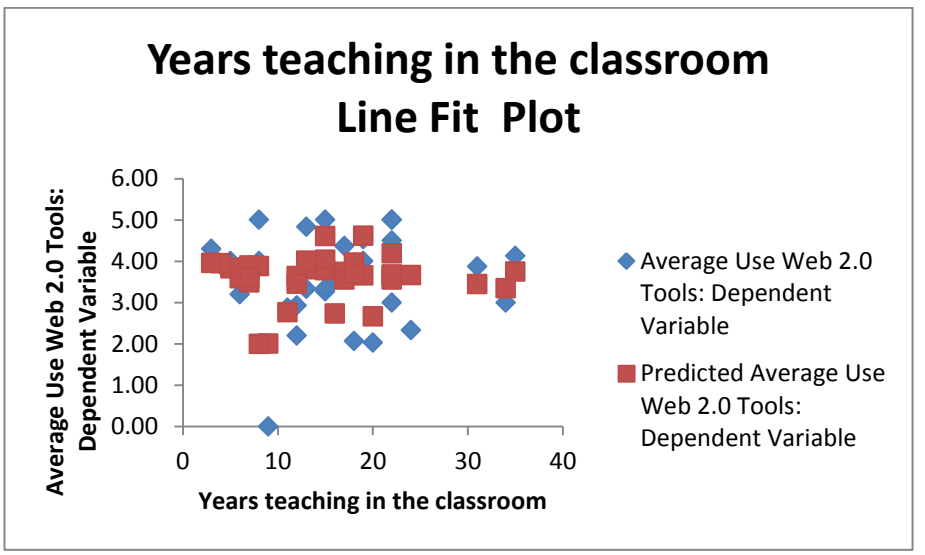


Table 15 identified the relationship existing between the integration of web 2.0 tools into the classroom and access to such web 2.0 tools within the classroom environment for the teacher. There was a negative regression coefficient between the two variables at -0.959, and a p-value of 0.299 while not statistically significant for consistency at the p<.05 level. Overall, an increase in

the access to web 2.0 tools at school yielded a positive increase in the integration of such tools in the classroom.

Table 15

Integration Compared with Access to Web 2.0 Tools at School

	Coefficients	
Access at school	-0.959	Regression coefficient
r-value	0.152	Correlation coefficient
p-value	0.299	p<.05

(Figure 6) Web 2.0 Tools Integration compared to Access to Web 2.0 Tools at School

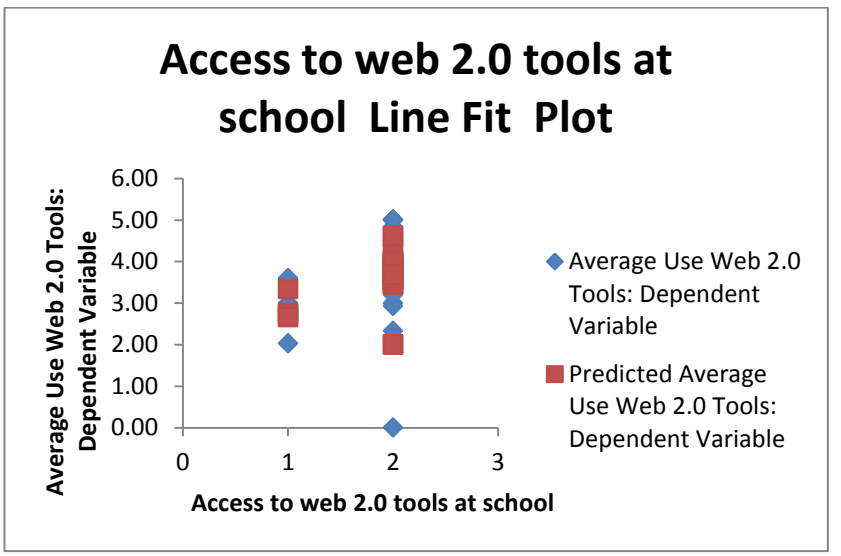


Table 16 identified the relationship that existed between the dependent variable of the integration of web 2.0 tools and using technology for teaching in school for each participant in the research study. While the p-value was higher than the .05 level, a relationship existed between the two variables; the more integration that took place in using web 2.0 tools, the more the participants used technology in the classroom to conduct lessons. The relationship between the two variables

could benefit from a larger sample size to determine if the relationship could exist consistently at the .05 level.

Table 16

Using Technology for Teaching in the School

	Coefficients	
Using Tech in School	-0.029	Regression coefficient
r-value	0.152	Correlation coefficient
p-value	0.322	p<.05

(Figure 7) Using Technology for Teaching in School

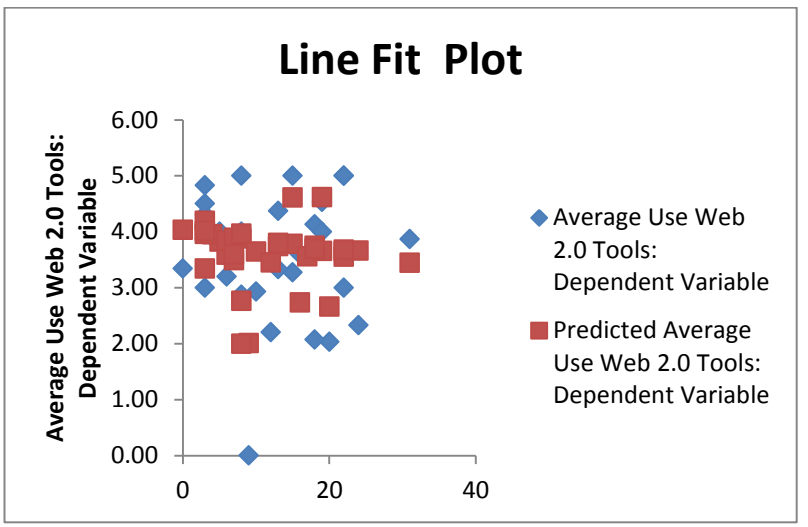


Table 17 examined the relationship existing between the dependent variable and the participant access to web 2.0 tools at home. The regression coefficient was at 1.910 which indicated that there was a relationship between the two variables. The p-value for the two variables was .014 indicating a significant relationship between the two variables at the p<.05 level. The more access the participants had to web 2.0 tools at home, the more likely they were to integrate them into the classroom environment.

