

January 01, 2012

## A participatory evaluation of the use of social networking tools in a high school math class

Randy J. Wormald  
*Northeastern University*

---

### Recommended Citation

Wormald, Randy J., "A participatory evaluation of the use of social networking tools in a high school math class" (2012). *Education Doctoral Theses*. Paper 31. <http://hdl.handle.net/2047/d20002623>

This work is available open access, hosted by Northeastern University.

A Participatory Evaluation of the Use of Social Networking Tools  
in a High School Math Class

A dissertation presented by  
Randy J. Wormald  
to the College of Professional Studies

In partial fulfillment of the requirements for the degree of  
Doctor of Education

Dr. Chris Unger  
Advisor

Northeastern University  
Boston, Massachusetts  
February, 2012

### Abstract

As we move into the 21<sup>st</sup> century, the needs of our students are more variable than ever. There has been a proliferation of social networking usage in society yet there has been little use of those emerging tools in schools as a means to enhance student learning. It is a common practice in school districts to block social networking sites and online collaborative tools (Cramer & Hayes, 2010; National School Boards Association, 2007; Toppo, 2011). This study explored the benefits of employing social networking tools into a math class in a rural high school to determine levels of engagement, motivation, and perceived educational advantages. This qualitative study was investigated through the lenses of student engagement theory, online learning theory and guided social constructivism. Participatory evaluation guided this collaborative research project that allowed participants (the teacher and his students) to be researchers and take ownership of their learning. A two-week unit was taught implementing social networking tools as the main instructional methodology to high school freshmen in an algebra II class. The teacher led his students in focus groups to reflect on their learning experience and inform future implementation of the social networking tools for learning. Following the first unit reflection, a second unit was implemented using the social networking tools again, but utilizing suggested revisions as identified by the teacher and his students. This study has the potential to inform the literature on the acceptance of using social networking tools for instructional use.

*Keywords:* student engagement, motivation, social networking, math, constructivism

### **Acknowledgements**

It is with heartfelt thanks that I acknowledge my advisor, Dr. Chris Unger. If you ask him, he would say, “It’s my job”. But, he goes above and beyond. Pushing me when I needed a push and encouraging me when I struggled. His guidance, encouragement, mentoring, and ability to help me see the big picture helped me in ways that cannot be overstated.

This journey would not have been possible without the love and sacrifice of my wife, Jodi. The late night work that took time away from us and the weekends that she took the boys on adventures to give me time to work. Her constant encouragement and the pride she took of my “little” accomplishments along the way made such a big difference in this journey: all my love and thanks. To Jack and Eli: for the inspiration to continue this journey and see it through to the end.

To my friend, brother, and editor, Dana, a very special thanks. Through this process, he taught me how to write. Whether he was looking over a little paper or tackling Chapter 4, he expertly provided guidance. To my parents, Jack and Earlene, and my sister, Heather for their constant support and encouragement throughout the years, thank you.

Thanks to Alison Bryant for observing my students and providing excellent insight and comments that helped tremendously with this research. To the rest of the Belmont High School faculty, thank you for your help and support throughout this process. To my co-researchers in the study, the 2011-2012 Algebra II Honors class, a huge thank you.

Finally, I would like to give a very special thanks to all of my students for the motivation to continue to improve my craft; particularly to Courtney Clary, Holly Julian, and Adlai Gordon for taking this journey with me and making it all worthwhile.

**Table of Contents**

Abstract .....	2
Acknowledgements .....	3
Table of Contents .....	4
List of Tables .....	7
Chapter 1: Introduction .....	8
Problem of Practice .....	8
Significance of the Problem .....	9
Practical Goals .....	10
Intellectual Goals .....	11
Summary of Research Questions .....	11
Theoretical Framework .....	12
Chapter 2: Literature Review .....	25
History of Educational Technology .....	26
Learning Styles .....	29
Culture of Learning .....	33
21 <sup>st</sup> Century Skill Acquisition .....	36
Student Autonomy and Personalization .....	38
Connections to Mathematics Education .....	41
Chapter 3: Methodology .....	44
Research Questions .....	44
Rationale for a Qualitative Design .....	45

Site and Participants.....	47
Data Collection .....	48
Data Analysis .....	50
Validity and Credibility .....	50
Protection of Human Subjects .....	52
Conclusion .....	52
Chapter 4: Report of Research Findings.....	53
Study Context.....	54
Pre-Study Survey Results .....	55
Unit Content and Method.....	59
Coding for Themes .....	63
Research Question #1 .....	64
Research Question #2 .....	72
Research Question #3 .....	80
Summary of Findings.....	85
Chapter 5: Discussion of Research Findings .....	86
Revisiting the Problem of Practice .....	86
Review of the Methodology.....	87
Discussion of Major Findings.....	90
Discussion of Findings in Relation to the Theoretical Framework .....	93
Discussion of Findings in Relation to the Literature Review .....	96
Final Researcher Commentary.....	100

Conclusion .....	102
Limitations and Future Studies .....	102
Significance of the Study .....	105
References.....	107
Appendices.....	121
Appendix A.....	121
Appendix B.....	122
Appendix C.....	124
Appendix D.....	125
Appendix E.....	126

**List of Tables**

Table 1 Participant Basic Information .....	58
Table 2 Topical Breakdown and Use of Social Network in the Matrix Unit .....	60
Table 3 Topical Breakdown of the Probability Unit.....	62
Table 4 Use of Data Sources According to Participant for Research Question #1.....	64
Table 5 Themes by Participant Group for Research Question #1 .....	64
Table 6 Illustrative Student Quotes regarding the Theme “Adjusting to Autonomy” .....	67
Table 7 Comparison of Previous Years' Assessment for Matrix Unit.....	71
Table 8 Use of Data Source by Participants for Research Question #2.....	73
Table 9 Themes by Participant Group for Research Question #2 .....	74
Table 11 Teacher Ratings Regarding Behavioral Aspects of Participation.....	77
Table 12 Cognitive Engagement as Observed in Face-to-Face Meetings .....	78
Table 13 Classroom Observation of Motivation through Emotional Engagement.....	79
Table 14 Themes from Students for Research Question 3 .....	80
Table 15 Major Themes Identified by Students and Teacher through the Study .....	91

## Chapter 1: Introduction

### Problem of Practice

The future of business has been postulated to look more and more like a fluid, ever-changing group of "e-lancers" (Malone & Laubacher, 1998) joining temporary networks of people to get jobs done collaboratively and then moving ahead to a new project. These groups are formed to maximize individual talents to accomplish a group task or job, and the "Hollywood teams" (Gardner, 2008a) will be the way of 21st century business. The Hollywood teams Gardner proposes are groups of people who bring their individual strengths to a project much like that of a Hollywood movie, whereby the producer chooses the best director, the best videographer, etc., to build the best team for a job. As the nature of the global economy evolves, the skill sets expected of new employees will change as well. The current state of education does little to address this possible future. This change in the global community will necessitate a change in educational methodology if we hope to provide this and future generations with the skills and abilities to be successful. Individual talents are best honed in an atmosphere where students are given some autonomy over how they learn. The skills developed through the use of social networks have the potential to be invaluable.

In its most basic form, social networking is a way for like-minded people to build a community. Given the interactive and collaborative nature that defines social networking, there is tremendous potential for the field of education. Over the last five years, sites such as Facebook, MySpace, Twitter and YouTube have become household terms, but the use of social networking in education has seen little growth, especially considering its rapid rise elsewhere in society. If we continue to teach without providing students with options for how and when to

learn the material, we are potentially missing opportunities to engage a significant percentage of the population. As Zhao (2009) suggests:

Schools should thus change the policies of students' use of technology in schools.

Students should not only be allowed to use their own technological devices for learning, but more importantly, they should also be given the opportunities to learn how to use technology across the curriculum, for handing in assignments, communicating with friends and teachers, developing multimedia products, and designing video games.

Schools should consider digital products as valuable and authentic indicators of student learning for assessment purposes (p. 197).

Social networking embraces these ideas, as well as anytime-anywhere learning, and each of these will allow students and teachers the latitude to redefine their roles in education. The use of social networking tools as an instructional method could enhance student engagement in the learning process. Given the growing ubiquity of technology and social networking activity, the use of these tools as a means to engage students in their learning should be considered. The emergence of social networking tools has changed communication and collaboration, yet little has been done to investigate how these tools could be used to support learning. This study seeks to investigate how social networking may be beneficial to the learning process for high school students.

### **Significance of the Problem**

Society has seen the rapid expansion of technology and social networks. In the United States, however, public schools' process of blocking access to technological services, particularly social networking, continues to be a prevalent practice (National School Boards Association, 2007). Daniel Pink (2006) argues that we are now in the "Conceptual Age," which requires a

focus on creativity and collaboration as never before. Social networking might significantly vary the scope of educational work by students, thereby possibly increasing the engagement of students. The proliferation of social networking among adolescents requires educators to embrace social networking in order to help students make connections. Connections between new material and things known are required for effective long-term memory storage (Kelly, McCain, & Jukes, 2009). The "flattening" of the world and increase in communication is upon us in the form of an ever-increasing availability of access to digital information and the oft-noted global community (Friedman, 2007).

As Bill Gates (2005) expressed, "The current high schools were designed for a different time and that design will no longer meet the needs of our rapidly changing 21st century world." It is this idea that drives the need for a change in practice if we hope to address the challenges ahead of us. Social networking promises to be a powerful educational tool that allows students to collaborate and share information as never before. As educators, keeping up to date with instructional methods that could enhance and expand learning opportunities for students is of great importance in the ever-changing global landscape.

### **Practical Goals**

There has been considerable discussion regarding the impact of technology on pedagogical practices (Cuban, 2001), as well as the potential impact on student learning through the modification of how teachers implement technology (Becker, 2000). Becker (2000) suggests that by using technology to change the culture, teachers "are creating classrooms where both they and their students are engaged in authentic efforts at increasing academic understanding rather than going through the more superficial practice of schooling" (p. 25). The use of social networking may add to pedagogical methods that engage both student and teacher. The blocking

of social networking sites in schools has limited the study of the use of social networking tools as a potential instructional method leaving a gap in the literature. The practical goal of this study will be to identify the beneficial aspects of using social networking tools in a rural high school math class from the perspectives of the teacher and students. It is through collaborative research and the focus on contextual meaning for all of the stakeholders that the practical goal will come to light (Maxwell, 2005). The results will help to determine future directions for the employment of social networking tools as an instructional method in my district and beyond.

### **Intellectual Goals**

Maxwell (2005) describes five intellectual goals that are served well by qualitative studies. Of the five goals, "understanding the particular context within which the participants act, and the influence that this context has on their actions" (p. 22) is particularly suited to this qualitative study. Through this study students will be researchers and participants striving to understand how social networking tools can add to the learning experience in a math classroom. The main intellectual goal that will drive this study is: Does the use of social networking tools at the high school level lead to an increase in student engagement? The intellectual goal of this study can be described by the participatory nature and will allow for an understanding of how events and actions are shaped within the context of social networking as an instructional method (Maxwell, 2005).

### **Summary of Research Questions**

I investigated the following research questions as viewed through the lenses of student engagement, online learning theory and guided social constructivism. The three research questions that guided my study are:

1. What are the beneficial outcomes of employing social networking tools in a high school mathematics classroom as perceived by a group of students and teacher in a rural classroom?
2. How might the use of social networking tools and practices increase each of the following, as perceived by students and the teacher:
  - a) participation among students,
  - b) cognitive engagement,
  - c) student motivation to learn
3. What do students believe to be the advantage of social networking for their learning?

### **Document Organization**

First, the introduction presents the problem of practice and the research questions and significance of the study, including the theoretical framework which with which to examine the findings of the study. Next, the literature review presents the bodies of research that helps to discover, inform, and advocate for the research questions and analysis of data (Machi & McEvoy, 2009). Third, the research design presents the research questions and methodology of the study, including the methods of data collection and data analysis. And finally, the findings are presented followed by an analysis and synthesis of the findings, including an analysis of the findings through the lens of the theoretical framework and research literature to date.

### **Theoretical Framework**

This proposed study of the potential benefits of social networking in education is best informed through the field of student engagement in conjunction with online learning theory and guided social constructivism. Each of these theories will serve to emphasize the magnitude of the potential positive implications of social networking.

**Student engagement theory.** According to Mosher and MacGowan (1985), the use of the term engagement in educational research has a surprisingly short history with the first mention in the early 1980s. Since that time there has been a number of studies dealing with the concept of student engagement, yet as Appleton, Christenson, and Furlong (2008) contend, there are tremendous inconsistencies as to the construct of engagement as it is used in various studies. It is with understanding of this divide and inconsistency in the use of the concept of engagement that a definition of engagement is chosen. For the purpose of this study the concept of engagement will follow the work of Fredricks, Blumenfeld, and Paris (2004) defining student engagement in a multi-pronged manner: Behavioral engagement as participation in the education process, emotional engagement as reaction to surroundings including people and curriculum and cognitive engagement as willingness to work toward full understanding of concepts. These three perspectives on engagement can be viewed as a singular idea expressed on a continuum from disengaged to highly engaged (Lohmann, 2009). Fredricks, Blumenfeld, and Paris (2004) suggest that student engagement be considered a "meta" construct due to the overlap of the multiple constructs. The idea of a meta-construct emphasizes both the depth and potential of this view of student engagement.

Each aspect of engagement will provide insight into the effects of social networking tools on student motivation. As the authors of *Engaging schools: Fostering high school students' motivation to learn* (National Research Council (U.S.) and Institute of Medicine (U.S.) Committee on Increasing High School Students' Engagement and Motivation to Learn, 2004) explain:

Engaging adolescents cognitively and emotionally in school and academic work is a challenge regardless of the social or economic status of the students or the location of

their schools. Adolescents are too old and too independent to follow teachers' demands mindlessly, and many are too young, inexperienced, or uninformed to fully appreciate the value of succeeding in school. Academic motivation decreases steadily from the early grades of elementary school into high school, and disengagement from coursework is common at the high school level. (p. 228)

This further supports the use of engagement theory as an important lens with which to view a pedagogical tool that has the potential to motivate high school students.

The effect of student engagement can be viewed from the culture of an institution or classroom in addition to the interpersonal relationships presupposed by previous definitions of engagement. Gary R. Pike and George D. Kuh (2005) summarize that student engagement theory, as a framework, includes research supported assumptions that engagement is "positively related to objective and subjective measures of gains in general abilities and critical thinking" (p. 186). They further postulate that the most important factor of student engagement is based on the practices adopted by learning institutions. The institutional view is not simply a building-level observation but is inherent upon the social reinforcers that have a large effect on behavior that can be witnessed through a peer group, family, classroom or school: The extended classroom can provide an overlap of positive reinforcers of student engagement (Akers, Krohn, Lanza-Kaduce, & Radosevich, 1979; Catalano, Berglund, Ryan, Lonczak, & Hawkins, 2004). The institutional view of student engagement can be seen through the use of the extended classroom that is created through the use of social networking.

The connection between student engagement and student achievement based on a variety of measures was suggested by Carini, Kuh, and Klein (2006). The analysis of student achievement as viewed through the lens of student engagement allowed the researchers to

consider the relationship of student engagement to student achievement from an individual and institutional viewpoint. The results of their study suggest links connecting student achievement and learning outcomes such as critical thinking and academic performance. This position is supported by numerous research studies (Fredricks et al., 2004; Klem & Connell, 2004; J. Lee & Shute, 2010; Skinner & Belmont, 1993). There are many factors of engagement that affect student achievement beyond the meta-construct previously outlined by Fredricks et al. (2004).

Kanevsky and Keighley (2003) suggest "five C's" that are determining factors of engagement: control, choice, challenge, complexity and caring. Each of these factors is directly related to one of the three constructs in the definition of student engagement by Fredricks et al. (2004). Control of success and choice of learning are directly related to the behavioral construct, challenge and complexity are aligned with the cognitive construct, and caring with the emotional construct. Student perceptions of how much choice they have over how and what to learn, as well as their belief in the control they possess to be successful, are noted by many researchers to be key components of behavioral engagement (Blumenfeld, Kempler, & Krajcik, 2006; National Research Council (U.S.) and Institute of Medicine (U.S.) Committee on Increasing High School Students' Engagement and Motivation to Learn, 2004; Trilling, Fadel, & Partnership for 21st Century Skills., 2009). The perception of control by the student can be reinforced by an instructional setting that allows for a "spiral of reciprocity" that allows for a flow between individual and collective work (Salomon & Perkins, 1998). This "spiral of reciprocity" will be a major component in the instructional techniques afforded by the use of social networking tools.