Table 17

Participant Access to Web 2.0 Tools at Home

Coefficients		
Home Access	1.910	Regression Coefficient
r-value	0.152	
p-value	0.014	Correlation coefficient
		p<.05

(Figure 8) Participant Access to Web 2.0 Tools at Home

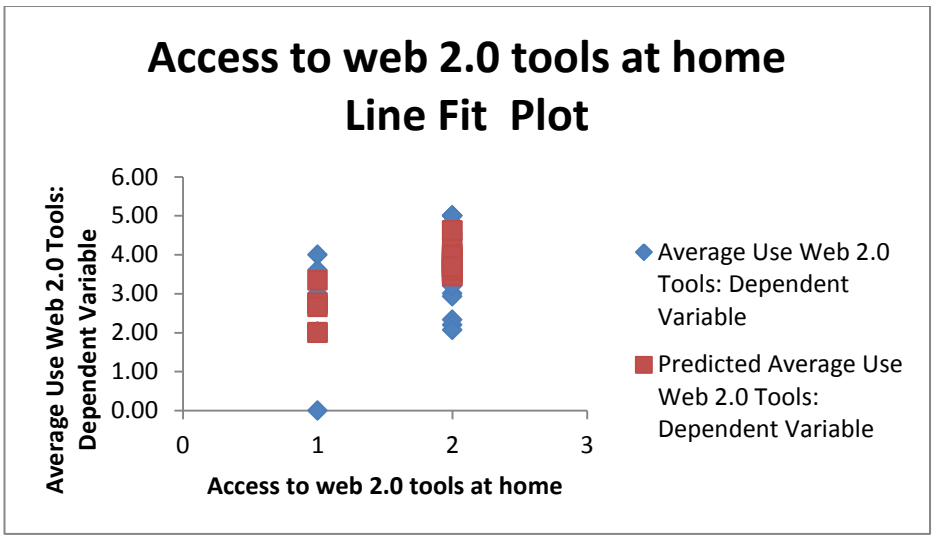


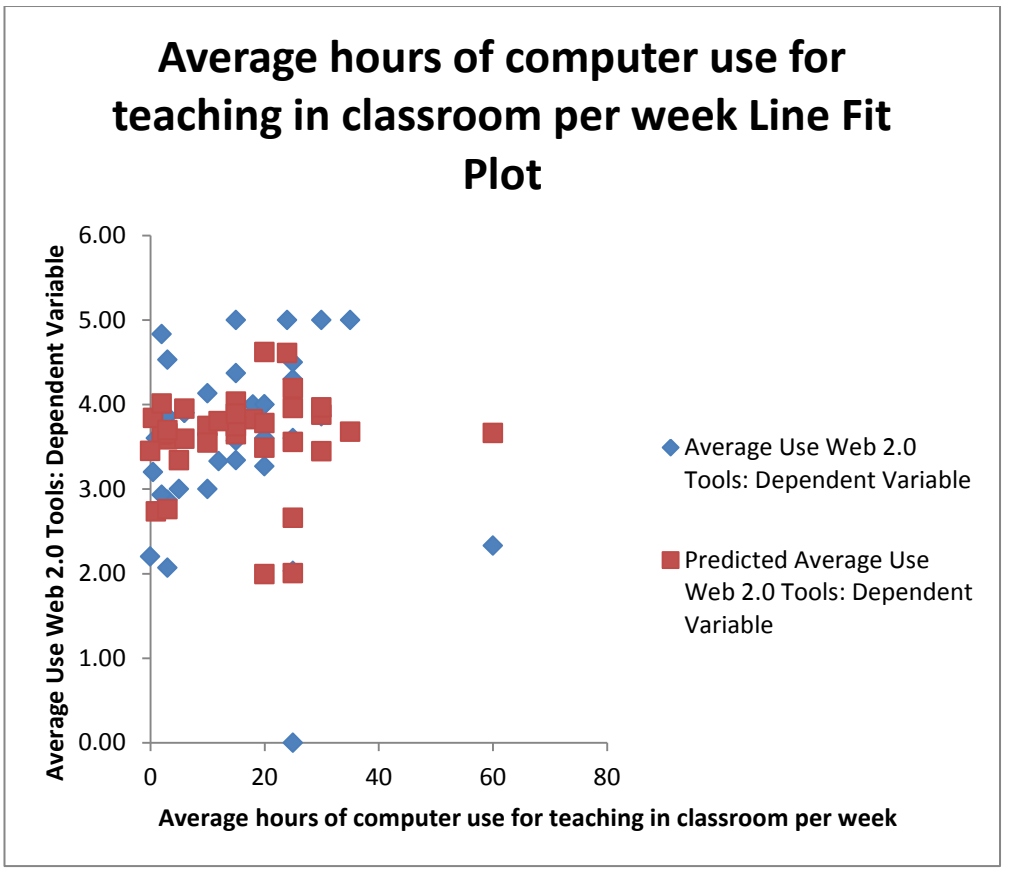
Table 18 examined the relationship existing with the dependent variable and the average computer use for teaching in the classroom per week. There was a relationship between the two variables and indicated a correlation coefficient of 0.002 between them; which yielded a p-value of 0.907 which is larger than the p<.05 level established for significance. The relationship could be further explained through an increased sample size.