The challenge offered by a particular instructional approach can be characterized by variety of activities and creative outlets afforded by the lesson designs (Kanevsky & Keighley, 2003; J. Lee & Shute, 2010). The variety of activities and approaches to the mathematics

instruction through the social learning and online asynchronous learning communities will allow many voices to raise the level of challenge. Challenge can also be viewed through the complexity of a task or set of tasks. Mikulas and Vodanovich (1993) purport that when levels of arousal are high, a person will look to reduce the arousal; when levels are low, the person experiences boredom. As the researchers further contend, "Optimal arousal level is by seeking out situations whose complexity, relative to the individual, is neither too high nor too low" (p. 4). This aspect of complexity as a factor of student engagement outlines a difficult balancing act between too challenging and not challenging enough. Allowing student autonomy may positively affect how the balance is achieved and perceived by students.

The extension of learning beyond the classroom has been identified by many researchers as integral to increasing and expanding student engagement (Blumenfeld et al., 2006; Persell, 2004; Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003). The extension beyond the classroom is a means to increase student autonomy that has been previously noted as similarly important to increasing student engagement. The extension of learning can occur in many different ways. The use of social networking tools to heighten students' sense of relevance of instruction will provide an opportunity to determine if and how those tools help to increase engagement. Limited opportunities have been given to Belmont High School students for learning beyond the walls of the classroom. The extended classroom for the purpose of this study will not be defined simply as an extension of the school day through school-based activities but an extension that relies on a community of participatory learners that is self-directed, teacher-directed or collaboratively arranged using a variety of tools to provide synchronous and asynchronous opportunities for learning. The collaborative nature of the use of

social networking tools and the asynchronous learning opportunities assist the idea of an extended classroom:

Students are also more receptive to challenging assignments when they can put their heads together rather than work in isolation. Collaborative work also can help students develop skills in cooperation. Furthermore, it helps create a community of learners who have responsibility for each other's learning, rather than a competitive environment, which is alienating to many students, particularly those who do not perform as well as their classmates. (Cohen as cited in National Research Council (U.S.) and Institute of Medicine (U.S.) Committee on Increasing High School Students' Engagement and Motivation to Learn, 2004, p. 51).

Each of the aforementioned aspects of student engagement will help to provide a lens with which the use of social networking tools in a high school math class can be addressed. Each of the factors of student engagement has been implemented into the design of the instruction as the social networking tools are considered. It is these factors and constructs that formulate the unit design to help the process of "enabling a rich fabric of connectivity among people" and "make it possible for people to communicate and interact in multiple media" (Wenger, 2000, p. 232).

**Online learning theory.** A thorough understanding of both the implementation and implications of learning using the tools and practices of social networking will also be required, including, the tools and practices of social networking in both online and face to face environments. This lens will allow me to investigate the potential benefits of social networking by way of providing learners with the opportunity to alter their learning environment in ways consistent with that of applied online learning theory (Hughes, 2004).

The tenets of online theory do not prescribe a particular school of educational thought but rather support numerous schools of thought. As Terry Anderson argues, "Online learning is a subset of learning in general" (2004, pp. 34-35). It is this aspect of online theory that strengthens its position as a theory of learning and therefore as a lens with which to view this study. Chris Dede (2007) posits that behaviorism, cognitivism and constructivism have served to shape instructional design. Each of these schools of thought can play a part in the implementation of social networking in a school setting. Behaviorist thought emphasizes the occurrence of learning as a response to environmental stimulus (Ally, 2004; Dabbagh, 2010). Online learning supports behaviorist thought through the constant feedback from the instructor given a well-implemented curricular design. The implementation of social networking can be developed by providing a wider range of feedback for the learner to respond to. One focal point of cognitivism is that base knowledge is developed by sequencing information and the depth of the processing (Ally, 2004; Dabbagh, 2010; Dede, 2007). This can be achieved via online theory by updating timelines and planning as part of the constant feedback loop associated with quality online learning. Constructivism has seen recent increased attention in online courses (Ally, 2004) and can contribute to the educational use of social networking by allowing students to present and receive information in a variety of ways that will help build connections by providing multiple approaches to a topic. Ertmer and Newby (1993) suggest that the three different schools of thought can be combined with practical applications to address the *what*, *how* and *why* of instructional design. Online theory is suited to unify the three different learning theories by providing appropriate activities based on a learner's particular style. From the concrete to the abstract and from the practical to the theoretical, well-developed online learning materials can supply a range of activities, from peer-based discussion forums to teacher-as-mentor, to allow

student interaction in a number of ways. Ally (2004) contends that, "Online learning can cater for individual differences by determining a learner's preference and providing appropriate learning activities based on that learner's style" (p. 27).

The ability of online social networking tools to engage a variety of learning styles from online theory reinforces one of the biggest draws of social networking to educational environments: the ability of students to choose an appropriate learning style for a more personalized experience. Dede (2007) contends that lack of diverse pedagogical approaches will lead to a continuation of the dropout crisis, which will have a negative effect on U.S. economic growth. Thus, the idea of mediated interaction, which implies the involvement of metacognition and communication, is a neglected skill set that can help online theory provide a rich, challenging learning environment (Dede, 2007). For example, the application of current online theory entails a variety of approaches for the "delivery" of material. One such approach is a discussion board that uses asynchronous communication; Lapadat (2002) cites the benefits as a way to enhance "literate forms of higher order thinking." Having time to reflect and process discussions allows learners to collect their thoughts in a way that would not be feasible in a traditional face-to-face (F2F) setting. The use of social networking tools will allow for asynchronous communication in addition to the traditional face-to-face synchronous discussions of the traditional classroom.

Mayes' (2006) approach to online learning theory supports and encourages social networking in education in each of the "different" breakdowns of interactivity. Terry Mayes (2006) describes interactivity as a "cyclical development" that requires a dynamic flow through concepts, tasks and people. Conceptual interactivity addresses the meaning that learners attach to the new material they are learning. Since social networks can provide many different

approaches to and descriptions of information, learners have more of an opportunity to connect meaning. Interactivity with tasks could be viewed as a dynamic process that changes based on the level of the learner and how the level of structure varies between and among learning tasks. The interaction among people in an online setting is the most important type of interactivity (Mayes, 2006), therefore this informs the basic design of assessments for social networking in education. Anderson (2004) concurs with the importance of interactivity in a theory of online learning and argues that meaningful learning can be accomplished as long as student-student, student-teacher or student-content interactivity is at a high level. Authentic learning can occur when the concept of online discussion, whether synchronous or asynchronous, is viewed with importance and not as superfluous to the learning.

The automation of "routine cognitive tasks" (Dede, 2007, p. 13) by computers has been identified by many as a probable future (Dede, 2007; Friedman, 2007; Pink, 2006) and requires the development of online learning to be geared toward higher-order, more complex tasks. Dede (2007) contends that lack of diverse pedagogical approaches will lead to a continuation of the dropout crisis that will have a negative effect on U.S. economic growth. The idea of mediated interaction, which implies the involvement of metacognition and communication, is a neglected skill set that can help online theory provide a rich, challenging learning environment (Dede, 2007). This further enlightens the possibility of the success of social networking in education by suggesting that knowledge is most effective when "distributed across a community" (p. 16) rather than individually. The call for the increase in the distributed sharing of knowledge for online theory will support and drive the implementation of social networking. If this practice in online theory demonstrates a significant improvement in cognitive processes and complex

problem solving, it will strongly help the case of social networking in education given the collaborative nature of such an endeavor.

The role that the Web is increasingly playing in education is continually expanding to include creative multimedia work in project-orientated teams (Gardner, 2008b; Kelly et al., 2009; Malone & Laubacher, 1998). Given this increasing role of online teams, the importance of explicitly training learners for their roles on online teams cannot be understated (Hurst & Thomas, 2008). Extreme care will need to be undertaken in the training of student to be effective team members during any non-face-to-face meetings. Trust was considered by Hurst and Thomas (2008) to be of the utmost importance to effective online team building. The researchers further contend that "good leadership is essential for building and nurturing cultural conditions that allow trusting relationship to flourish" (p. 465).

The implementation of social networking in education is reliant upon online theory to inform instructional design. There is unanimous agreement among the aforementioned online theorists that online learning cannot simply be instruction from a 20<sup>th</sup>-century classroom placed online if we hope for a positive change in the level and depth of learning. Focus must be on the strengths that online theory can deliver to inform the use of social networking in education. The successful implementation of social networking will hinge on the full development of online learning models that focus not on the medium of instruction but the pedagogical methods and instructional strategies built into the learning tasks (Ally, 2004; Terry Anderson, 2004; Dede, 2007; Mayes, 2006).

**Guided social constructivism.** A historical perspective of constructivist thought will enrich the discussion of its use as a method of learning in the 21st century. Although constructivist theory can be traced back to Giambattista Vico in the 18<sup>th</sup> century (Von

Glaserfeld, 1984), the main force behind constructivist thought is generally attributed to John Dewey and Lev Vygotsky (Popkewitz, 1998). It is these fundamental underpinnings of constructivist pedagogies that will help me gain a broader base of understanding of the historical aspects of the theory. The historical perspective and the changes that have led to the current social constructivist theory will inform a possible future of the theory and its implications for use in online learning theory and social networking.

The terms guided social constructivism and social constructivism often are accepted as a way to describe an unclear approach to teaching and learning (O'Connor, 1998). This view is typically void of any research-based backing. Vygotsky (1978) outlines the importance of the social context of learning and how context effects what is learned by individuals. Vygotsky's concept of the zone of proximal development (ZPD) is in essence the distance between an individual's developmental level and their potential level under the guidance of someone more capable. Glassman (2001) expounds that Vygotsky's zone of proximal development focuses on the need of a "social interlocutor" and that the "role of the educational process is to prepare children for more complex activity in the larger social community" (p. 4). This suggests the social learning model and collaborative problem solving of what is now defined as *social constructivism* (Huang, 2002). Gunawardena et al. (2009) propose the concept of the ZPD expanded by technological tools and social networking tools toward a formation of a group ZPD. The researchers found that "as viewpoints are challenged within the group, individuals may clarify their reasoning, comparing their own ideas with others"(p. 9) and that the peer-to-peer feedback on contributions enhanced the learning process. Goos, Galbraith and Renshaw (2002) similarly found that "when students interacted with each other, their monitoring activity was directed at both their own thinking and the ideas of their peers (p. 207)". The researchers'

concept of *collaborative metacognitive activities* supports the idea of a group ZPD. The idea of a group ZPD enhanced by social networking tools strengthens the use of constructivism as a lens with which to analyze this study.

The Dewey-inspired model of long-term projects suggests a method of education by which students will "eventually coalesce around a topic that is of interest to them" (Glassman, 2001, p. 4). Students will begin to understand through the projects that they are in control of and responsible for inquiry and their personal goals (Dewey, 1916). This viewpoint may suggest a lack of participation of a mentor or facilitator, but Dewey (1902/2001) contends that it is similar to using an explorer's map:

Well, I first tell what a map is not. The map is not a substitute for a personal experience. The map does not take the place of actual journey. The logically formulated material of a science or branch of learning, of a study, is no substitute for having the individual experiences. The mathematical formula for a falling body does not take the place of personal contact and immediate individual experience of the falling thing. But the map, a summary, an arranged and orderly view of previous experiences, serves as a guide to future experience; gives direction; facilitates control; it economizes effort, preventing useless wondering, pointing out paths which may lead most quickly and certainly to a desired result. (p. 115)

It is this aspect of Dewey's theory that defines constructivism in a markedly different way from that of Vygotsky and others.

Many researchers in the sociology of knowledge define social constructivism by addressing the construction of knowledge with a focus on the analysis of the individual's participation as part of a group (O'Connor, 1998). Chris Dede (2007) further defines guided

social constructivism as "students actively constructing their knowledge with instructional support" (p. 21). The long-held practice that places students as passive recipients of knowledge is in stark contrast to the desired implementation of social networking. Social constructivism redefines the roles of teacher and learner in the classroom allowing the teacher to become both a participant in and facilitator of the learning process (Edelson, Pea, & Gomez, 1996). The incorporation of constructivist ideas into a model of social networking will help change the teacher's role as outlined by Richard Prawat (1992), "The traditional telling-listening relationship between teacher and student is replaced by one that is more complex and interactive" (p. 357). Learning outcomes are not pre-established and cannot be fully controlled given the collaborative nature of constructing knowledge in a social setting (Jonassen as quoted in Petraglia, 1998, p. 63). An essential part of lesson design dictated from this view of social constructivism, particularly when technology is figured in, is that students are "free to fail" (Petraglia, 1998, p. 62). This release of control allows autonomy and shifts the onus for learning to the individual.

Sivan (1986) describes social constructivism as a process of skill acquisition, socialization, and an outlook that enables the individual to participate in group settings. The practice of guided social constructivism replaces the individual as the "sole meaning-maker" (p. 211). This belief guides social constructivism by emphasizing the importance of culture on cognitive activity, further removing the emphasis on individual adaptation without regard to the culture of the individual. Sivan (1986) further suggests that social constructivism elucidates the relationship between culture and cognition while pushing the individual toward independent functioning by transferring meaning-making to the individual.

The field of student engagement informed by online theory with guided social constructivism as a pedagogical approach yields a powerful framework to drive this student-

centered, technology-based research. These frameworks are complementary and will enrich the depth of understanding of the essential learning outcomes. Social constructivism can provide a model for the social nature of the research and connect students to their learning while helping to define roles of teacher and students.

## **Chapter 2: Literature Review**

Following a look at the historical use of technology in education, this section is structured around four main categories that cover the reviewed literature. The categories are: (1) Learning Styles; (2) Culture of Learning; (3) 21<sup>st</sup> Century Skill Acquisition and (4) Student Autonomy and Personalization. This section will conclude with a connection between each of the themes as they relate specifically to mathematics education.

*Learning Styles* explores how students learn given varying backgrounds and methods of learning. Although the theme of learning styles is in many ways intertwined with the other themes presented, the implications of different methods of learning and the impact on student engagement will be demonstrated.

The *Culture of Learning* will describe student and teacher responsibility, both inside and outside of the traditional classroom and its impact on the relationship to learning. Scholars have explained the importance of the context of learning and cognition and its connection to the established culture. A culture rich with collaboration provides students with skills and motivation to engage in becoming lifelong learners.

*21<sup>st</sup> Century Skill Acquisition* has been explored by many scholars and will be examined as it relates to the underlying theme of the student motivation and engagement. Included in this theme are connections to each of the other three themes and a look at how preparedness and student anticipation of their perceived future affects student-teacher relationships.

The category of *Student Autonomy and Personalization* outlines the motivation and theory surrounding the role that teachers and students play in learning. The category points to a more participatory approach to the development of when and how students learn, thereby providing motivation for student engagement and relationship building. The impact of anytime-anywhere (asynchronous) learning inherent in social networking on the personalization of education is explored.

### **History of Educational Technology: What is the historical use of technology in education?**

Educational technology as defined by the Association for Educational Communications and Technology (AECT) is: "the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources" ("Reflections on the 2008 AECT Definitions of the Field," 2008). The history of educational technologies could include the introduction of the chalkboard, pens, notebooks, typewriters, radio, and television, among others. Each *new* technology had advocates and cynics as to the potential benefits of the *new* technology. In 1922, Thomas Edison remarked:

I believe that the motion picture is destined to revolutionize our educational system and that in a few years it will supplant largely, if not entirely, textbooks. I should say that on the average we get about two percent efficiency out of schoolbooks as they are written today. The education of the future, as I see it, will be conducted through the medium of the motion picture...where it should be possible to obtain one hundred percent efficiency.

(Cuban, 1986, p. 9)

Since 1922 this viewpoint has continued among proponents of technology integration and has been argued against by skeptics of technology integration as the United States moved along the continuum from film to computers and beyond (Reiser, 2001). As technological processes have

changed throughout the years, the idea that the replacement of an older process by a newer one will likely occur has been a common theme (Reiser, 2001).

Since the early 1960s, computer-aided (or computer-assisted) instruction began to take shape, and by the late 1960s the National Science Foundation (NSF) supported the creation of 30 regional computing networks consisting of over 300 institutions of higher education and high schools (Molnar, 1997). The growth of access to computers continued throughout each of the next four decades with increasing availability. Molnar (1997) concludes, "The world of education has changed from an orderly world of disciplines and courses to an infosphere in which communication technologies are increasingly important" (p. 9). Communications technologies have seen growth over the past 14 years and hold promise as effective "repurposing of social technologies" (Hemmi, Bayne, & Land, 2009). The researchers further suggest that these new social communications "ask us to engage with a new research agenda, [and] continue to work creatively with new pedagogies appropriate to these novel digital spaces" (p. 29).

Saettler (2005) suggests that there have been four distinct paradigms in educational technology use during this century: media view, communications and system concept, the behavioral science-based view, and the cognitive science perspective. The media view represents the use of audio-video equipment for the presentation of material with a focus on the "effects of devices and procedures rather than with the differences in individual learners" (p. 8). The communications and system concept represents the first time that instructional design became the focus to provide a guide to the teaching-learning process. The behavioral science-based view highlights the fusing of human behavior with a scientific approach to the study of implementing educational technology. The cognitive science perspective, the fourth paradigm, represents the move to focus on "the learner not as passive, but as active, constructive, and

playful" (p. 14). It is the fourth paradigm that suggests the benefits of the use of social networking as an effective use and natural progression of educational technology use.