Table 18

Participant Average Computer use for Teaching in Classroom Per Week

Coefficients		
Avg. Use	0.002	Regression Coefficient
r-value	0.152	
p-value	0.907	Correlation Coefficient
		p<.05

(Figure 9) Participant Average Computer Use for Teaching in Classroom Per Week



After examining the relationships that existed between the dependent variable in *Web 2.0 Tools Integration* and the six independent variables a relationship exists between all of them and

the overall significance or f value was .0945. This is larger than the established p-value of $p<.05$ for significance between all of the variables and the dependent variable. The research questions illustrated by the study are:

1. What type of correlation exists between the role of the teacher acting as a facilitator of content knowledge, using web 2.0 tools for instruction and that of the traditional approach to teaching science?

The role of the participant in the study, acting as the facilitator of content knowledge is essential to the success of the classroom environment. The added use of the web 2.0 elements increases the instructors likelihood that there will be a relationship between the integration of the web 2.0 elements and the 6 dependent variables. The more exposure and comfort of use that teachers have with the web 2.0 elements, there is an increased likelihood that they will integrate them into the classroom environment.

2. How do high school science teachers in Montana use web 2.0 tools in the classroom?

The participants in the research study who were science teachers in the largest high schools in Montana with a student population of 900 or more who have integrated web 2.0 tools into their classrooms in an attempt to redefine educational pedagogy. The elements of the research study indicated that the more comfortable the participants were with using the tools the more likely they were to integrate them into the classroom environment. The participants in the research study used blogs, wikis, podcasts, social networking, and course management software to help aid them in the presentation of content material in the classroom environment.

3. How do high school science teachers in Montana use web 2.0 elements to guide science instruction?

The participants of the research study guide instruction through the use of web 2.0 elements in the classroom, once they feel comfortable using the elements themselves. The participants of the

research study used blogs, wikis, podcasts, social networking, and course management software to guide content instruction in the classroom. The key element of the research study was the professional development and support for instruction in the classroom for integration to occur.

The results of the multiple regression instruments suggest that two of the six independent variables made significant contributions to the study. Access to web 2.0 tools at home and the integration of web 2.0 tools into the classroom were the only variables that met the significance threshold of a p-value of .05 or less. Part of the discrepancy between the other five independent variables lies in the need for a larger sample size. The regression equation for the study was as follows:

(Figure 10) Multiple Regression Formula

Multiple Regression Formula
$Y=a + b_1X_1 + b_2X_2 + b_3X_3\, b_4X_4 + b_5X_5 + b_6X_6$
$Y_{\text{Web 2.0 Tools Integration}} = a + b_{-0.021696561} X_{\text{Age}} + b_{0.032851038} X_{\text{Years of Teaching in the classroom}} + b_{-0.959194064} X_{\text{Access to Web 2.0 tools at school}} + b_{-0.028977444} X_{\text{Using Technology for Teaching in School}} + b_{1.909534732} X_{\text{Access to Web 2.0 Tools at Home}} + b_{0.001674854} X_{\text{Average of Hours of Computer use for Teaching in the Classroom per Week}}$
Y= Dependent Variable a= Constant b= Regression coefficient X= Multiple Independent Variables H_0: R^2=1, b=1,2,3,4,5,6 H_A: at least on regression coefficient is not zero H_0: R^2= 1, the change of R^2 is significant when the independent variable, *Web 2.0 tools integration self-efficacy is added* The dependent variable of the study will be the *Web 2.0 tools integration survey*

Summary

This chapter reported the results of the multiple regression analysis, collection of demographic data, answered the research questions, and provided participant insight into the reasons they used or did not use web 2.0 elements in their classroom. The multiple regression analysis indicated that one of the six independent variables was access to web 2.0 elements at home, with a significant impact on the web 2.0 tools integration into the classroom. The other five independent variables had a p-value that was higher than the $p<.05$ level. A possible explanation for this lies in the need for an increased sample size of the target population. Although when examining the f value for the entire study there was a closer value of significance but still it was above the set value for significance. The major themes that emerged within the study were the need for teacher leadership in the area of integrating technology into the classroom, access to technology for teachers and students, professional development for successful technology integration to guide instruction, and administrative support for integration of technology into the classroom. Chapter five will explore the findings of the research study in more detail, in addition to making recommendations for future research.

Chapter Five

Discussion of Findings

This chapter discussed the findings of the research study, synthesized the information and made recommendations for further research in the area of web 2.0 elements and their integration into the classroom environment. *The Web 2.0 Integration* survey served as the dependent variable for the research study and sought to identify if there was a significant relationship with that of the six independent variables identified in *The Web 2.0 Tools Self-Efficacy* survey. The mean of the average use of the web 2.0 tools integration for the research study was 3.60, indicating that the web 2.0 elements are beginning to be integrated and used at least monthly with the participants of the research study in their classrooms. The participants reported that they used web 2.0 elements in the classroom but by far they did not use social media as it returned the lowest median score of 5.0 (Table 3). Of the six measures that united together to make the Web 2.0 Tools Integration survey their rank in order of reported means had content management software in first, second was podcasts, followed by photo/image software, blogs, wikis, and finally social networking. Surprisingly the averages of integration were higher in this research study as compared to the previous research done on the subject with Pan (2011). The results of examining the means of element integration into the classroom indicate that the participants of the research study are beginning to realize the importance web 2.0 tools can have in the classroom. Blogs in the classroom are receiving little attention. As stated in previous research on the topic, blogs are not being incorporated into the classroom on a consistent basis. The participants did not apply this type of teaching and learning in their classrooms. There are still issues of privacy and content availability with using this type of technological medium in the classroom as identified in previous research by Richardson (2006) Solomon & Schrum (2007) and Pan (2011).

Social networking is very prevalent among students in the 21st century and participants within the research study failed to fully incorporate social media to help students learn. Among the participants in the research study, social media was the lowest category for implementation with students in the classroom. This finding was consistent with recent studies on educator use of social media in the classroom as a teaching tool (Grey, 2010). Social media is growing in popularity with educators. Twitter is a leader as a location for educators to find ongoing professional development. Social media in education is progressing and the profession as a whole has not fully realized the impact. The notion of using the *Web 2.0 Elements Integration* survey with that of the *Web 2.0 Elements Self-Efficacy* survey attempted to use the two measures with one another to examine the relationships and statistical significance.

The *Web 2.0 Tools Self-Efficacy* survey was used to gain insight into the participants self-efficacy with respect to their technology integration with blogs, wikis, podcasts, social media, and content management software. The research was an extension of previous research done by Pan (2011) and elaborated upon the self-efficacy work by Albert Bandura (1999). The research indicated that the participants felt some uncertainty with using web 2.0 elements in the classroom as many responses indicated that they 'never' or 'disagree' with the survey questions concerning their integration of web 2.0 elements into the classroom environment. This was an extension of Bandura's concept of self-efficacy where he argued that the participants were in a condition of no confidence in the tools for instruction (Bandura, 1977; 1982; 1994; 1997). Moreover, Bandura argued that self-efficacy is the judgment of one's own capabilities in preforming job duties (Bandura, 1997, Pan, 2011). Bandura (1982) believed that people with a high self-efficacy would be able to accomplish job activities at a higher level, than those with a low self-efficacy.

Professional Development

The research study took the elements of the *Web 2.0 Tools Integration* and *Self-Efficacy* surveys and used them to predict the levels of technology integration into the participants classroom environments. A key outcome established by the research study was the need to keep dedicated professional development embedded into the fabric of the organization. Without the professional development allocations, the teacher's commitment to true integration would not occur. This was evident within participants responses to the survey instruments and their self-efficacy scores related to the levels of integration of the web 2.0 tools into the classroom. The notion of supported professional development was consistent with prior research on the topic of the importance of professional development to sustain change (Fullan, 2001; Guskey, 2000). The independent variable in professional development in respect to integration of web 2.0 tools into the curriculum did not have a significant relation to the dependent variable for this research study as it yielded a correlation coefficient of -.028 and a $p<.05$ level of .321. While the finding was not significant, there was a relationship between the two variables and increased statistical consistency, and a smaller p-value could be found given a larger sample size with further research on the topic.

The demographic information that was collected for the research study in the area of professional development focused on the number of hours of computer related professional development in the last year for participants. The mean number of hours for each participant in the research study was 10 hours of professional development related to computers in the last year. When compared to the levels of integration of the entire set of web 2.0 tools, this indicated that more professional development is required to close the gap in teachers self-efficacy, leadership, and implementation of web 2.0 tools into the classroom environment (Project Tomorrow, 2009a;

Wells and Lewis, 2006). The teacher as leader is one method that the literature suggests as a proven method of truly integrating change within the organization (Lawless & Pellegrino, 2007).

Conclusions

This study revealed several key elements with respect to the participants' use of web 2.0 elements in their classroom and that of their self-efficacy and comfort level in using and leading others in the integration of the web 2.0 elements into the classroom environment. The two survey instruments that were used the *Web 2.0 tools Integration Survey* and the *Web 2.0 Tools Self-Efficacy* survey illustrated a relationship existed between the dependent and six independent variables based upon the responses by the 31 participants in the research study. Of the six independent variables, tested one yielded a significant finding in relationship to the dependent variable. Teacher access to technology at home was a significant indicator of integration of web 2.0 tools into the classroom. The other five independent variables indicated that there was a relationship between the dependent variable but that the relationship was not significant because of the limited sample size of the study. The null hypothesis is therefore rejected for the *a priori* portion of finding a mean difference between the dependent variable and the independent variables of at least 2.0. The research study did in fact find significance for experimental importance but not experimental consistency as the p-values for the relationship between the dependent variable and that of all of the independent variables exceeded the *a priori* threshold of $p<.05$ level. The f value for the overall study was 0.094 which is slightly higher than that of $p<.05$ level set for significance. With an f value of .094 this indicates that the relationship will be significant 9 times out of 100 when the study is replicated. Therefore the researcher rejects the null hypothesis: that there would be no experimental importance or statistically reliable difference between *The Web 2.0 Tools Integration Self*-Efficacy, professional development, access to web

2.0 tools at school, access to web 2.0 tools at home, with respect to the dependent variable in *The Integration of Web 2.0 Tools*. There was a significant relationship between the dependent variable and one of the six independent variables and that the experimental importance levels were met by the research of a defined median score of at least 2.0 was found for one of the independent variables as measured against the dependent variable.

Recommendations for Further Research

The research into science teachers in Montana's largest 14 high schools with a student population of 900 or more has led to several recommendations for future research in the area of the integration of web 2.0 tools into the classroom environment and they are:

1. The research study would benefit from a larger sample size to investigate the relationships between the dependent and six independent variables. The researcher attempted on numerous occasions to contact via e-mail and personal phone calls to the principals of the 14 high schools to try to obtain additional participants but the research study only obtained 35 participants out of a potential population of 152 or 23% of the population.
2. Professional development is essential to the success of full integration of web 2.0 tools and further exploration of different elements of professional development would make the research study stronger. Elements that have proven successful surround the idea of mini-courses throughout the school year that target professional development for teachers.
3. Student engagement is always a key element in the integration of technology into the classroom setting. Further exploration of student engagement in the classroom as a result of the integration of web 2.0 tools is definitely a key element that could help the study in the future. Being able to quantitatively measure student achievement, and engagement as

predictor variables for web 2.0 tools integration into the classroom would help the research.

4. Consistent administrative support for the changing culture of the organization is essential. As this study examined teacher integration and teacher leadership a broader scope to include the leadership elements of the building principal would also contribute to the research.