Reiser (2001) contends that there will be greater changes in instructional practices due to the influx of computers with Internet access. Not until the change through the first decade of the 21<sup>st</sup> century did the promise of instructional change through the use of educational technology begin to take shape as the ratio of students to instructional computers with Internet dropped from 12.1 to 3.1 (National Center for Education Statistics, 2010). Although prediction with confidence is difficult, these new technological approaches involving computers and the Internet may provide the level of reform promised in past generations (Cuban, 2001). However, the *next step* in technology integration to include social media and a decentralization of the learning process faces some obstacles that past introductions of new technology have not had to face, namely, legal issues. The State of Missouri recently passed legislation requiring school districts to "promulgate a written policy concerning teacher-student communication and employee-student communication" (Cunningham, 2011, pp. 14-15). The law gives districts the right to ban teachers and current or former students from being *friends* on social networking sites. The law further states that written policy shall be at least as stringent as elements described in Missouri SB 54 and leave an opening for districts to entirely forbid any contact via electronic devices. Similar to proponents and cynics of technology use, legal issues have organizations on both sides of the issue with Manatee Education Association, a Florida teacher's union, challenging the constitutionality of the Manatee school district's policy that regulates teachers' use of social networking (National School Boards Association, 2011). The additional hurdle of implementing social networking given legal issues may halt or slow the progress of use in some classrooms. As Shirley (2011) notes, "Even the fiercest critics of new technologies recognize the difficulty of

going back to an age before the Internet and cell phones" (p. 197). The literature review did not yield any data that suggests that technology has led to an increase in inappropriate teacher-student relationships. Even given the possible constraints, the addition of social technologies has the potential to significantly push the promise of communication technology by incorporating the cognitive and constructive aspects suggested by the aforementioned researchers.

Researchers and educational theorists have persistently made predictions as to what the future may bring for the role of technology in education. Given the speed at which technology is becoming more ubiquitous, predictions 18 months into the future are often dubious, however many researchers attempt to predict what schools will be like 10 to 15 years in the future. Papert (1984) predicted: "There won't be schools in the future. There will be new kinds of social inventions that we can hardly even imagine... I think the computer will blow up the school" (p. 38). While Papert's prediction has not yet come to fruition, the increase in online learning has been tremendous and the full implication of the online social learning potential has yet to be realized.

### **Learning Styles: What does the research tell us are the implications of different styles of learning and the impact on student engagement?**

The term learning styles often elicits a quick emotional response from teachers and scholars as to the efficacy and application of learning style theory. "There is general acceptance that the manner in which individuals choose to or are inclined to approach a learning situation has an impact on performance and achievement of learning outcomes" (Cassidy, 2004). Given this qualitative acceptance, the concept of learning styles has been quantified into inventory form by a number of educational theorists (e.g. R. S. Dunn, Dunn, & Price, 1981; Kayes, 2005; Kolb, 1984). For the sake of this argument the idea of learning styles will be simply a variety of

strategies used to accommodate individual differences in learning (Ally, 2004). These learning styles combine a variety of strategies including: cognitive, metacognitive and behavioral (J. Lee & Shute, 2010). Lee and Shute (2010) identified the use of different learning strategies as being "significantly related" (p. 191) to student academic performance. The use of social networking tools could significantly increase the scope and variety of learning strategies used in education and therefore yields an increase in academic performance. Dede (2007) contends that lack of diverse pedagogical approaches will lead to a continuation of the dropout crisis, which will have a negative effect on U.S. economic growth. Researchers for many years have suggested that without changing our approaches to schooling to adjust to the learning styles of students schools will not meet the challenges of the future. The combination of changing learning strategies and increased student success could have a positive impact on student motivation and engagement.

Many scholars have addressed the idea of changing curriculum and instructional methods to adapt to the cognitive style of students in the ever-changing world, and that this change may be necessary to increase the connection between instruction and relevance to the students (Gardner, 1983; Kelly et al., 2009; Prawat, 1992; Tapscott, 2009). The use of social networking to facilitate the process of altering instructional methods gives students both time and multiple opportunities to reflect upon their learning (Ally, 2004). The opportunity for reflection is a component in the processing of information and is therefore directly tied to the cognitive and metacognitive aspects of learning styles. The reflective aspect of any learning style is paramount to student success and achievement. It has been suggested by many that consideration of what Howard Gardner (1983) would refer to as interpersonal intelligence can and should be developed through the varying instructional methods and learning strategies (Dede, 2007; Gardner, 2004; Gunawardena et al., 2009).

There is evidence to suggest that the use of learning style inventories does little to help the formation of groups and identification of areas for differentiation for individual students. The difficulty on either side of the issue stems from the difficulty in narrowing down the result of a single factor in a complex construct such as learning. Kolb's (1984) Learning Style Inventory (LSI) is a learning style assessment based primarily on experiential learning theory that led to the placement of learners into quadrants based on a processing continuum and a perception continuum as the axes. Other prominent inventories such as the Dunn, Dunn and Price (R. Dunn, 1990; R. Dunn, Beaudry, & Klavas, 1989) LSI break down learning into various strengths or preferences to determine where learners will benefit most through differentiated instruction. While the use of such a learning style assessment seems justified in determining grouping of students by learning style, there has been substantial research arguing against the use of such assessments (Pashler, McDaniel, Rohrer, & Bjork, 2008). The controversy in the research on the validity and reliability of the use of such tests further clouds the potential trustworthiness of using such assessments. Studies that support the reliability and validity such as Kayes (2005) are in direct contrast to earlier studies by Stumpf and Feedman (1981). While there are contrasting views of the efficacy of a learning styles approach from an LSI, what is not debated is that there is no one right way to teach all students and that a variety of methods is beneficial. Regarding learning styles, Schroeder (1993) contends that as educators "perhaps the greatest contributions we can make to student learning is recognizing and affirming the paths that are different from our own" (p. 26).

Discussions of learning styles regained momentum after the publication of Howard Gardner's *Frames of Mind: The Theory of Multiple Intelligences* (1983), which was not written as a contribution to the world of education, but rather as a contribution to his own field of

cognitive psychology. The poor reception by cognitive psychologists of his idea of multiple intelligences and the subsequent acceptance of the idea in the academic world changed the focus of his future works. The later chapters of *Frames of Mind: The Theory of Multiple Intelligences* (Gardner, 1983) addressed the idea of the use of multiple intelligences (MI) in education, yet it was certainly not the focus of the book. While there are psychologists, such as Eyesnck (1998), who contest the ideas of MI theory, the impact of MI theory on schooling has been dramatic (Cuban, 2004). Many aspects of MI theory support the use of social networking in schools, particularly the concept of students using multiple approaches to demonstrate knowledge. The implementation of learning styles or MI in a classroom setting can be overwhelming for teachers or professors if all styles or intelligences are attempted in every class. Felder and Silverman (1988) suggest that attempting methods that seem feasible can lead to a teaching style that is effective for students and "will evolve naturally...with a potentially dramatic effect on the quality of learning that subsequently occurs"(p. 681) .

The concept of learning styles as a method of increasing student engagement and achievement may have new meaning given the increase in online components of classes and with the nature of this study. Diaz and Cartnal (1999) conclude that the learning styles of online students differ significantly from their on-campus counterparts. The researchers found that "faculty will encounter significantly different learning preferences as well as other different student characteristics" (p. 135). The idea of the social learning aspect of the implementation of social networking tools will be informed by this caveat. It is clear that instructional techniques that would be used in a classroom cannot simply be used online without thought or regard for the student learning styles, including comfort with technology. Given the introduction of the Web into the learning style discussion, Ross and Schultz (1999) suggest that:

Independent learners can choose to limit their time collaborating with others, while social learners can choose to spend as much time as necessary on course chat boards, exploring relevant issues and internalizing course material in ways that would not have been possible if it were not for the Web medium. (p. 126)

The Web and the introduction of social networking tools provide both a challenge and an opportunity to implement learning style differences to help meet the needs of all students.

**Culture of Learning: What does the research tell us about the importance of environment and relationships to student engagement?**

The importance of a strong culture of learning cannot be understated in any educational discussion. The cultivation of relationships that embrace interactivity, student self-expression and collaboration is essential to an authentic community (Hadjioannou, 2007). Teachers contribute significantly to the classroom climate and therefore the culture of learning that is put forth. The introduction of online learning and the implementation of social networking tools add another dimension to the need for a strong culture of learning in the classroom. For students to feel connected to a class, a number of factors outside of the individual's control must be in place. Lee and Shute (2010) argue for a bidirectional relationship between social-contextual and personal factors in student achievement due to the culture of learning. Lee and Shute (2010) suggest peer support, norms and behavior as well as the teachers' empowerment and sense of affiliation are variables within the social-contextual factors that are major contributors to student academic achievement.

The idea that a community is a group of people who share a common bond, who learn and interact together and build relationships (Wenger, McDermott, & Snyder, 2002), is of extreme importance to the building of a culture of learning that will extend beyond the classroom

walls to engage students. A strong culture of learning provides not only a framework for student engagement but also a social support to influence learning when schools are academically oriented in that culture (V. E. Lee & Smith, 1999). A strong culture of learning also breaks down walls superficially in place in many classrooms. Newman (2008) points out that, "Traditionally, students who seek help with schoolwork have been characterized as needy and incompetent, whereas those who can accomplish tasks on our own without requiring help are mature and competent" (p. 4). A strong culture of learning can begin to change this attitude to welcome what Newman (2008) refers to as *adaptive help seeking* as an important skill for both resolution of academic difficulties and future learning. This self-regulation strategy can only take place when a supportive culture of learning is in place. The use of social networking tools and the decentralization of knowledge that is a result requires this type of self-regulation and adaptive help seeking.

Individual knowledge and the sharing of knowledge to build knowledge within a community can be facilitated by social networking tools (Gunawardena et al., 2009). This sharing of information can reinforce the culture of collaboration and student engagement. When students feel value in their contributions they are more likely to maintain their contribution in an established climate. Lev Vygotsky's (1978) idea of the zone of proximal development (ZPD) can be expanded when viewed through the lens of a culture of learning that supports collaboration. A collaborative ZPD or group ZPD (Gunawardena et al., 2009) is supported when social networking tools are implemented to establish a shared vision or understanding of learning. This collaborative approach provides students with an additional support system necessary in any culture of learning to allow students to feel safe and more likely to engage in their learning.

A culture of learning must be based on the mutual respect between teachers and students. This idea was reinforced in the experimental study by Joseph P. Mazer, Richard E. Murphy & Cheri J. Simonds (2007) in which they propose that teachers' self-disclosure on Facebook must be consistent with their classroom persona. Lee and Shute (2010) concur with those results by stressing the need for the teachers' sense of affiliation. If students do not feel that a teacher is connected to the material or the class, they would be less likely to engage. Mazer et al. (2007) further contend that social networking sites, such as Facebook, can offer a "unique method to nurture the student-teacher relationship"(p. 71) . The nurturing of the student-teacher relationship provides reciprocal benefits in both personal and social contextual factors important to academic achievement.

Blumenfeld, Kempner and Krajcik (2006) propose that learning environments involving collaboration, technology and student autonomy enhance cognitive engagement. Each of these aspects of a learning environment is part of the construct of lessons involving social networking tools. Factors directly tied to the culture of learning such as, student autonomy, authentic academic work, and instructional format are similarly cited as being of importance to student engagement in a study by Shernoff, Csikszentmihalyi, Schneider, and Shernoff (2003) . Schools cannot remain the same as they were in the 19<sup>th</sup> and 20<sup>th</sup> centuries if those schools hope to be relevant, effective and viable (Kelly et al., 2009). The culture of learning in any 21<sup>st</sup> century school must include a variety of approaches to support relevance and effectiveness, such as: individualization, interdisciplinary approaches, 21<sup>st</sup> century skills, and both synchronous and asynchronous opportunities for engagement (Kelly et al., 2009).

Many approaches to education involve a didactic approach, with knowledge separated from the context of the knowledge acquisition (Brown, Collins, & Duguid, 1989). Brown et al.,

(1989) suggest that the culture of a school can show improvement with activities and instructional techniques that "make deliberate use of the social and physical context" (p. 32) that is consistent with research in learning. Brown and colleagues further suggest that to improve on the collaborative nature of social learning students must be explicitly taught collaborative work skills (p. 40). The concept of explicitly teaching collaborative work skills is extremely important to establishing a culture of acceptance and student feelings of worth. As Ames (1992) suggests, "Students' perceptions of their ability appear to be especially responsive to social comparison information" (p. 264). Therefore, it is particularly salient to make sure that lack of ability to collaborate is not a major inhibitor of success on mathematical tasks that would involve collaboration.

### **21st Century Skill Acquisition: How can 21st-century skill acquisition help to engage students?**

The importance of 21<sup>st</sup> century skills for participation in the global society has been noted by numerous scholars and reports (Ally, 2004; Greenhow, Robelia, & Hughes, 2009; Kelly et al., 2009; "Partnership for 21st Century Skills," 2009; SETDA, 2008; Stoskopf, 2010; Zhao, 2009). One aspect of student engagement is that of relevance. Students of this generation are growing up in a digital world with very different expectations than those of the previous generation during the industrial age. Antonio Battro (2004) views the "profound change in education in this century...as the unfolding of a very powerful intellectual capacity" (p. 94) being driven by digital tools and the human interaction afforded by these tools. Students use a variety of digital tools outside of school every day; if we do not embrace the use of these tools and the skills developed by these skills we will miss opportunities to engage the students in learning.

According to the Pew Internet and American Life Project (2010), 93% of teens ages 12-17 go online. Acknowledgement and use of this aspect of student life will help foster the relationships and culture that will contribute to student engagement and motivation. Yong Zhao (2009) stated, "the virtual world is as real as the physical world, psychologically, economically, politically, and socially" (p. 128). It is this reality that students live in and our hopes for engagement must account for this change in lifestyle of generation next.

The assumption cannot be made that because students have the "digital native" label that they are prepared to participate in this new global community (Zhao, 2009). Relationships must be built to support and foster a 21st century skill set. While care should be taken to support and foster the skill set, there is evidence that digital skills are found in infants and that there is a "digital intelligence" just waiting for the right technological tools (Battro, 2004).

The three critical learning skills of the 21st century, according to Trilling, Fadel and Partnership for 21st-Century Skills (2009), are critical thinking, communication and collaboration, and creativity and innovation. Trilling et al. (2009) propose that the application of critical thinking and problem solving to content knowledge leads to improved motivation and learning outcomes. Communication, particularly with the greater community, regarding the importance of how students learn as opposed to the learning of content that will soon be out of date will be of significant importance (Friedman, 2007). Communication with the greater community can be accomplished through the use of emerging technologies like social networking and have the potential to increase student motivation. Studies by Junco, Heiberger, and Loken (2010) and Yu, Tian, Bogel and Chi-Wai Kwok (2010) suggest a positive effect on engagement and motivation for students involved in the use of social networking tools. The use of social networking tools in education necessitates the need for students to collaborate and

communicate their knowledge to a larger audience, which is contrasted by past practices involving work shared only between the student and the teacher. The sharing of learning in a larger community "encourages deeper engagement with learning through the act of authoring, simply because of the awareness of an audience, no matter how virtual or tentative, encourages more thoughtful construction of writing" (Jacobs as cited in Wheeler, Yeomans, & Wheeler, 2008, p. 987).

Creativity is of the utmost importance as routine work can become automated or outsourced in the near future (Friedman, 2007; Pink, 2006). This necessary skill for success in the 21st century is fostered in learning environments that consist of high levels of trust and openness, and encourage questioning (Trilling et al., 2009). Robinson (2006) contends that schools, as they currently operate, kill creativity and that to serve the best interests of students and society as a whole, schools must foster and nurture creativity. The processes of allowing students autonomy and a personalized educational experience and expanding the audience for students may result in an increase in creativity as students become more engaged in their learning.

**Student Autonomy and Personalization: What effect do personalization of education and a shifting of instructional decision making have on student engagement?**

The term personalization is used in a number of different ways in literature. While the commonly accepted connotation of personalization in education is that of flexibility and individualization with levels of learner control, Pykett (2009) suggests "personalization is not simply a neutral and practical set of classroom activities which will necessarily benefit individuals" (pp. 375-376). Pykett (2009) suggests that politics of educational policy-making

push a neo-liberal agenda toward privatization under the guise of personalization. Leadbeater (2004) assigns a more constructive view of personalization:

Personalised learning does not apply market thinking to education. It is not designed to turn children and parents to consumers of education. The aim is to promote personal development through self-realisation, self-enhancement and self-development. The child learner should be seen as active, responsible and self-motivated, a co-author of the script which determines how education is delivered. (p. 70)

The concept of students as co-authors is particularly relevant to the introduction and implementation of social networking tools. Personalization, according to Gardner (1995), can be witnessed when curriculum, pedagogy and assessment are carried out with individual differences in mind as much as possible.