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Appendix A

Web 2.0 Tools Integration and Self-Efficacy Survey

Please check how often you use the following Web 2.0 tools with your students (check one for each category) and indicate what kinds of Web 2.0 tools you use.

* Required

First Name *

Last Name *

Age *

E-mail address *

What is the name of the High School where you work? *

What grades do you teach? *

What subject areas in Science do you teach? (Check all that apply) *

- [ ] Integrated Science
- [ ] Earth Science
- [ ] Biology
- [ ] Chemistry
- [ ] Physics

- [ ] AP/IB Biology
- [ ] AP/IB Environmental Science
- [ ] AP/IB Chemistry
- [ ] Other:

***Education Status** **

- BA
- MA
- Doctorate
- Other:

***Do you have access to web 2.0 tools at school?** **

- Yes
- No

***Do you have access to web 2.0 tools at home?** **

- Yes
- No

***Do you have access to web 2.0 tools through mobile devices(Ex. iphone, ipod, etc..)?** **

- Yes
- No

***Do you access the internet at school?** **

- Yes
- No

***Do you access the internet at home?** **

- Yes
- No

Do you access the internet through mobile devices (Ex. iphone, ipod, etc...)? *

- Yes
- No

How many hours of professional development (such as workshops, computer courses, seminars, or conferences) in relation to technology did you take during the past school year? (Please insert number of hours) *

How many years have you been teaching? (Please insert the number of years) *

How long have you been using technology for teaching in your classroom? (Please insert the number of years) *

How many hours do you use the computer to teach in your classroom per week on average? (Please insert the number of hours) *

The high school for which I am working supports and offers resources in the use of web 2.0 tools *

- We have been using web 2.0 elements for a while
- We are starting to use web 2.0 elements
- We are investigating the use of web 2.0 elements within the classroom
- We do not use web 2.0 elements
- I do not know what you are talking about concerning web 2.0 elements

If you have any suggestions for using web 2.0 tools with your students, please provide your comments below.

Please check one for each category *

	Daily	At least once/week	At least once/month	At least once/year	Never
Blog					
Wiki					
Podcast					
Social Networking sites (Ex: Facebook, MySpace)					
Image/Photo sharing sites (Ex: Flickr, Picassa)					
Course Management Systems (Ex: Blackboard, Moodle, Joomla)					

List any of the blogs you use for teaching. *

List any of the wikis you use for teaching. *

List any of the podcasts you use for teaching. *

List any of the social netwoking sites you use for teaching. *

List any of the photo/image sharing sites you use for teaching. *

List any of the course management systems you use for teaching. *

When using Web 2.0 tools in teaching, I feel confident that I can.... *

	Strongly Agree (SA)	Agree (A)	Neutral (N)	Disagree (D)	Strongly Disagree (SD)
create my own blog (to be accessed by my students as part of a lesson)					
post news or comment on a blog					
edit or delete information on a blog					
add links on a blog					
upload attached files on a blog					
add information on a wiki					
edit information on a wiki					
delete information on a wiki					
revise the information for what I want on a wiki (use the history record tool to verify the version that I want)					
upload files to a wiki, such as pictures, PowerPoint, word documents, pdf files, ...etc)					
use computers to create podcasts, such as an mp3 file.					
use podcast software or applications to record, edit, and					

	Strongly Agree (SA)	Agree (A)	Neutral (N)	Disagree (D)	Strongly Disagree (SD)
convert audio files into mp3 files					
upload podcast files online					
download podcast files online					
use RSS feeds to subscribe to podcasts					
create my own social network site					
post information on social networking sites					
maintain contact with my friends through social networking sites					
invite friends to join my social networking sites					
set up profile security level of my social networking sites					
create an Image/Photo sharing site account					
use Image/Photo sharing sites to upload images/photos online					
use Image/Photosharing sites to edit images/photos (such as add text, resize, image, and add tags)					
use Image/Photo sharing site to create slideshow or video presentations					
post comment on Image/Photo sharing sites					
use a course management system to manage classroom materials, such as post a syllabus and curriculum documents					
arrange the layout of my course management system site, such as display course material as weekly, topics or social issues					

	Strongly Agree (SA)	Agree (A)	Neutral (N)	Disagree (D)	Strongly Disagree (SD)
use course management system embedded tools to communicate and interact with my students, such as blogs, wikis, announcements, chat rooms					
use a course management system to create quizzes for my students online					
use a course management system to assess the progress of my students					