One way in which individual differences can be carried out through instructional methods is through the use of asynchronous learning networks. According to Moore, Sener and Fetzner (2009), the use of asynchronous learning networks has steadily increased since the expansion of the Internet and has the potential to become as ubiquitous as the Internet within the next ten years. Student autonomy is enhanced through the use of anytime-anywhere learning associated with asynchronous learning networks by allowing students the option of when to learn and collaborate. Ally (2004) contends that this type of learning allows for "interaction between the learner and other learners, between the learner and the instructor, and between the learner and experts to collaborate, participate in shared cognition, form social networks, and establish social presence" (p. 38). This approach to learning, inherent in social networking, allows for personalization by giving students the opportunity to interact as they see fit. Adena M. Klem and

James P. Connell (2004) suggest that the creation of a more personalized learning experience increases student engagement in the learning process.

Yu, Tian, Vogel and Chi-Wai Kwok's (2010) study on the impact of online social networks identifies the positive effect on students' self-esteem and self-concept as a result of properly implemented social networking. The study implies that the relationships built among students will fulfill many social needs and skill development leading to an increase in learning outcomes consistent with increased engagement.

Ellen A. Skinner and Michael J. Belmont (1993) contend that student engagement is optimized when certain needs of students are met, including social interaction and autonomy. They further conclude that the relationship and interaction between teacher and student has a profound effect on student engagement. Given these conclusions, the reform of educational approaches to include an increase in social interaction and autonomy would yield an increase in student engagement.

In *Catching up or Leading the Way*, Yong Zhao (2009) points out that student voice is a crucial element of personalized learning. He contends that implementing personalized learning by embracing the idea of student voice is carried out by restructuring classes and classrooms and through the creative uses of new (or existing) technologies. The importance of creativity and the development of social skills in virtual worlds are denoted as important to student engagement. Zhao argues for personalization to foster "well-rounded human beings" (p. 198) who will be confident and unique in their education.

The process of giving students autonomy to demonstrate their knowledge will give teachers and students more creative ideas to advance the required 21<sup>st</sup> century skill set, including initiative and self-direction (Trilling et al., 2009). Personalization requires students to have

autonomy but also to have useful feedback on the product and process of their learning to facilitate their ownership and connection to the learning outcomes (Kelly et al., 2009). As an extension of personalization and affording students autonomy in their learning, Shirley (2011) suggests that:

Beyond the customization and personalization of education through technology may lie something grander: schools that help our young people to find the personal passions and cultivate them in a manner that takes them deep into the core of what it means to be human. (p. 206)

### **Connections to Mathematics Education**

Among the calls for the reform of mathematics education, the inevitable call for equity for all learners is paramount (Carey, Fennema, Carpenter, & Franke, 1995). Groups concerned with learning styles contend that the idea of equity for all learners necessitates the use of diverse curricula and instruction across many learning styles (Carey et al., 1995). However, the research suggests that there is not a causal link between differentiated learning style instruction and improved learning (Tiedemann as cited in Carey et al., 1995, p. 95). Although Carey et al. (1995) suggest a position against learning styles to increase learning, they continually discuss the need for recognition of individual learning differences, which suggests that their stand may be a matter of semantics.

The archetypical math class establishes the solving of word problems as a demonstration of "what real mathematicians do" while the syntax and delivery of those problems is contrived and not closely related to what practitioners do (Brown et al., 1989). A culture born of authentic tasks and social interaction will provide a rich experience for students (Brown et al., 1989). To be truly successful in mathematics "students need much more than abstract concepts and self-

contained examples" (p. 34). The focus on "mathematical ways of knowing, rather than on mathematical knowledge" (Cobb & Yackel, 1998, p. 166) allows for a culture of inquiry to develop. The culture of inquiry and collaboration allows for the class to experience a connectedness based on the teacher's willingness to be empathetic to social and cognitive aspects of this group relationship (Raider-Roth, 2005).

There is little debate about the importance that mathematics will play as we continue into the 21<sup>st</sup> century. According to a State Educational Technology Directors Association (SETDA) (2008) report, 15 of the 20 fastest growing occupations will require significant training in math and science. The debate occurs in how we, as a nation, can best prepare our students for the 21<sup>st</sup> century. Schoenfeld (2004) in *The Math Wars* outlines the swing between traditional and reform efforts throughout the past century, which provides a historical perspective that demonstrates that these "arguments" should be set aside to find middle ground, thus beginning the process of better preparing students for the 21<sup>st</sup> century. Ball (2003) suggests that the key to the future of mathematics instruction lies in our practice of thinking about and working with mathematical tools and ideas. Given the changing mathematical tools and ways to think about mathematics, it will be more important than ever to embrace the learning and innovation skills outlined by Trilling, Fadel and the Partnership for 21<sup>st</sup>-Century Skills (2009).

The personalization of mathematics can be viewed from many perspectives. One way that personalization can be accomplished is by rewording word problems to incorporate information about individual students (Davis-Dorsey, Ross, & Morrison, 1991). This simple process suggests that the personalization may be a way to motivate students in math class. The development of intellectual and social autonomy in mathematics has been addressed as a goal of reform efforts over the past two decades (Cobb & Yackel, 1998). Intellectual autonomy in

mathematics is suggest by students who are cognizant of and use their own capabilities to make mathematical judgments (Kamii as cited in Cobb & Yackel, 1998). The use of social networking tools may help to provide a personalized approach as students work together to take ownership of their work and begin to demonstrate their individual strengths.

### **Implications for Further Research**

There is limited research surrounding social networking as an instructional method, but it is apparent from this review of literature that the potential impact of including social networking in a well-developed curricular approach is tremendous. It was clear from the review that relationships are a key component of student engagement. It is further demonstrated that social networking provides an avenue to improve student-teacher relationships. A number of views of that relationship building, such as personalization, relevance and collaboration demonstrated this link to student engagement.

The importance of relevance to the student in light of the ever-changing emerging technologies available to 21<sup>st</sup> century learners and how that impacts relationships between student and teacher was well established. This raised questions of the appropriate use of new technologies and learning approaches given the collaborative and social nature of "generation next." The breaking away from a teacher-centric model to include a more social learning methodology that encompasses more than one "expert" in an area was clearly established throughout the review. The review of online theory demonstrated a need for a varying approach to educational methodology, particularly in light of the increase in the use of emerging technologies. The determination of the proper blend of constructivism and teacher-directed approaches given the introduction of social networking into the educational landscape would be prudent in future research.

A longitudinal study involving the identification of student engagement factors from the use of social networking as an instructional method could remove the novelty factor of the introduction of social networking. Factors such as student and teacher comfort with social networking were noted in the review as contributory to the success of the implementation of social networking and should also be considered.

It was demonstrated that personalization increases student motivation and engagement in the learning process, and the review established that social networking personalizes education and therefore infers a relationship between social networking and motivation. The review further demonstrated a clear link between the educational aspects of social networking with the formation of improved student-teacher relationships important to increased student engagement. While there was no research that could articulate a direct causal relationship between social networking and increased student engagement, further research should investigate if such a relationship exists.

### **Chapter 3: Methodology**

The ability of online social networking tools to engage a variety of instructional and learning methods from online theory reinforces one of the biggest draws of social networking to educational environments: the ability of students to choose an appropriate time, place and method of demonstration of knowledge for a more personalized experience. Furthermore, the use of participatory evaluation will establish students as researchers with a voice in, and ownership of, the learning process.

#### **Research Questions**

The three research questions of this study are:

1. What are the beneficial outcomes of employing social networking tools in a high school mathematics classroom as perceived by a group of students and teacher in a rural classroom?
2. How might the use of social networking tools and practices increase each of the following, as perceived by students and the teacher:
  - a) participation among students,
  - b) cognitive engagement,
  - c) student motivation to learn
3. What do students believe to be the advantage of social networking for their learning?

Regarding the first question, student engagement theory provides a framework for analyzing the beneficial aspects of a change in instructional methods in a mathematics classroom. It provides the basis for successful implementation of a collaborative work environment that frames the first question.

The second question combines aspects of both online theory, as well as social constructivism, in that each theory is linked to student attitude. Each theory addresses the "how" of the learning experience and is therefore pertinent to the framing of the second question.

The third question blends student-engagement theory and social constructivism as students reflect on their learning. Each theory provides insight into how students construct knowledge and what impact their learning style has on their engagement.

### **Rationale for a Qualitative Design**

The research questions are process questions due to the fact that they seek to answer "how" questions and are attempting to search for answers as to how students experience the use of social networking tools as a method of learning. Additionally each question "involve(s) an

open-ended, inductive approach" (Maxwell, 2005, p. 75). This necessitates a qualitative approach to the research. The research plan cannot be overly prescriptive, and this emergent design is characteristic of a qualitative approach (Creswell, 2009; Maxwell, 2005). According to the National School Boards Association (National School Boards Association, 2007) publication, 52% of schools have an outright ban on social networking and 84% ban any type of online chatting, which is a fairly significant part of social networking activity. Therefore, the relatively untested use of social networking would not lend itself well to quantitative design due to a limitation of sample size.

The qualitative strategy of inquiry requires more specificity to move toward a research design. Participatory evaluation can be defined as "a partnership approach to evaluation in which stakeholders actively engage in developing the evaluation and all phases of its implementation" (Zukoski & Luluquisen, 2002, p. 1). Gawler (2005) points out that participatory evaluations are "solution-orientated--they do not dwell primarily on problems, but rather on learning lessons from both successes and failures" (p. 2). Greene (1986) suggests many different purposes for the use of participatory evaluation, including "increased utilization of evaluation results" (p. 2) and "empowerment of especially lower status stakeholders" (p. 2). Participatory evaluation will allow students to be researchers in the process of implementing social networking tools into the high school math class. The process will create a learning environment that allows evaluation findings to be processed and immediately used for the betterment of the learning process (Garaway, 1995). According to Cousins and Whitmore (1998), the systematic inquiry afforded by this form of "practical" participatory evaluation will allow for the evaluator and participants to be in partnership, with deep participation by the primary users (in this case the evaluator and the students). Additional benefits of this method are

discussed by Gawler (2005) and include: promoting learning, increasing communication among students and with adult stakeholders, building mutual responsibility, and giving students a sense of ownership. It is within this realm that my research questions are best addressed. The above mentioned characteristics make participatory evaluation particularly applicable to my research goals and questions. The flexibility of the method to allow adjustments to research questions/methods/approaches is a major strength given the changing nature of social networking and the students' adaptation and input.

The "purposely selected participants" (Creswell, 2009, p. 178) in the study were a group of high school freshmen in an Algebra II class and were chosen as the *actors* for their access to materials required, willingness to be part of the research, and structure of having the same instructor to eliminate differing approaches as a variable.

### **Site and Participants**

The study was conducted in a rural high school in central New Hampshire of approximately 450 students in grades 9-12. The school is the only high school in a four-school district of approximately 1,500 students. There are two elementary schools and one middle school that feed into the high school. The school demographic makeup is consistent with similarly sized schools in New Hampshire. I purposely picked this school due to the nature of participatory evaluation and my access to the participants for this shared research study. The results of the study will help to guide future instructional decision making regarding social networking tools in this school and beyond.

The participants in this study consisted of: one class of 15 freshman students from an Algebra II class, myself as researcher/participant, and one other doctoral student to assist with coding and observation. The student participants may have previous knowledge of the

researcher through older siblings or friends. All students agreed to be participants in the focus groups, and there were 4-5 students in each group to allow maximum participation by each stakeholder.

### **Data Collection**

The data collection for this study took place during two, two-week units in the fall semester of the 2011-2012 school year. The units were taught using social networking tools as the main instructional method. Following the first unit involving social networking tools, a follow-up discussion took place in focus groups to assess how the class use of social networking tools could be improved (see Appendix B). In addition, data collected addressed indicators of student learning and engagement in two categories: student work with corresponding assessment rubrics and observation of student participation in class and online. Daily observations in the form of teacher field notes were also reviewed. A variety of data collection techniques were employed including:

- *Preliminary survey.* A preliminary survey was given to students to identify what exposure they have had to social networks in and out of a school setting to provide a basis for initial grouping of students into focus groups. (See Appendix A.)
- *Focus groups.* Focus groups of 4-5 students were used during the mid-review at the end of the first two-week unit and at the conclusion of the two unit study. During both the mid-study review and final review, students were asked about their perceptions of the benefits of the social networking tool in helping them to learn math as well as cautions and other comments regarding its use. The mid-study focus groups identified and evaluated the implementation of the first unit and identify

relevant questions and direction for the second unit (Zukoski & Luluquisen, 2002).

(See Appendix B)

- Recorded observations. Recorded observations by a volunteer second doctoral student during targeted classes as well as the teacher through use of daily field notes (directly after teaching classes as well as through observation of classroom videos) allowed for the emergent nature of participatory evaluation. In this way, observations were carried out in two distinct ways, observation as participant and observation as an observer (Creswell, 2007).

**Survey.** The use of a pre-study survey was used to determine students' background in the use of social networking tools, their comfort level with technology, and their basic feelings of engagement in previous math classes.

**Focus groups.** The interview protocol for the focus groups followed the guidelines of Seidman (2006) and of Krueger (1998). Seidman (2006) points out that "interviewing is both a research methodology and a social relationship" (p. 95) and should be treated as such. A balance is necessary between an "I-Thou" relationship and a "We" relationship when interviewing, and a balance to preserve the autonomy of the student participants' words will be carefully considered (Seidman, 2006). The interview protocol questions will follow Krueger's (1998) suggested categories of introductory, transition, key, and ending. (See Appendix B)

**Observation.** Observation is a customary part of formative assessment in my mathematics classes and continued to be as part of this study. The observation of face-to-face engagement was assessed using an observation rubric by a second volunteer doctoral student (see Appendix C) as well as a review of classroom videos. In addition, online participation and observation was assessed using a participation rubric for online work (see Appendix D). Quality

of work was measured according to traditional grading standards and individual assignments had corresponding rubrics as needed.

### **Data Analysis**

Analysis of the varied data from the participatory evaluation required an interactive, iterative approach. After gaining a general sense of the data from the varied sources, data was transcribed and coded. The codes was analyzed according to Creswell's (2009) suggested breakdown of codes: expected, surprising, unusual, and those that have a larger theoretical perspective. A combination of predetermined and emerging codes was used to guide the coding process (Creswell, 2009). *In Vivo* was used as the first cycle coding method due to its strength in educational studies involving youth that will "prioritize and honor the participant's voice" (Saldaña, 2009, p. 74). The second cycle coding method was *Pattern Coding* for its appropriateness in the development of major themes and for patterns of human relationships (Miles & Hubberman as cited in Saldaña, 2009, p. 152). MAXQDA, a qualitative data analysis software package, was used to help develop theories based on the codes and themes that emerged from the data.

### **Validity and Credibility**

There are a number of ethical considerations that were addressed in this participatory evaluation study. First and foremost was the process of informed consent to provide participants with written information about the purpose of the study, the voluntary nature of the study, data usage, etc (Creswell, 2009; Stringer, 2007). Similar to action research, participatory evaluation requires a more diligent than usual attempt to be sure that "processes are inherently transparent to all" (Stringer, 2007, p. 55) given the participatory nature of the research.

The utmost care was taken to maintain a style of unbiased language in accordance with the APA Publication Manual (American Psychological Association., 2010). One particular area of concern is my role as teacher of the small group of students who were the participants in the study. Students were given the option to opt-out of the study but care was needed to be taken to avoid the view of coercion given my duties as teacher of assigning grades and also, that the study occurred during class time. Given the highly collaborative nature of this study, participants were considered co-researchers and therefore any hints of coercion were handled given the reciprocity that is a result of the participatory evaluation (Creswell, 2009).

While there is no way to remove researcher bias and subjectivity from any study, quantitative or qualitative, a realization of the existence of my biases and their effect on the study was crucial to the integrity of the study (Maxwell, 2005). Validation strategies suggested by Creswell (2007) were employed to help provide validity to the study. The first validation strategy I used was *clarifying researcher bias* at the inception of the study to help make my position and biases explicit for participants (Creswell, 2007). As a math teacher and technology integrator, I believe that technology can be a help or a hindrance depending upon its use. I have used various constructivist approaches with varying degrees of success. There is no one best way to teach all students, but it is my belief that using approaches that allow students to have a voice will better prepare them for the ever-changing global community they will be part of. Given the above clarification of my past experience and bias, I believe that the closeness and participatory nature of the study, as well as my 20 years of experience as a teacher, allowed me, as a researcher, to view the collected data with as much objectivity as possible.

The second validation strategy described by Creswell (2007) that I employed was the use of *member checking*, whereby the participants provided feedback based on the preliminary

analyses of the data. Allowing the participants this additional opportunity to have an influence over how and what is said may have led to additional feelings of ownership as well as increasing the validity of the study.

### **Protection of Human Subjects**

All participants had signed letters of consent from their guardians and were offered a pseudonym to guarantee confidentiality. All data collected was held in confidence, and there was no personally identifiable information used in publications that describe the study (Fraenkel & Wallen, 2009). All audio recordings and research materials were digitally secured on one laptop and backed up on a secure cloud-based storage service. There is no possibility of harm to the participants as observation, small and whole group discussions, and group work are all an accepted part of school practice at the study site (Fraenkel & Wallen, 2009). As suggested by Creswell (2009), all participants will be offered access to a preliminary copy of any publication that comes out of the research. This research project is in full compliance with Northeastern University's Institutional Review Board (IRB) policies.

### **Conclusion**

The current state of education does little to address the growing issues facing students of the 21<sup>st</sup> century as the new global community and *flat* world require more skills of collaboration and creative problem solving (Friedman, 2007; Pink, 2006). Engaging students and motivating them to collaborate and communicate ideas is one technique to help prepare them for the uncertain future. Implementing social networking tools into a high school math class has potential benefits in this regard. When viewed through the lenses of student engagement, online learning theory and guided social constructivism, this study gains new insight and depth to examine the research questions.

Participatory evaluation provided a qualitative research approach with many benefits to the stakeholders, school community and a potentially larger community. Students, as stakeholders and researchers had a voice and became actively engaged in the process of evaluating and learning. It is this interaction and approach that informed the research questions and provided a richer study. A two-unit approach, with time in between to make adjustments based on participant input, provided the participant-researchers not only the opportunity to suggest changes to the instructional method but also to see those changes adapted right away. This iterative process allowed the participants an empowerment in a democratized process of learning (Garaway, 1995).

Students' cognitive engagement, participation, and motivation to learn, as well as their perceived advantages in using social networking tools, were addressed through this study. The learning process will be inextricably linked to social interaction as we continue into the 21<sup>st</sup> century (Howard, 1996), and this study seeks to provide insight into this aspect of the learning process.

#### **Chapter 4: Report of Research Findings**

The purpose of this chapter is to report and discuss the key findings from the research conducted over a one-month period in a rural high school mathematics class. The first section provides a brief review of the study context and defines technical terms associated with the study. The second section presents the pre-study survey data. The next three sections present emerging themes as connected to the research questions using the researcher's field notes, classroom observations, teacher-student discussions, and focus groups. The final section presents a summary of the key research findings.

### **Study Context**

Social networking has many connotations for different groups of people. For the sake of this study, the idea of social networking will be defined as any service that allows individuals to construct a personal or professional profile, connect with other users with whom they share a connection, and collaborate with or share information among participants (boyd & Ellison, 2008; Lange, 2007). This study used two such social networking sites, Edmodo and Google Docs. Edmodo is a secure social networking site designed for schools that features a Facebook-like interface, which allows students to message each other. Edmodo allows members of the community to share links or videos to foster discussion among individuals, small groups or the community as a whole. Google Docs “is an easy-to-use online word processor, spreadsheet and presentation editor that enables you and your students to create, store and share instantly and securely, and collaborate online in real time” (Google, 2011). Students were introduced to Edmodo one week before beginning the study and were introduced to Google Docs as part of a freshman course in Information and Communication Technology (ICT) but had not used either in any formal way prior to the study.

Student voice and input was an essential component of the study and was elicited both formally and informally during class, small group discussions, focus groups, and personal reflections. The study took place over the course of one month and involved two units, one chosen by the teacher and the other decided upon by the students. A period of one week between the units was spent on a traditional, instructor-led unit. This break allowed the instructor (who was also the researcher) time to implement changes to the method suggested by results from the first focus group session after the first unit that implemented social networking tools.

### Pre-Study Survey Results

The pre-study survey (see Appendix A) involved students from a relatively homogeneous group of 15 freshmen mathematics students with varying levels of self-reported technological knowledge and comfort. The survey was given to students to help determine placement in focus groups and to establish a baseline for the students' general perspectives regarding mathematics and their use of technology. The researcher believed this to be important because if there was a large discrepancy regarding comfort with technology those students with less comfort may struggle with the online component. It was important to make this differentiation so that proper intervention and guidance can be offered to individual students. Similarly if there was a group of students with less comfort with technology and at the conclusion of the study that same group had similar experiences it would have provided another angle for analysis. The student responses to their confidence in mathematics would have yielded a similar rationale for the survey. The following figures represent the data collected in the pre-study survey regarding student self-reported comfort and abilities in mathematics and with technology.

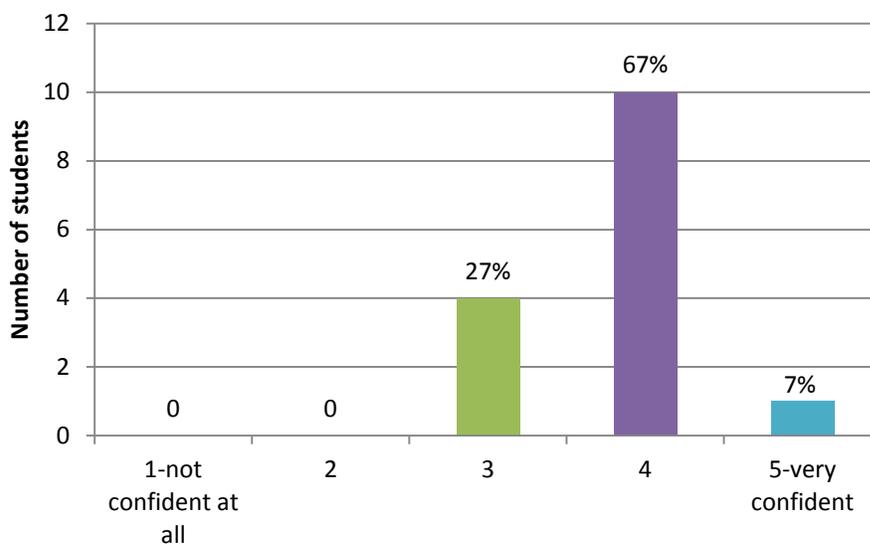


Figure 1. How confident are you in your abilities in math?

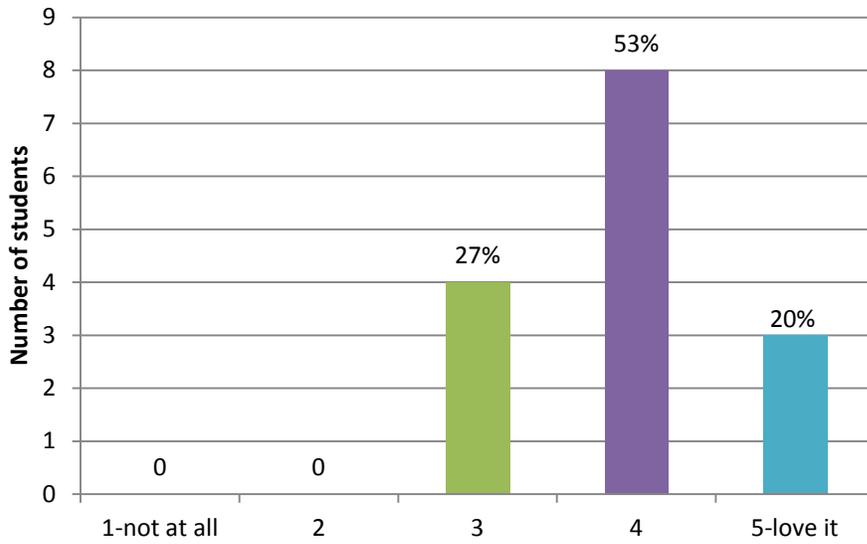


Figure 2. How much do you like math?

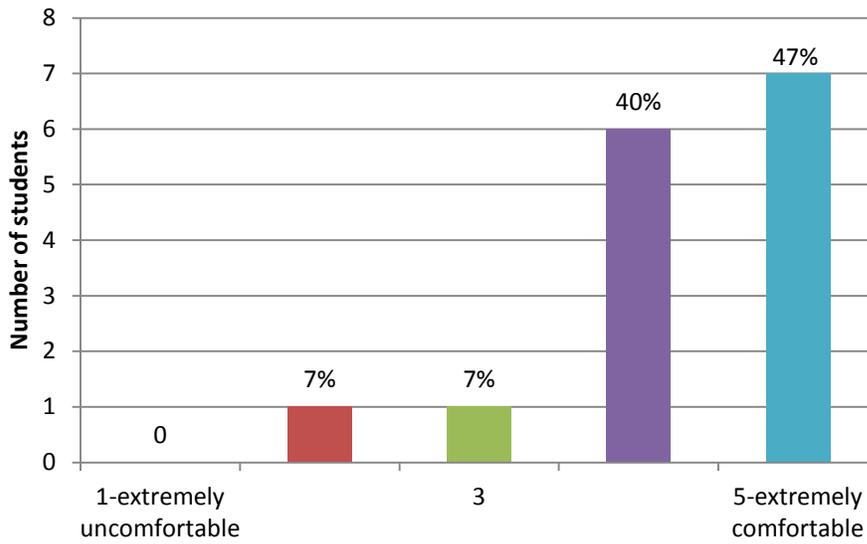


Figure 3. How comfortable are you with technology?

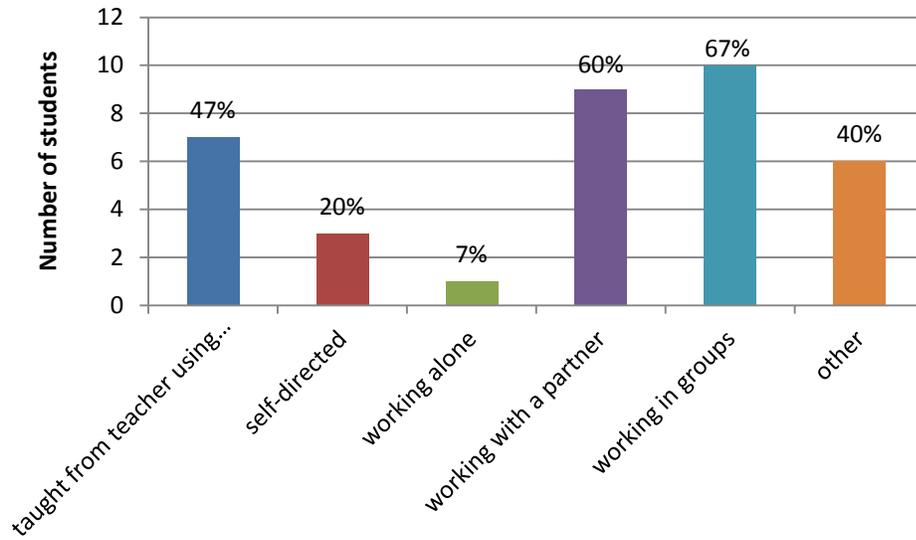


Figure 4. How do you feel you learn best?  
 (Note: percentages add up to more than 100% due to multiple answers by participants.)

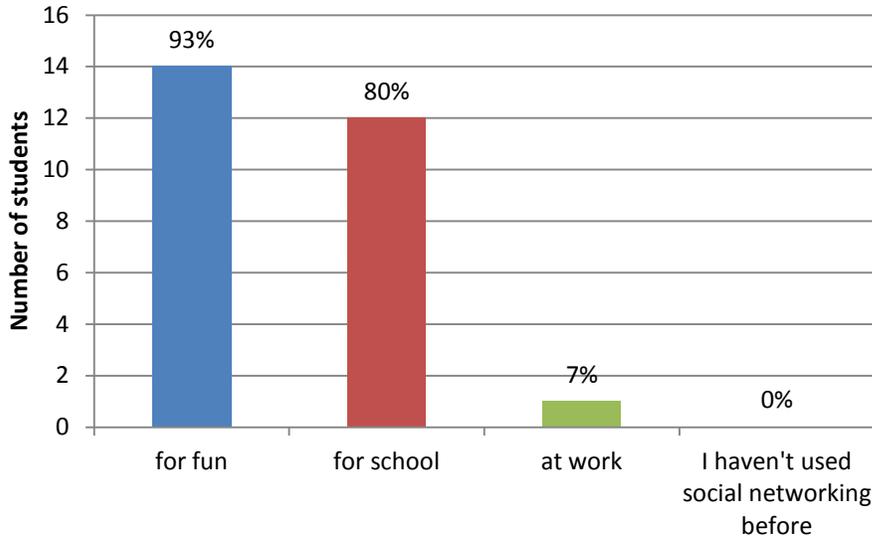


Figure 5. In what ways have you used social networking?  
 (Note: percentages add up to more than 100% due to multiple answers by participants)

As indicated in Figures 1-5, the class consisted of students who were relatively comfortable with technology and mathematics. The majority of the students had dealings with social networking either in a school or social environment. Therefore collaboration with one person or a group of people was cited by the majority of the students as favored methods. Nonetheless, the teacher and teacher observer were careful to make sure that technology was not a barrier to collaboration and the students were able to approach the learning of material without issue. Table 1 identifies individual responses and helps connect individuals to their quotes.

Table 1

*Participant Basic Information*

Alias	Use of Social Networking	Comfort with Technology	Like Math	Confidence in Math	How do you feel you learn best?
Carson	Fun	3	3	4	d, e
Gary	Fun, school	5	4	5	a, d, e
Bill	School	5	5	4	b, e
Patty	Fun, school	4	5	5	b, d
Maria	Fun, school	4	4	4	a, d, e
Caden	Fun, school, work	5	4	3	b, d, e, f
Nathan	Fun, school	4	5	4	a, e
Chloe	Fun, school	5	4	4	a, d, e
Jodi	Fun	2	4	3	e
Annie	Fun, school	4	3	3	a, c, e
Mary	Fun, school	5	3	4	a, d, e, f
Drew	Fun	5	3	4	f
Ian	Fun, school	4	4	4	f
Aiden	Fun, school	5	4	4	a, d
Ben	Fun, school	4	4	4	e, f

Note: Each of the categories: comfort with technology, like math and confidence in math were asked rated on 5-point Likert scale, with 1 being least and 5 being the greatest. For the category, "How do you feel you learn best?"; a- taught from teacher using notes, b- self-directed, c- working alone, d- working with one partner, e- working in groups, and f- other.

### **Unit Content and Method**

Before the study, students discussed how group formation should occur within the social network. The class suggested that the first unit on matrices would consist of learning teams that they would choose. It was agreed that movement among the groups would be possible and encouraged. They felt that the second unit should consist of learning teams chosen at random with the same idea that movement would be possible.

The first unit on matrices was set up with virtually no direct instruction. Students connected to the information and each other via Edmodo, Google Docs and face-to-face during class time. Students found assignments on the Google calendar on the class website or on Edmodo. A video would often accompany the lesson. The videos were made by the researcher and personalized for the class and contained instruction via a screen capture of a lesson done on a SMART interactive whiteboard to demonstrate examples that were then uploaded to Edmodo to allow individuals to reflect or comment on the videos. Students chose their own groups based on whom they felt they could have the best working relationship with, and the groups were intended to be fluid to allow students to go to different groups to help facilitate the learning. Students were encouraged to ask questions of their small groups as well as the whole group. They were also encouraged to use a variety of resources including online and traditional print materials to facilitate their learning. Table 2 represents a daily topical breakdown of the matrix unit with how a particular topic was approached. Each day a suggested workflow of problems from the textbook, online resources, and teacher-created materials was outlined and given to students. Students and groups of students were given the flexibility to decide how many problems they would do to sufficiently understand the material.

Table 2

*Topical Breakdown and Use of Social Network in the Matrix Unit*

<b>Day</b>	<b>Topic</b>	<b>Approach and use of social networking tools</b>
1	Introduction to matrices	Video posted on Edmodo students took online poll as to the effectiveness of the video. Group assignments posted on Edmodo.
2	Multiplying matrices	Video posted on Edmodo. Problem posted with authentic applications covering the basics of matrices and multiplication.
3	Multiplying matrices cont.	Students continued work on authentic problem and traditional "book" problems. Answers to all assignments from the previous two days were posted. Students took an online poll regarding their ability to absorb the material to this point.
4	Determinants and area of a triangle	Unannounced quiz on the material thus far video posted on Edmodo.
5	Code making and code breaking	Learning teams share a Google Doc to discuss/teach inverse and identity matrices to their team. Teams message teacher regarding preparedness in code making and breaking.
6	Code breaking scavenger hunt	Teams compete in a code breaking scavenger hunt around the school as an assessment.
7	Solving systems of equations	Teams share a Google Doc to discuss systems of equations with matrices compared to other algebraic methods.
8	Augmented matrices/group review	Student conducted review where teams of students were responsible to generate review items for a particular topic from the unit.
9	Unit assessment	Traditional pencil and paper test.