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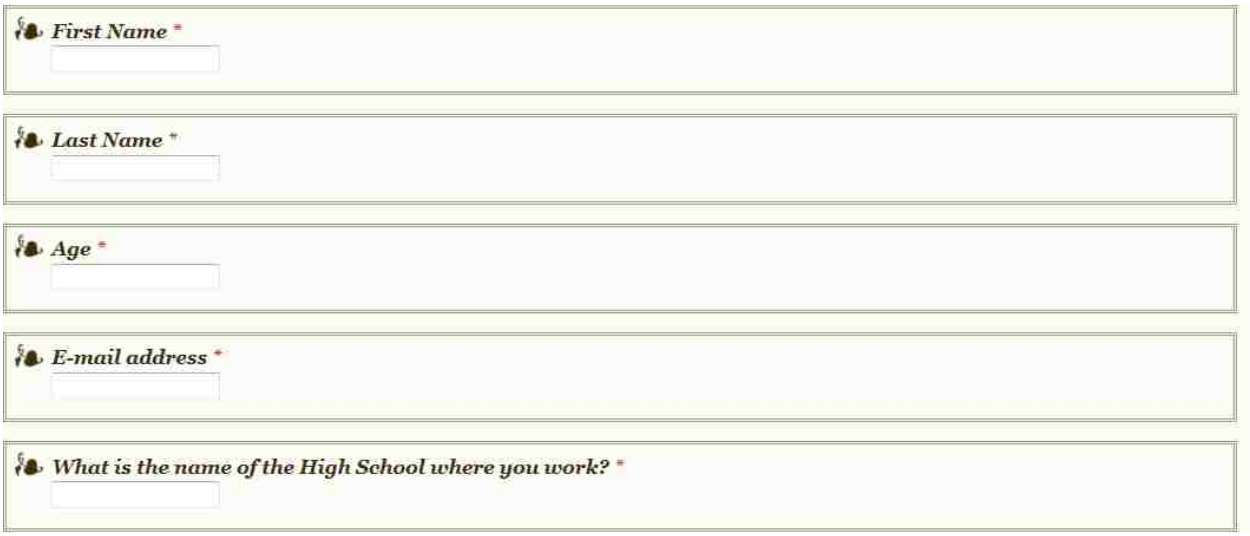
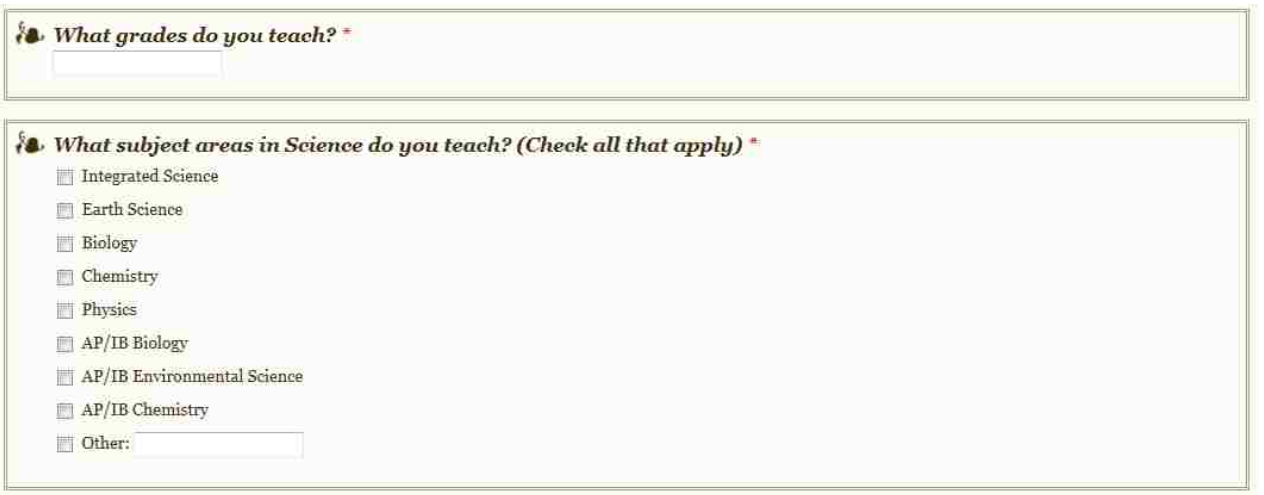
Appendix B

Item Analysis for survey instrument and the reasons for asking the questions in the survey as related to the literature review.

Demographic Information



Grades Taught in School and Subject Areas Taught in Science



Education Status Achieved

Teacher Access to Technology

Teacher Professional Development in Technology

How many hours of professional development (such as workshops, computer courses, seminars, or conferences) in relation to technology did you take during the past school year? (Please insert number of hours) *

How many years have you been teaching? (Please insert the number of years) *

Teacher Utilization of Technology in the Classroom

How long have you been using technology for teaching in your classroom? (Please insert the number of years) *

How many hours do you use the computer to teach in your classroom per week on average? (Please insert the number of hours) *

Support for Educational Technology in the School

The high school for which I am working supports and offers resources in the use of web 2.0 tools *

- We have been using web 2.0 elements for a while
- We are starting to use web 2.0 elements
- We are investigating the use of web 2.0 elements within the classroom
- We do not use web 2.0 elements
- I do not know what you are talking about concerning web 2.0 elements

If you have any suggestions for using web 2.0 tools with your students, please provide your comments below.

Teacher use of Technology in the Science Classroom

Please check one for each category *

	Daily	At least once/week	At least once/month	At least once/year	Never
Blog	○	○	○	○	○
Wiki	○	○	○	○	○
Podcast	○	○	○	○	○
Social Networking sites (Ex: Facebook, MySpace)	○	○	○	○	○
Image/Photo sharing sites (Ex: Flickr, Picassa)	○	○	○	○	○
Course Management Systems (Ex: Blackboard, Moodle, Joomla)	○	○	○	○	○

List any of the blogs you use for teaching. *

List any of the wikis you use for teaching. *

List any of the podcasts you use for teaching. *

List any of the social netwoking sites you use for teaching. *

List any of the photo/image sharing sites you use for teaching. *

List any of the course management systems you use for teaching. *

When using Web 2.0 tools in teaching, I feel confident that I can.... *

	Strongly Agree (SA)	Agree (A)	Neutral (N)	Disagree (D)	Strongly Disagree (SD)
create my own blog (to be accessed by my students as part of a lesson)					
post news or comment on a blog					
edit or delete information on a blog					
add links on a blog					
upload attached files on a blog					
add information on a wiki					
edit information on a wiki					
delete information on a wiki					
revise the information for what I want on a wiki (use the history record tool to verify the version that I want)					
upload files to a wiki, such as pictures, PowerPoint, word documents, pdf files, ...etc)					
use computers to create podcasts, such as an mp3 file.					
use podcast software or applications to record, edit, and convert audio files into mp3 files					
upload podcast files online					
download podcast files online					
use RSS feeds to subscribe to podcasts					
create my own social network site					
post information on social networking sites					
maintain contact with my friends through social networking sites					

Summary of Statistics for Research Study

SUMMARY OUTPUT

Regression Statistics			
Multiple R	0.550792988		
R Square	0.303372915	R	0.151686458
Adjusted R Square	0.154095683		
Standard Error	0.955688357		
Observations	35		