Students were given a choice for the second unit from a list of three topics. The students chose to study probability. The unit was set up similarly to the first unit on matrices. Minor modifications were suggested by the students and implemented into the design and execution of the second unit. Students suggested that all assignments be posted and accessible from one central location. The group decided to use the shared Google calendar as the "home base" for all assignments, and that Edmodo would be used for messaging and small and large group questioning and discussion. They also decided that Google Docs would be used for sharing information as well as for synchronous and asynchronous collaboration for learning teams. Based on student suggestion, the assessment for the unit was broken down into three sections: a group test using Google Docs as the delivery method, a multiple choice test using a student response system, and a traditional paper and pencil test. Students were given the option to form whatever learning teams they wanted and had one night to work through the group assessment for the Google Docs portion of the assessment. They worked individually on each of the other two sections. Table 3 represents a daily topical breakdown of the probability unit with how a particular topic was approached. As with the matrix unit, each day a suggested workflow of problems from the textbook, online resources, and teacher-created materials was outlined and given to students. Students and groups of students were given the flexibility to decide how many problems they would do to sufficiently understand the material.

Table 3

*Topical Breakdown of the Probability Unit*

<b>Day</b>	<b>Topic</b>	<b>Approach and use of social networking tools</b>
1	The counting principle and permutations	Video posted on Edmodo. Workflow established and links to topics not covered in the video were shared.
2	Introduction to combinations	Google Doc shared "There is no permutation pizza" highlighting examples of combinations vs. permutations with discussion. Announced quiz shared on Google Docs on probability topics so far due next day.
3	Theoretical and experimental probability	Groups to create shared Docs to figure out what they know and need to know about the next few topics.
4	Geometric probability	Assignment check-off poll on Edmodo. Answers to all work so far was shared in a Google Doc.
5	Review of topics and adjustment of learning teams	Posted extra help problems and challenge problems to differentiate for the varying levels. Class discussion and reorganization of learning teams due to general difficulties with communication and collaboration.
6	Conditional probability	Video posted on Edmodo. Authentic problems posed. Group Google Doc shared to share helpful websites and web resources.
7	Binomial and normal distribution	Teams share a Google Doc to discuss systems of equations with matrices compared to other algebraic methods.
8	Binomial and normal distribution continued/group review problems	Video posted to Edmodo. Sections chosen for group review responsibilities.
9	Review/ Part 1 of the unit assessment	Students met face-to-face to work out review problems created by their peers. The online group portion of the unit was posted.
10	Parts 2 and 3 of the unit assessment	Part 2 of exam- using student response system. Part 3 of exam- traditional pencil and paper.

### **Coding for Themes**

Themes were coded in relationship to each of the three research questions by study group, teachers and students. The themes were established from an analysis of transcribed data from field notes, observations, focus groups, online postings, and notes from individual and small group discussions. Data was coded using In Vivo coding for the first cycle which is a coding method that preserves the actual language of participants and helps to ensure that the participants' voices were honored (Saldaña, 2009). The iterative, subsequent coding was undertaken using Pattern Coding which helps to develop major themes and examines patterns in human relationships and social networks (Miles and Huberman as summarized in Saldaña, 2009). The vehicle for the coding process was MAXQDA software.

### **Research Question #1: What are the beneficial outcomes of employing social networking tools in a high school mathematics classroom as perceived by a group of students and a teacher in a rural classroom?**

The first research question was: What are the beneficial outcomes of employing social networking tools in a high school mathematics classroom as perceived by a group of students and a teacher in a rural classroom? Table 4 identifies the data sources used for each group involved in the study. Table 5 highlights the themes according to participant.

Table 4

*Use of Data Sources According to Participant for Research Question #1*

<b>Participant</b>	<b>Data source(s)</b>
Students	Focus groups Field notes
Teacher/Researcher and 2nd Teacher Observer	Observations Field notes

Table 5

*Themes by Participant Group for Research Question #1*

<b>Participant</b>	<b>Theme</b>
Students	Enhanced collaboration Allowed for greater learning opportunities anytime, anywhere Allowed for greater control of how to learn
Teacher/Researcher and 2nd Teacher Observer	Increased student self-regulated learning Allowed for greater feelings of Personalization Facilitated content mastery

**Student commentary.** Three themes were identified through an analysis of student focus group transcripts regarding the use of social networking tools: (1) enhanced student collaboration, (2) allowed for greater learning opportunities anytime, anywhere, and (3) allowed for greater control of how to learn.

***Enhanced student collaboration in learning.*** During the first focus group sessions, 15 of 15 students cited being able to work with learning teams online as one aspect of using social networking tools that helped them learn the matrices. During the second focus group session 13

of 15 students mentioned the learning teams as a key to their personal success with the probability content. Throughout the focus groups and discussions in class, students often mentioned that collaboration helped them not only to understand the material but also to not feel like they are all alone when they struggle with something. Students cited the benefit of the collaboration whether they were in the role of teacher or student with a particular concept. One student, Caden, summed up what many students mentioned about being the teacher of the group:

I think that helped me learn because online I had to explain things so I had to keep going over in my head with myself. So I think it helped me learn as I was explaining to my group how I got my answer.

Jodi added, “Yeah, I think that when you have to explain it to somebody, you understand it better yourself.” Ben suggested the benefits of the receiving end of help that was alluded to by many students: “So if you didn't get a certain part of it, maybe someone in your group did and they can help you out. That happened for me a lot.” Students expressed feelings of being influenced positively by collaboration whether as mentors or mentees.

*Allowed for greater learning opportunities anytime, anywhere.* Throughout discussions and focus groups, students continually came back to accessibility as a key benefit of using the social networking tools. Accessibility to both material and help from peers was a common theme throughout both units of study as noted by students in both focus groups one and two. All 15 students mentioned access during at least one focus group session. The students all seemed to welcome this aspect of the unit because of the scope and time commitment of co-curricular activities that they are involved in outside of the school day. Many of the students suggested that because they were involved with many things after school and in the evenings, being able to work on their assignments whenever and wherever was a welcome change. As Nathan said:

I had play practice, and in between scenes I was able to open up my Google Doc on my phone, do some work and leave notes for my group. I was able to do some work while I was just sitting there.

This concept was reiterated by many students over the course of both units. Having content and assignments online and shared seemed to be a positive even for the students who went home after school. The students who did not participate in many co-curricular activities mentioned that they liked not having to bring their book home and that they did not worry if their notes were incomplete, thus reducing stress.

Some students did have difficulty with the concept of asynchronous communication and felt that if their learning team was not online at a certain time that they felt like they could not really contribute. Students varied in the magnitude of how this affected them. Although six students preferred to be online at the same time as their group, only two students, from the same learning team, felt that it was problematic. During the second focus group, Aiden talked about the online group assessment during the probability unit. He said, “Because of the varsity game in White Mountain, we didn’t get back until 10 o’clock, and I figured out that everybody else had done it.” This suggests a breakdown in the learning team concept of collaboration and movement toward an individual model of “just getting the problems done.” Given that the two students who felt that asynchronous communication was problematic may suggest that the overall effectiveness of the group may shape feelings of the value of asynchronous communication in individual group members.

*Allowed for greater control of how to learn.* In a traditional class setting, students are not given autonomy to choose the amount of work or the timeline for completion of the material. Comments in small group discussions and focus groups suggest that this took getting used to but

proved to be one of the more powerful freedoms. Table 6 shows select comments from focus groups and field notes related to the general difficulties and the benefits that students expressed regarding autonomy.

Table 6

*Illustrative Student Quotes regarding the Theme “Adjusting to Autonomy”*

<b>Challenges</b>	<b>Benefits</b>
...we could get off-task when we were in the hallway	So the stuff we got we could just cut time off of that and start another thing and if we need more time we'd have it.
It was just a bit tough to transition to the freedom.	It's getting us ready for when we are older and you have to figure out how to get things done on your own schedule.
At the beginning it was hard to get used to.	We didn't have as much pressure to get things done.
It was hard just because we've never done that before.	... you have more options on how to do things.
I think the only thing I didn't like was that I wasn't always being taught by a teacher.	... so it wasn't just you telling us we had to do things.
I wasn't really entirely sure what our assignment was.	Like if we had a busy one night we can do another night and figure it out, maybe get ahead.

Most of the students who said they felt challenged explained that these feelings were temporary and that the benefits outweigh the uneasy adjustment period.

**Teacher commentary.** Three themes regarding students' use of social networking tools were identified through an analysis of teacher observations as noted through teacher field notes

and observation rubrics: the social networking tools (1) increased student self-regulated learning, (2) allowed for greater feelings of personalization, and (3) facilitated content mastery.

***Increased student self-regulated learning.*** For the sake of this discussion, self-regulated learning will be defined according to Pintrich (2000) as “an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and the contextual features in the environment” (p. 453). The use of social networking tools as an instructional method required that the timeline for learning be much more open than a traditional class. The increase in constructivist methodology and learning teams created a need for a suggested workflow and timeline for work as opposed to the more traditional model of “work tonight, due tomorrow”.

This concept and implementation was met with overwhelming support and comment from the student participants in small group discussions and during both focus group sessions with 14 of the 15 students specifically mentioning this idea as contributing to their engagement. This implementation, in addition to being welcomed by students, compelled students to be more self-regulated. As Chloe said, “I think having options in the class is great part of it. We were responsible enough to know what we should be doing and not blow stuff off.” Students varied in their reasons for why they considered the more open timeline and suggested workflow to be a benefit. Nathan and Chloe presented one benefit of the suggested workflow:

Nathan: If we were struggling with something you didn't have to do all 26 problems where you just felt flustered. We could work through together with someone and it lifted the pressure off of his shoulders.

Chloe: Yeah, and if you understand something already why do 20 more problems. It is just a waste of time if we already understand how to do something.

This discourse suggests that when students reflect on their learning, they realize they are ultimately responsible for their own learning – and that they are the best judges of how to manage their learning. Many students said that in a traditional class the timeline for what and when to learn is driven by one teacher, yet the “what and when” is different for each student.

As noted in my field notes and observation forms from a second observer, Alison Bryant, students were highly engaged in the math concepts for the vast majority of the time. From my field notes dated November 1st:

Ben and Drew were discussing how to break up the work for the night when class ended.

As everyone began to leave for the school-wide break and the two were walking down the hall, Drew said, “I really understand how to find determinants.” Ben responded, “I get the 2X2 but I am not sure about the 3X3.” Drew then continued to explain the process until Ben said, “Oh, really. That's it. Thanks.”

This observation demonstrates students collaborating and regulating their own learning, not basing it on the time schedule of a class but on a desire to know and understand the material.

*Allowed for greater feelings of personalization.* There were certain unanticipated results from some aspects of the implementation of the social networks. Videos were made to be posted online with password protected access to allow students to use the videos as a resource and share or comment on videos. After the classroom observation, doctoral student Alison Bryant commented on the very high scores in the category of emotional interest on the classroom observation (See rubric in Appendix C). One explanation for the high scores in this category is suggested by the fact that in both focus group sessions, every student (15 of 15 in each focus

group) mentioned the videos as a great part of each unit. The only negative that was suggested was that there were not as many videos in the second unit. Students suggested that the videos made by the teacher/researcher were more personalized than just watching a YouTube video. As Nathan expressed,

I think a good plot line in the videos is helpful, as you like this cool secret agent guy in the first one in the second line you're in 2-D. It kinda gets us wrapped into the whole, "OK this is what happened now" now what do we need to do.

This explanation was met with many students nodding in agreement. Students seemed to feel that the videos were just for them and that seemed to increase their connection to the video. Some students mentioned that they showed the videos to family members and to other students outside of class.

***Facilitated content mastery.*** From an educational standpoint, any instructional method that does not yield satisfactory assessment results cannot be considered a viable method. Small group discussions with the researcher using a variety of formative assessments demonstrated a satisfactory understanding of concepts. From my field notes dated October 28th: "Groups of students were in four different locations around the school. Whenever I walked into a room, students were on-task. As I asked them basic questions, they were able to answer them very well." Likewise, the use of social networking, in this limited study, demonstrated satisfactory summative assessment results. From my field notes dated November 4th:

Students were given a surprise pencil-and-paper quiz on the material they learned so far. The quiz was a non-calculator quiz that hit each of the topics. The quiz took a fair bit longer than I expected, but the overall grades were decent. The mean score of 90% and

the median score of 88% were fairly consistent with similar quizzes given during past years.

The end of unit assessment was very similar to past years with equal or greater depth of material, which allowed a comparative look at the results of the test scores. The results are shown in Table 7.

Table 7

*Comparison of Previous Years' Assessment for Matrix Unit*

Year	Number of Students	Median Score on Matrix Assessment	Mean Score on Matrix Assessment	Standard Deviation
2011-2012	15	94%	87%	12.5
2010-2011	14	95%	92%	5.8
2009-2010	19	77%	77%	7.8
2008-2009	14	73%	73%	6.5
2007-2008	16	77%	78%	9.1
2006-2007	18	84%	83%	7.6

The data from past tests suggests that the method involving social networking tools as the primary instructional method does as well or better than past performance. The median and mean scores were the second highest in the 6 years of data. While the unit assessment was not the exact same test for each of the six years, the assessments were similar enough with equal rigor and depth of knowledge assessed to suggest that student achievement is as good or better than traditional methods of instruction.

The difference in the median and mean scores and the high standard deviation during this year might be explained by one outlier, Ben, who had taken a family vacation for two of the days during the unit and never made up the work that he missed. Although Ben had a learning team set up, he chose not to let them help him go over the missed material. He was relatively engaged

in the material that he was present for but the missing work showed his full lack of understanding when the unit assessment was given.

**Research Question #2: How might the use of social networking tools and practices increase each of the following, as perceived by students and the teacher: (a) participation among students, (b) cognitive engagement, and (c) student motivation to learn?**

This section presents findings to this question as determined through multiple data sources, as seen in Table 8. Findings are presented first in relationship to students' perspectives, as determined through a review of the focus group data and review of student comments online and in the classroom. Then findings to this question are presented based on teachers' observations and field notes. Table 9 highlights themes according to participant.

Table 8

*Use of Data Source by Participants for Research Question #2*

<b>Category</b>	<b>Participant</b>	<b>Data Source(s)</b>
a) participation among students	Student	Focus groups Online discussions Class discussions
	Teacher(s)	Classroom observations Online observations Teacher and observer observations and field notes Review of student online postings
b) cognitive engagement	Student	Focus groups Online discussions Class discussions
	Teacher(s)	Classroom observations Online observations Teacher and observer observations and field notes Review of student online postings
c) student motivation to learn	Student	Focus groups
	Teacher(s)	Classroom observations Online observations Teacher and observer observations and field notes Review of student online postings

Table 9

*Themes by Participant Group for Research Question #2*

<b>Category</b>	<b>Participant</b>	<b>Themes</b>
a) participation among students	Student	Students could learn independent of physical location Allowed easy access to assignments and help
	Teacher	Increased access limits excuses Enhanced online learning as a result of face-to-face learning
b) cognitive engagement	Student	Allowed students to set their own goals Allowed for instant feedback to ideas and questions
	Teacher	Increased channels of communication Perceived authenticity of problems contributed to student buy-in
c) student motivation to learn	Student	Reduced stress Able to show knowledge and learn in multiple ways
	Teacher	Increased student interest through video postings and material Recognized future skill set

**Student commentary.** Six themes were identified across the three categories identified in Research Question #2 through focus groups and whole group discussions: (1) ability to vary physical location, (2) easy access to assignments and help, (3) setting of their own goals, (4) instant feedback on ideas and questions, (5) reduced stress, and (6) multiple ways to learn and demonstrate knowledge.

**Participation.** An increase in student participation can be facilitated in a number of ways using social networking tools. One unanticipated response from students was that it was helpful when they *could learn independent of physical location*. This factor was noted by several students and confirmed by the others. The students stressed that working with a learning team

and being able to go to different places in school helped them “get down to work,” as one student suggested and as Nathan said, “I liked splitting off and not having to take a corner of the room. So we could go in the hallway or on the SMART board or some computers somewhere else.”

The second theme that emerged from the coded data was the use of these tools *allowed easy access to assignments and help* on those assignments. Twelve of the fifteen students said having materials, assignments and peer assistance online alleviated the need to remember to carry books and notebooks around with them. They suggested that this allowed for more opportunities for participation. As Jodi said during the first focus group:

The thing I like about it most is that you can access it from anywhere didn't need the book you just had a computer and Internet you could access it from anywhere you could see what others are doing and we could like communicate and talk with each other.

Other students added that even without a computer, a phone or iPod could be used to access the Web-based content and comment on Edmodo or Google Docs.

***Cognitive engagement.*** Cognitive engagement, as previously defined for the purpose of this study, is a willingness to work toward a full understanding of concepts. The data suggest students (13 of 15 students from focus group sessions) consider that being *allowed to set their own goals* an important aspect of their learning using social networking tools. While some (4 of 15) students felt uneasy with this aspect of their learning, Jodi summed up the feelings of those few, “I think we did adapt over time. It was just a little bit tough to transition at the beginning.” Receiving *instant feedback to ideas and questions* emerged from the data as the second theme that had an impact on how these tools supported cognitive engagement. Ten of the fifteen students spoke of the fast response time from peers and/or the teacher as important to them as learners. During a whole class discussion, Annie remarked, “Yeah, I have had teachers that I

emailed them on the weekend that I needed help and they didn't get back to me until Tuesday. It was too late." Others added that posting in the more social way allowed for a faster response time. As Nathan suggested, "Hey, we are all teenagers. I mean we have our phones and iPods all the time. It is easy to just send a message."

**Motivation.** Twelve of the fifteen students suggested that the social aspect of the units *reduced the stress* they felt to complete assignments even though they were completing as much work as they would have without the group. As Nathan noted: "If we were struggling with something you didn't have to do all 26 problems where you just feel flustered. We could work through together with someone and it lifted the pressure off his shoulders." Eleven of the fifteen students commented that they were *able to show knowledge and learn in multiple ways*. Students were afforded many opportunities and strategies to approach the material as part of the social networking tools. The students felt that having multiple viewpoints of the material from their learning team helped to extend the knowledge they would have received from a single point of reference -- the teacher. As Drew summed up: "I think that it was a lot better. Instead of getting the view of what to learn from one person, you get it from a lot of people."

**Teacher commentary.** Six themes were identified across the three categories in Research Question #2 through teacher observations, field notes, and observation rubrics: use of the social networking tools (1) increased access limits excuses, (2) active face-to-face projects increase online posting, (3) increased channels of communication, (4) perceived problems as authentic, (5) student interest in video posting and material, and (6) recognition of future skill set.

**Participation.** The overall participation and engagement of students in the two units during class time was equal to or better than participation during the teacher-led units before the

study. The ratings from the classroom behavioral observations done by the researcher and the second teacher observer and doctoral student, Alison Bryant, over the course of the two units are presented in Table 11.

Table 11

*Teacher Ratings Regarding Behavioral Aspects of Participation*

<b>Behavioral Observations</b>	<b>Rating</b>
On-task	9.6/10
Persistence	9.4/10

The scale was a 1-10 scale with 10 being the highest rating. Observations were done once per unit per student by each observer.

There was a noticeable lack of excuses for work not completed. Students were observed discussing the fact that they could not get away with saying they left their book at school or that they forgot their flash drive. The *increased access limits excuses* for missed work and had a direct bearing on participation outside of class. It was further witnessed that there was *enhanced online learning as a result of face-to-face learning*. Following classes with active projects involving the learning teams, nightly postings and collaboration increased to nearly double other nights.

***Cognitive engagement.*** The classroom observation rubric (see Appendix E) addresses three aspects of cognitive engagement observed by the researcher and second observer. The mean score of each of the three categories is shown in Table 12.

Table 12

*Cognitive Engagement as Observed in Face-to-Face Meetings*

<b>Category of Cognitive Engagement</b>	<b>Rating</b>
Response to Challenges	9.47/10
Psychological Investment	9.53/10
Strategic depth	9.53/10

The scale was a 1-10 scale with 10 being the highest rating. Observations were done once per unit per student by each observer.

The ratings of cognitive engagement from the observations are relatively high but generally close to this level given the course. The data certainly suggest that the cognitive engagement was at least as high as a traditional class and most likely higher. The *increased channels of communication* were a direct result of the social networking tools employed in the two units. The students were observed posting and collaborating in addition to written work being completed. Eight of the fifteen students used technological tools to aid communication beyond those suggested, including Skype and group texting.

The difference in traditional mathematics problems and authentic problems lies in the presentation and syntax of those problems. “Traditional mathematics instruction typically provides the goal and the numbers and simply requires the student to execute a procedure selected from a restricted set of options” (Cognitive and Technology at Vanderbilt as quoted in Lampert & Blunk, 1998, p. 82). Lampert and Blunk (1998) contend that the use of authentic math problems that challenge students to figure out context and methods, “supports the development of mathematical knowledge and discourse”(p. 83). Teachers’ observations identified that authenticity or *perceived authenticity of problems contributed to student buy-in* when the problems were posed to the learning teams. Students were observed discussing roles

and strengths of team members as they commented that they were going to have to have these skills as adults.

**Motivation.** The teacher observations revealed high scores for the emotional engagement portion of the classroom observation rubric (see Appendix C) that is most closely tied to student motivation. The three categories are: interest, reaction to surroundings and flow. As noted in Appendix E, Flow is a conceptualization of investment or emotional engagement coined by Csikszentmihalyi (1988) and was used as a subjective measure as suggested by Fredricks et al. (2004). The summary of the observation ratings are found in Table 13.

Table 13

*Classroom Observation of Motivation through Emotional Engagement*

<b>Emotional Engagement</b>	<b>Rating</b>
Interest	9.67/10
Reaction to Surroundings	9.63/10
Flow	9.63/10

The ratings for each of the categories of emotional engagement were higher than for either behavioral or cognitive engagement. Emotional engagement is most closely tied to student motivation and suggests that students were motivated during each of the units on social networking. Based on teachers' observations, the *increased student interest through video postings and other online material* supported student learning by providing what Blumenfeld et al. (2006) described as a "need-to-know situation to learn specific ideas and concepts and provide a reason to understand" (p. 479). The collaboration and problem solving as part of the *recognized future skill set* was observed to expand students' attempts at a variety of problems

posed in collaborative online and face-to-face settings. The potential future impact of the social and collaborative skills resonated with students.

**Research Question #3: What do students believe to be the advantage of social networking for their learning?**

The data are addressed and emerging themes developed through focus groups as well as teacher-researcher field notes from small group and whole class discussions. Students' comments regarding the advantages of social networking for their learning fell into two main categories: immediate transferrable benefits and future benefits. A summary of the advantages discussed by students are presented in Table 14 and further discussed in the following section:

Table 14

*Themes from Students for Research Question 3*

<b>Immediate transferable benefits</b>	<b>Perceived future benefits</b>
Social skills were enhanced	Collaboration and communication via the computer will continue to expand
Learned more than just math	Increase in the number of jobs using social tools on the Internet
Use social networking tools in other classes	Way of the future for both higher education and job prospects

**Immediate transferrable benefits.** Beyond the content of the math units, nine of fifteen students identified *social skills that were enhanced* through the use of a social approach to learning in both face-to-face and online. As Chloe pointed out about learning math during the units implementing social networking tools, “It did make things a lot easier, not just what we're learning about but also how we are learning.” She continued to explain that they *learned more than just math*:

I would say it broadened our way of learning, we found out new ways to learn. Not only were we learning math things, we were learning about the Internet and computers and how to talk to our group. We were also being more independent but also more dependent on our groups at times.

This view was shared by the majority of the students (13 of 15 students in focus group 2) as they reflected on what they learned beyond the subjects of matrices and probability. The idea of at once being more independent yet also more dependent upon others on the learning team was a difficult concept for students to express.

The idea of independence and dependence coexisting combined with a few students' views of collaboration led to a struggle. The idea that collaboration could be asynchronous and that simply because a group had a shared document did not mean that the group had to be online at the same time was a point of contention among some of the students. Many students felt that this area was something each learning team had to contend with and work out in their own way. While some groups were fine with the concept of asynchronous communication, others felt that they preferred or even needed to have synchronous communication.

The breakdown in the effectiveness of asynchronous communication appeared to be dependent upon the composition of the group. In his first group, Carson suggested that he really enjoyed the online group work after getting used to it. During the second unit with a different learning team, Carson said, "I thought it was a lot easier to do in school when everyone was there. You couldn't all be on it at the same time unless you set a certain time aside." This may suggest that the overall effectiveness of the group may shape feelings of the value of asynchronous communication in individual group members. The struggles with asynchronous versus synchronous communication were not shared by the majority. In fact, many (11 of 15

students) saw this as a learning opportunity. The majority preferred to be online at the same time, but they realized that this was not always possible and felt they needed to figure out a system for their asynchronous communication. For instance, Caden mentioned a benefit of asynchronous communication when he talked about working through problems and then checking with his learning team online. He said, “If you get the same answers, then that’s kind of reassuring.” He continued to say that it is similar to having an answer key that can explain the answer to you when you check with others.

Students often (9 of 15 students in focus group 2) stated that the use of social networking tools in this class gave them the knowledge to apply the tools in other classes. As Jodi mentioned:

Like in our English class we started a project yesterday. I had never used Google Docs as much as I do now. All the work we have ever done now we have on a Google Doc and we’re all sitting there working on the Google Doc, and I think that math really helped us get used to that and understand that we can all have a paper that we can all work on at the same time.

Many students expressed their surprise at the fact that before this year they had never even heard of Google Docs and now it has become “normal” as a few students pointed out. Many students expressed they were using *social networking tools in other classes*. Students comment that they do not even give any thought to saying, “Let’s start a Google Doc and share what we have come up with so far.” As Gary suggested,

Edmodo is helpful for us because it is a secure social network, and you can post ideas to our classmates and any questions we have. On Google Docs we can collaborate and comment on each other’s work to help make it better in any of our classes.

Nathan commented that his use of social networking tools has made work in different subjects easier and more accessible. He explained, “I went to play practice, and I was sitting back stage and was able to work on my homework in a couple of classes using Google Docs, just sitting there.”

**Perceived future benefits.** The vast majority of the students (13 of 15 with 2 students not commenting specifically) felt strongly that *collaboration and communication via the computer will continue to be an expanding aspect of society*. None of the students expressed any thoughts that jobs they might have in the future would lack a collaborative component involving technology. Many students pondered the future of what their jobs might look like and what role social networking may have on those jobs. Students unanimously said that there would be an *increase in the number of jobs using social tools on the Internet*. As Bill explained:

I definitely think collaboration is the way things are going in the business world, and if you want to get a head start on that it is great to be able to work with a group. So Google Docs and other social approaches allow you to work as a team and all contribute to something that really helps it to get done.

Nathan added:

Yes, not just teaching math, it's teaching social skills too. Not every job is face-to-face, sometimes you have to work online and you have to explain things to people without actually talking to them. So, it is how to get ready for things that you will encounter in the real world that aren't exactly matrices and probability but probably something.

Jodi suggested many of the beneficial aspects of social networking as she looked ahead to her future:

I think it's really important because as we get older and start work we will have our boss just telling us what to do, not how to do it. We will have to just figure it out for ourselves. Then we will be told, "You have until this certain date." And now with Google Docs and all social networking, that's what we do. I think it also helped us work with our peers because my group had some difficulty with that so we had to overcome it and work together, which was kind of hard. So I think it is good 'cause by the end we got it so some of the social skills.

Other students suggested ways that their parents are using online collaboration in their current jobs due to the rural area that they live in and their chosen profession. As Nathan and Maria discussed,

Nathan: As far as life and other things, my mom does so many things electronically she sees her coworkers about once a month so she has to be able to explain things in an e-mail or on a Word document. I think if her company used Google Docs it would be a lot easier for them to all work on the same training format on just one sheet.

Maria: Same with my dad, because he is really far from work, he lives on the computer.

The vast majority of students (14 of 15 in the second focus group) pointed to the collaborative aspect of using social networking tools as a benefit now and in the future. Many students predicted a more collaborative future and that approaches similar to those that they had used for this project will be the *way of the future for both higher education and job prospects*. The students felt that technology will continue to provide both learning and job opportunities for people who are not necessarily in the same geographic area.

### **Summary of Findings**

The findings from this study come together from a participatory project giving students voice and autonomy in their educational objectives in a high school math class. The collection of data from a number of different sources provided a look into the various aspects of how social networking tools can be used to enhance student learning in a math class. Analyzing the use of social networking tools from students' and the teacher-researcher point of view allowed for a deeper understanding of how these tools can impact the educational process and what the future may hold for the use of social networking as an instructional method.

In sum, students' comments in the focus groups and class discussions indicated that: (1) collaboration was enhanced by the increased access to materials and assistance, as well as, the ability to vary physical location and online meeting times; (2) learning opportunities were increased due in part to the variety of ways to discover and demonstrate knowledge; and (3) students had greater control and felt less stress in the learning process by setting their own goals.

The teachers' observations were in keeping with these findings. Teachers observed that: (1) student collaboration and access of materials and assistance was greatly facilitated by the use of social networking tools; (2) student motivation was increased by having many opportunities to discover and demonstrate knowledge through the social networking tools; and (3) the amount of control that students had over their own learning through the use of social networking tools yielded an increase in cognitive engagement. Teachers' observations further noted that the use of these tools facilitated content mastery equal to or greater than levels of mastery using a teacher-led model.

## **Chapter 5: Discussion of Research Findings**

### **Revisiting the Problem of Practice**

There has been significant discussion in educational communities about the importance of preparing students for the rapidly changing 21<sup>st</sup>-century world. Educational practices have failed to adapt to allow for a more connected, collaborative world that is a result of the technological changes this century. Sixty-five percent of adult Americans use social networking sites (Madden & Zickuhr, 2011) while 95% of teens are online with 80% of those teens being on social media sites (Lenhart et al., 2011). Given this level of infusion into everyday life, social networking has seen little growth in education. Even given the high percentage of the population using social networking sites, the use of social networking is still banned in many schools. In August 2011, Senate Bill 54 was passed by the Missouri House and Senate making it illegal for teachers and students to communicate via social networking sites (the law was repealed in October 2011) (Heaton, 2011). The Missouri law and other national discussions point to how contentious the issue is among the general public. The use of social networking has the potential to be a powerful educational tool. This study sought to address the potential benefits of using such tools. There is an increasing need to engage students in the global society using technological tools and collaboration.

The use of social networking tools has the potential to allow students and teachers to redefine their roles by embracing student autonomy, fostering creativity, improving technological skills and allowing for anytime-anywhere learning. This study was designed to specifically address the following research questions:

1. What are the beneficial outcomes of employing social networking tools in a high school mathematics classroom as perceived by a group of students and teacher in a rural classroom?
2. How might the use of social networking tools and practices increase each of the following, as perceived by students and the teacher:
  - a) participation among students,
  - b) cognitive engagement,
  - c) student motivation to learn
3. What do students believe to be the advantage of social networking for their learning?

### **Review of the Methodology**

This participatory evaluation consisted of students and a teacher from a rural high school math class implementing social networking tools into two different units in an Algebra Two class. Data was collected and then analyzed through a pre-study survey, small and large group discussions, field notes, observations, and focus groups. Focus groups were conducted two different times during the study – at the conclusion of the first unit and upon conclusion of the second unit – and then coded for significant themes.

**Participatory nature of students as researchers.** Before the study, students were questioned as to what degree of freedom they would like to have in learning the material. According to my first memo written on October 27th:

Three questions were asked at the beginning of the matrices unit. What alternative ways would you like to be assessed on this unit on matrices? What would be a reasonable method of grading classwork and homework considering the online component that will have some social aspects? How should groups or learning teams be assigned? Students

answered the questions individually then broke down into groups and discussed what they thought and came to an agreement as a small group. I went around to each group to get feedback and we discussed as a whole class some possibilities for each of the questions.

In response to the first question, 14 of 15 students felt a traditional paper and pencil test would be the best assessment, yet the majority said they would be open to other options. As Annie summarized: “I would be open to different ways to grade us. I just don't know what they might be.”

In response to the second question about a reasonable method of grading classwork and homework, as noted in my October 27th memo:

Students like the idea of a peer and self assessment. Following a group discussion, we agreed to have peer and self assessment in addition to the teacher assessment of the blended learning, the online component, and the use of class time. The class worked collaboratively on the rubric that is uploaded to Google Docs. They were required to comment and look at each part of the rubric and can add to or subtract from the rubric.

The same rubric can be used for peer, self and teacher assessment.

The rubric initially posted (See Appendix E) was met with acceptance. There were, however, some questions raised about the language used in some places. After the collaboration on the wording, I replaced the initial rubric with what became our final rubric (See Appendix D).

Students felt that the language in this rubric was much better suited to the goals of the unit.

In response to the third question, students overwhelmingly agreed that they should develop their own learning teams for the first unit and suggested that random groups be chosen

for the second unit. They noted that choice is great, but, as Patty suggested, "I like the idea of random selection, too, because we might learn from different people".

Students were given the choice of three different units of study to undertake following the first unit on matrices. The students had provided feedback about the overall process involving the implementation of social networking tools in the first unit with overwhelming support. Following a whole-class discussion, 12 of 15 students chose the unit on probability. Students had suggested random groupings to set up the learning teams for the second unit. Three days into the unit on probability, the groups were struggling to communicate online and to work together in a face-to-face environment. The lack of cohesiveness of the groups led to small group and whole-class discussions as to the reasons. According to my field notes from November 18th:

I realized that because the basic idea of social networking is to get with "friends" online that the forcing of groups may have been outside of the scope of this project. By allowing the groups to be more fluid gives students the autonomy to choose. I feel that we can make gains on the learning therefore that (forced grouping) will be changed as of Monday.

The realization of allowing students full autonomy as to their own grouping practices strengthened both the use of social networking tools and mathematical content. Students unanimously agreed during focus groups that having autonomy to choose learning teams played a big role in the success of their learning in the probability unit. This was in contrast to students' initial suggestion that having learning teams chosen randomly would be advantageous. Although the idea of working through issues in a team setting is valid and important, it was considered beyond the scope of the goals of this study.