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	6	11.13697054	1.856161757	2.032278536	0.09451682
Residual	28	25.5735266	0.913340236		
Total	34	36.71049714			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.610837023	1.228254041	2.12564904	0.042488431	0.094872673	5.126801373	0.094872673	5.126801373
Age	-0.021696561	0.01463305	-1.482709375	0.149320594	-0.051671005	0.008277884	-0.051671005	0.008277884
Years teaching in the classroom	0.032851038	0.029724621	1.105179386	0.278488306	-0.028037087	0.093739163	-0.028037087	0.093739163
Access to web 2.0 tools at school	-0.959194064	0.907378717	-1.057104433	0.299499457	-2.817875107	0.89948698	-2.817875107	0.89948698
Using technology for teaching in school	-0.028977444	0.028722819	-1.008864904	0.32167877	-0.087813472	0.029858584	-0.087813472	0.029858584
Access to web 2.0 tools at home	1.909534732	0.724597291	2.635304818	0.013547936	0.425264466	3.393804999	0.425264466	3.393804999
Average hours of computer use for teaching in classroom per week	0.001674854	0.01426182	0.117436189	0.907352769	-0.027539159	0.030888867	-0.027539159	0.030888867

RESIDUAL
OUTPUT

Observation	*Predicted Average Use Web 2.0 Tools: Dependent Variable*	*Residuals*
1	3.82335063	0.17664937
2	3.645514993	1.354485007
3	3.746182778	0.383817222
4	3.550354481	-0.550354481
5	2.735271053	0.864728947
6	3.778650032	-0.508650032
7	4.031364939	-0.691364939
8	3.742056801	0.627943199
9	3.800897136	-0.470897136
10	3.445141413	0.424858587
11	3.951254717	-0.051254717
12	3.876766217	1.123233783
13	2.762792003	0.107207997
14	3.58513581	0.27486419
15	3.957506784	0.342493216
16	2.006123931	-2.006123931
17	4.19113841	0.30886159
18	3.642960846	-0.712960846
19	3.556109319	0.043890681
20	4.618613716	-0.618613716
21	3.841307405	-0.641307405
22	3.663540917	-1.333540917
23	3.487302552	0.112697448
24	3.891162939	-0.321162939
25	2.660782553	-0.630782553
26	3.657189089	0.872810911
27	3.341154391	-0.341154391
28	4.008833358	0.821166642
29	3.451476885	-1.251476885
30	3.594033965	0.305966035
31	3.966614427	-0.106614427
32	1.993876069	2.006123931
33	4.609818757	0.390181243
34	3.696708617	-1.626708617
35	3.679012068	1.320987932

APPENDIX: C

November 26, 2012

Dear (Will Insert Name of Principal),

My Name is Robert DoBell and I am a doctoral candidate at The University of Montana. For my doctoral dissertation research at The University of Montana under the direction of Dr. Frances L. O'Reilly, I will be writing my dissertation on The Relationship between Montana's Science Teachers Self-Efficacy and the Integration of Web 2.0 Elements in the Classroom in Schools With a Student Population Over 900. I am interested in receiving your permission to contact your science teachers to ask for their participation in this study. If you could forward me the names of your science teachers and their associated e-mail addresses, I would greatly appreciate the help! Please send the teachers contact information in an e-mail to me at the following address rdobell@threeforks.k12.mt.us. I would be happy to provide you a copy of the study at the conclusion of the research. Should you have any questions please feel free to give me a call or e-mail.

Yours in Education,

Robert DoBell
406-370-0053
rdobell@threeforks.k12.mt.us

November 26, 2012

Dear (Will Insert Teacher Name),

Science teachers in the 21st century have at their disposal many different elements to instruct students using educational technology. For my doctoral dissertation research at The University of Montana under the direction of Dr. Frances L. O'Reilly, I will be writing my dissertation on The Relationship between Montana's Science Teachers Self-Efficacy and the Integration of Web 2.0 Elements in the Classroom in Schools With a Student Population Over 900. I am interested in your participation in my study to evaluate the state of web 2.0 tool use by teachers in science classrooms, in the 14 largest public high schools, in Montana. The findings of this research will inform the 21st century teaching of science in the largest 14 public schools in Montana. The results of the study will be made available to you and other interested teachers.

To gain a representative sample of eligible participants I ask that you complete the survey at your earliest convenience. None of the data will identify you personally, and all surveys will be kept confidential. The survey can be found at the following URL: Survey Link. Should you have any questions please feel free to give me a call or e-mail.

Yours in Education,

Robert DoBell
406-370-0053
rdobell@threeforks.k12.mt.us

IRB Protocol No.:

_____

THE UNIVERSITY OF MONTANA-MISSOULA
Institutional Review Board (IRB)
for the Use of Human Subjects in Research

ONLINE SURVEY
(SurveyMonkey, Select Survey, Qualtrics, etc.)

Statement of Confidentiality

When developing the online survey instrument for my project, The Relationship between Montana's Science Teachers Self-Efficacy and the Integration of Web 2.0 Elements in the Classroom in Schools With a Student Population Over 900 my signature below certifies that:

1) I will design my online survey so that the front page of the instrument includes the project description, a risk/benefit statement, and contact information for questions. Participants will not be forced to respond to a question before being able to move on to the next question. Participation will be clearly voluntary and subjects' consent will be implied by their proceeding into the survey; and,

2) If my survey is anonymous,
    a. I will provide the URL link to the survey via a hand-out, or in the body of an email, but will **not** send it electronically through a feature of the survey software; and
    b. I will **not** include any potentially identifiable technical data (e.g., IP address) in my collection configuration. If, however, I am unable to deselect and technical data is captured by default, I, as the instrument designer, will destroy it immediately. As a result, I will be the only one (of my research team, if applicable) to see this data, and it will not be used it in any way.

The highest form of online security available utilizes secure sockets layer (SSL) and ensures data is transmitted in an encrypted fashion. *Select Survey* does not use SSL and for some survey software (e.g. SurveyMonkey), this security is available only via purchase.

The survey software I am using is Google Form

It utilizes SSL: ____ Yes __X__ No

Robert D. DoBell 11/26/12

Signature of Principal Investigator Date

I AM AWARE that electronic submission of this form from my University email account constitutes my signature.

ONLINE SURVEY CONSENT FORM

You are invited to participate in a research project about The Relationship between Montana's Science Teachers Self-Efficacy and the Integration of Web 2.0 Elements in the Classroom in Schools With a Student Population Over 900. This online survey should take about 20 minutes to complete. Participation is voluntary, and responses will be kept confidential to the degree permitted by the technology being used.

You have the option to not respond to any questions that you choose. Participation or nonparticipation will not impact your relationship with The University of Montana. Submission of the survey will be interpreted as your informed consent to participate and that you affirm that you are at least 18 years of age.

If you have any questions about the research, please contact the Principal Investigator, Robert DoBell, via email at rdobell@threeforks.k12.mt.us or the faculty advisor, Dr. Frances L. O'Reilly at frances.oreilly@umontana.edu If you have any questions regarding your rights as a research subject, contact the UM Institutional Review Board (IRB) at (406) 243-6672.

Please print or save a copy of this page for your records.

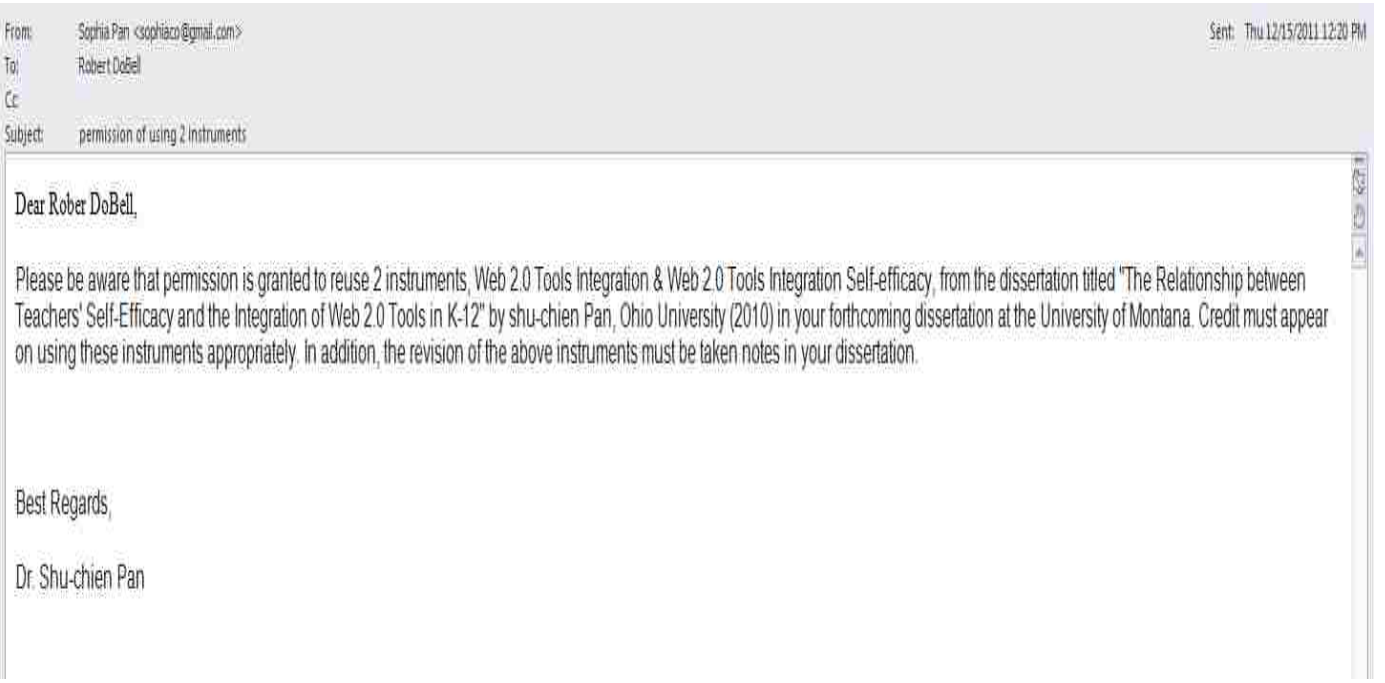
** I have read the above information and agree to participate in this research project.*

Enter survey:
https://docs.google.com/spreadsheet/viewform?formkey=dDZUd3ItZmdueUt6ZWo2WEJyNWRpS1E6MQ#gid=0

APPENDIX: D

The survey instruments can be accessed at the following web address:

https://docs.google.com/spreadsheet/viewform?hl=en_US&formkey=dDZUd3ItZmdueUt6ZWo2WEJyNWRpS1E6MQ#gid=0



From: Sophia Pan <sophiaco@gmail.com>
Sent: Thu 12/15/2011 12:20 PM
To: Robert DoBell
Cc:
Subject: permission of using 2 instruments

Dear Rober DoBell,

Please be aware that permission is granted to reuse 2 instruments, Web 2.0 Tools Integration & Web 2.0 Tools Integration Self-efficacy, from the dissertation titled "The Relationship between Teachers' Self-Efficacy and the Integration of Web 2.0 Tools in K-12" by shu-chien Pan, Ohio University (2010) in your forthcoming dissertation at the University of Montana. Credit must appear on using these instruments appropriately. In addition, the revision of the above instruments must be taken notes in your dissertation.

Best Regards,

Dr. Shu-chien Pan