Steps were taken throughout the process to ensure and maintain the validity of this research project. Validation strategies included clarifying researcher bias and member checking. Due to the participatory nature of the study, particular care was taken to make every part of the process transparent to the participants and to avoid any hints of coercion. A limitation of this study was the small sample size of the single class involved in the study.

This chapter will be broken down into the following sections: discussion of the major findings, discussion of the findings in relation to the theoretical framework, discussion of the findings in relation to the literature review, conclusion, significance of the study, and next steps.

### **Discussion of Major Findings**

Through the two focus groups, discussions, and observations, various themes emerged. Students identified major themes as to the benefits of implementing social networking tools into the math classroom. They addressed benefits through things that they simply "liked" and aspects of the approach that they felt helped them to better learn and understand mathematical concepts introduced in the lessons. Themes were also identified from the teacher and second teacher observer that complemented and built upon the benefits that the students identified. Table 15 highlights these themes.

Table 15

*Major Themes Identified by Students and Teacher through the Study*

---

<b>Themes</b>
Increased collaboration
Enhanced learning opportunities due to anytime-anywhere access
Increased autonomy promoted more responsibility and reduced stress
Increased self-regulated learning
Increased personalization led to greater student motivation and connectedness
Facilitated learning beyond the acquisition of content

---

**Increased collaboration.** Increased collaboration was mentioned by every student at some point and time during data collection. The students stressed the importance of collaboration to help them learn and have the opportunity to help others learn. The students also suggested that the social skills gained from online and face-to-face collaboration would be beneficial to them in the future. Increased online collaboration was cited by students as being a "way of the future" and they felt that the more opportunities they had to hone their skills, the more benefit they would get from it. The teacher noted similar benefits of the collaboration that the students so often mentioned. Students appeared to connect with their peers more during class and online because collaboration and learning teams were a more prominent part of the unit design in the math class.

**Enhanced learning opportunities.** Enhanced learning opportunities were aided through an "anytime-anywhere" approach to learning, with content discovery and mastery identified as an important aspect of the implementation of social networking tools into the math class. Having

course material and tutorials online and shareable increased collaboration, connection to the material and access in such a way that students seemed to feel less stress about having time to get assignments done. Being able to access materials and pose a question to a small group or the whole class to seek assistance or make suggestions was mentioned by many students as being beneficial. As Nathan said, “I really enjoyed it. It brought math to a whole new level.”

While students at times struggled with the “transition to the freedom,” as one student noted, the benefits of the increased autonomy to choose how and when to learn was another recurring theme of the study. Students often cited the reduced stress and increase in the responsibility they felt for their own learning as two by-products of the *increased autonomy* they felt were particularly helpful to their learning. During the course of the study, students were given latitude and control of the workflow and who they chose to work with on a learning team. This type of autonomy proved to be very different from what students were used to and after the adjustment period was something that many of the students embraced.

**Increased in the student self-regulated learning.** The teacher and second teacher observer noted the increase in the student self-regulated learning that combined the student-identified themes of autonomy, access, and collaboration. Students seemed to feel in control of their own learning and motivation to accomplish the tasks they identified as important. The increased control the students had of the various aspects of learning increased their feelings of responsibility and thus their feelings of ownership of their own learning.

**Increased personalization of learning.** The increase in the personalization of learning through the use of social networking tools was identified as an aspect of the instructional units that had an impact on student engagement. Every student mentioned the videos created by the teacher as one of the most engaging and beneficial aspects of the units. When asked why those

particular videos differed from others that could be found online, students said they felt like the videos were “for them” and created by someone who knows them as learners. The theme of personalization tied back to access to materials and support. Students mentioned that they felt that having the video “at the ready” gave them the option to pause and rewind the teacher or, as one student suggested, “having a teacher in a box.”

**Facilitated learning beyond content acquisition.** The students overwhelmingly felt that the benefits afforded to them through the use of social networking would be beneficial both in their current and future lives. Eleven of fifteen students cited learning beyond content acquisition as a benefit of using social networking tools in their learning and cited many benefits of the collaborative approach. Students commented frequently about the use of computers and collaboration as aspects of their future. The students could not foresee any future possibilities that did not include the collaborative and technology-based elements used in social networking. The students also said they were beginning to use some of the social networking tools in their other classes because of the collaboration, accessibility and ease of use of the tools.

### **Discussion of Findings in Relation to the Theoretical Framework**

This study was informed through the perspective of student engagement theory, online learning theory, and guided social constructivism. Each of these theories served as a lens to investigate the implications of the use of social networking tools.

**Student engagement.** The idea of student engagement used in this study as outlined in Chapter 2 follows the work of many practitioners but most closely resembles the definition put forth by Fredricks et al. (2004). The engagement meta-construct is the combination of behavioral, emotional, and cognitive components of engagement. Each of these constructs allowed a look into the effects of implementing social networking tools into a mathematics

classroom. The classroom observations gauged each of the constructs to help determine the level of engagement across the spectrum of constructs (see Appendix C). During the course of the two observation cycles, the observed level of engagement was particularly high across all of the engagement categories. There are three aspects of engagement that are of particular note to this study: collaboration, extension of learning beyond the classroom, and the control of success and choice of learning by students.

***Collaboration.*** Most students felt a duty or responsibility to post and check online because of the learning teams that they had formed. The collaborative approaches implemented across the two units yielded high levels of engagement, which is consistent with work in the field that suggests that a high level of collaboration can increase engagement (National Research Council (U.S.) and Institute of Medicine (U.S.) Committee on Increasing High School Students' Engagement and Motivation to Learn, 2004).

***Extension of learning beyond the classroom.*** As stated in Chapter 2, many researchers identified the extension of learning beyond the walls of a classroom as integral to increasing students' engagement (Blumenfeld et al., 2006; Persell, 2004; Shernoff et al., 2003). This study is consistent with those findings. While there were some students whose level of engagement did not appear to increase significantly, the majority of the students welcomed the opportunity to learn outside of their class with a variety of opportunities through self-directed learning, learning teams, and teacher guidance.

***Control of success and choice of learning by students.*** The "spiral of reciprocity" suggested by Salomon & Perkins (1998), which allows for a flow between individual and collective work, increases the perception of control by students. Throughout the study, students often suggested that the ability to control what and how they were learning led them to be more

connected to or engaged with the content. During the probability unit, when control of demonstrating learning was taken from students, one particular group of students experienced a drop in engagement. The challenging online group quiz set a specific timeline and required collaboration if students hoped to achieve the best possible result. That result could have been predicted based on the fact that autonomy was essentially withdrawn. Although the collaboration was still in effect, the choice and control were removed.

**Online learning theory.** Online learning theory presented a lens to look at this study through instructional design while integrating aspects of student interactivity. Anderson (2004) argued that student-student, student-content or student-teacher interactivity was required for meaningful learning to take place. The study yielded interesting results in the student-student and student-content interactivity constructs. Students reported high levels of student-student interactivity and embraced the collaboration it afforded.

Online learning theorists suggest that one of the benefits of online learning is the use of asynchronous communication (Lapadat, 2002). This study did not fully support the benefits of asynchronous communication. Students often expressed that desire to be online when members of their learning team were and would go out of their way to have synchronous communication whenever possible. There may be many reasons that the students preferred synchronous communication but the most plausible is that because they are in a class together during the day they feel the need to "meet" at the same time outside of the class. Students seemed to welcome asynchronous communication when it was a short post on Edmodo to check in or ask a question. Synchronous communication was preferred when teams were collaborating on a Google Doc. The workings of the online team in non-face-to-face meetings could have been improved with

more attention to explicitly training learners for their roles on the team as suggested by Hurst & Thomas (2008).

**Guided social constructivism.** The idea of constructivism is generally attributed to John Dewey and Lev Vygotsky (Popkewitz, 1998). Vygotsky's (1978) concept of the zone of proximal development (ZPD) highlights an individual's level compared to their potential level. This concept was expanded upon by Gunawardena et al. (2009) to include social components to create a group ZPD. The researchers suggest that individuals will clarify positions and their understanding of a topic by comparing ideas and discussing them. This concept was fully supported by the results of this study. Students often commented on how explaining to others helped them to understand the topic better. One learning team, during the online group quiz, conducted a group chat on the side of their Google Doc and went back and forth on a particular topic for 35 minutes. By the time the group came to consensus, each member of the team expressed a much deeper understanding of the topic.

As noted in Chapter 2, Sivan (1986) describes social constructivism as a process of skill acquisition, socialization, and an outlook that enables the individual to participate in a group. Each of these three aspects of Sivan's description was reinforced by this study. Students felt comfortable in the group settings and when given the option chose the group model each time. Although students were responsible for their own work and were being assessed individually the majority of the time, they chose to participate in groups to help them gain a deeper understanding of the material.

### **Discussion of Findings in Relation to the Literature Review**

The findings from this study have a strong connection with the literature review presented in Chapter Two. The literature review focused on five main themes to inform this

study: learning styles, culture of learning, 21<sup>st</sup>-century skill acquisition, student autonomy, and the connection to mathematics education.

**Learning styles.** The findings from this study were consistent with the current literature on learning styles. The concept of learning styles in this study was most closely linked to Ally (2004) to mean simply a variety of strategies used to accommodate individual differences in learning. The curriculum and instructional methods were changed in this study to allow for an adaptation to the cognitive style of students consistent with the suggestions of many researchers (Gardner, 1983; Kelly et al., 2009; Prawat, 1992; Tapscott, 2009). This adaptation seems to have increased the connection between the instruction and relevance to students given the overall increase in students' feelings of ownership and responsibility of their own learning as suggested by findings in chapter four.

The strength of the findings from this study is supported by Schroeder (1993), who suggests that overall learning is enhanced when students are allowed to take learning paths different from those of others, particularly the teacher. The findings from this study strongly suggest that students' feelings of choice of how to learn played a large part in their success. This is supported by Ross and Schultz (1999), who advocate for the idea of choice afforded by the Web, which supports the ability of students to be independent learners but allows social learners the option to explore learning in that way. This study found that this idea was almost universally supported by the findings from this study. While it is not possible to say whether a student would have learned more or more deeply by choosing another method of learning, the findings from this study imply that the autonomy afforded to the students provided learning depth equal to or greater than what they would have attained in a more traditional teacher-led, single-modality classroom.

**Culture of learning.** The literature review revealed vast agreement of the importance of a strong culture of learning. As put forth by Hadjioannou (2007), the cultivation of an authentic community of learners embraces the concepts of interactivity, self-expression, and collaboration. It is suggested by this study that the beginning stages of an authentic community of learners was starting to develop. Students were collaborating on the majority of their learning activities, were interactive in both online and face-to-face learning opportunities, and began to allow their self-expression to develop as a keener understanding of their metacognitive processes as demonstrated by their online group work.

The increase in the strength of the culture in the class can be witnessed through what Newman (2008) refers to as *adaptive help-seeking*. Adaptive help-seeking is in direct contrast to the traditional view that students who seek help are incompetent and the independent learners are somehow more mature. Every student in this study often sought help and collaboration from peers, suggesting a strong supportive culture of learning consistent with research outlined in the literature review.

Blumenfeld et al. (2006) propose that cognitive engagement can be enhanced through the use of learning environments that involve collaboration, technology, and student autonomy. The findings from this study support that proposition as demonstrated in chapter four. Collaboration, technology, and student autonomy were all cited by the vast majority of students as being key components to their engagement with the material.

Brown et al. (1989) suggest that collaborative nature of social learning can be enhanced by the explicit teaching of collaborative work skills. Although collaborative work skills were not explicitly taught during these units, the findings suggest that many students could have benefited from such an approach. The struggle of some students with asynchronous versus synchronous

communication could be explained by the lack of explicitly teaching collaborative skills that differ based on the type of communication.

**21st-century skill acquisition.** Battro (2004) suggests a profound change in education this century due to digital tools being used to increase human interaction. This study cannot lay claims to support a profound change, however student interaction was increased due to the amount and depth of the collaboration witnessed by the teacher/researcher and was referenced by the students in the two focus groups. The movement toward a learning community supported by the use of digital tools such as social networking may help to develop the profound change suggested by Battro.

The importance of how students learn as opposed to the learning of content was a common topic in the literature review of 21<sup>st</sup>-century skill acquisition. This study fully supports the results of the previous studies (see Junco, Heiberger, & Loken, 2010; Yu et al., 2010) in regard to the positive effect on engagement and motivation among students involved in the use of social networking. Students were observed to have a high level of engagement throughout both units of study, and students' responses during focus groups suggested high levels of motivation.

As routine work becomes automated, the importance of creativity, openness, and trust become paramount to success (Friedman, 2007; Pink, 2006; Robinson, 2006; Trilling et al., 2009). This study demonstrated a possible avenue to expand the findings to fully support these ideas. Every student mentioned the personalized videos as a tool they were motivated to use. This opens the door to future study on how responses to personalized videos could impact creativity, openness, and trust among a community of learners.

**Student autonomy and personalization.** Personalization of education is more than simply individualizing a learner's plan and differentiating learning. Leadbeater (2004) advocated for the learner "as active, responsible, and self-motivated, a co-author of the script which determines how education is delivered." (p. 70) Increasing student autonomy in the educational process, including feedback on that process, was suggested by many researchers (see Kelly et al., 2009; Shirley, 2011; Trilling et al., 2009) as beneficial to the development of 21<sup>st</sup>-century learners. They cite initiative and self-direction as byproducts of increased personalization. This study revealed the beneficial aspects of personalization through the use of social networking tools and fully supports the suggestions of researchers citing personalization (see Ally, 2004; Klem & Connell, 2004; Leadbeater, 2004).

The literature review did reveal researchers such as Moore et al. (2009) purporting the benefits of asynchronous communication. Ally (2004) praises the possibilities of asynchronous communication. Lapadat (2002) suggests that "the process of participating in asynchronous online conferences enhances literate forms of higher order thinking" (p. 22). Asynchronous communication was one area that did not fully support the benefits suggested by previous studies. While the students were not opposed to asynchronous communication, almost every student preferred synchronous communication whenever possible. The results of this study suggest some possible benefits of asynchronous communication but may also reveal that explicit training in asynchronous communication may be needed to maximize those benefits.

### **Final Researcher Commentary**

The students spoke often of the freedoms afforded to them through the change in instructional method. They spoke often and passionately about collaboration, accessibility of content and help from peers, and the feelings of the personalized education that they felt through

the process. While the students tended to struggle at times with asynchronous communication and the freedom to choose work and deadlines, they expressed that the benefits in the end result outweigh the challenges that they faced. The teacher view of each of these themes corroborates the students' views.

The students further spoke of increased engagement and motivation to complete work due to the fact that others were counting on them as learning partners. Although this view was held by the vast majority of students, there were a few students who did not embrace the concept of increased motivation and cognitive engagement for the benefit of their learning team. The few students who were not as committed to the team concept did not appear to do less than they typically would in a traditional class. Overall, an increased motivation and engagement was witnessed by the student participants as well as the teacher and second teacher observer.

As students spoke about the overall benefits of employing the use of social networking tools in education, they cited numerous examples of immediate and future benefits of the practice. They overwhelmingly feel that collaboration via the Internet will be a way of the future. As Caden summarized, "I think we need to continue to explore things like social networking and using it to learn because that's where it's going. That's where things have to go if we want to keep up."

There were some unexpected results from the study, including the students' reluctance to be on fluid teams. The students formed groups but stayed in those groups even though there was the possibility of a team better suited for their skill set. Also surprising was the strong preference for synchronous over asynchronous communication, particularly given the students' use of texting and Facebook messaging as communication methods outside of the educational setting.

The study has provided me, as a classroom teacher, with a look at the benefits associated with the implementation of social networking tools, as well as some of the aspects of the implementation to work on for future units. The study has provided me, as a researcher, with a number of possible studies that could benefit the field of education, specifically in the area of improving instructional practice.

### **Conclusion**

The three research questions that direct this study focus on: what the beneficial aspects of implementing social networking are, how that implementation impacts the engagement of students, and what students believe the benefits to be. The student responses and the teacher observations provide a glimpse into a possible future embracing social networking. While the skill set required for the 21<sup>st</sup> century has been widely discussed (Friedman, 2007; Gardner, 2004; Pink, 2006; Trilling et al., 2009), there is not one particular method that will meet the requirements. However, the results of this study suggest that implementing social networking tools into a high school mathematics curriculum can foster many of the 21<sup>st</sup>-century skills outlined.

The findings from this study will hopefully demonstrate the impact on student engagement through the use of social networking tools as an instructional method. The positive implications open the possibility of future studies to continue to examine the benefits of using social networking tools as an instructional tool to increase motivation and engagement of high school students.

### **Limitations and Future Studies**

Given the small sample size and demographics of the participants in this study, claims cannot be made regarding the scalability of the implementation and results. The following list

represents recommendations for further study that would begin to address the universality of the findings and the scalability of the implementation of social networking tools in high school:

- expansion to other core subject areas
- investigation with suburban and urban areas
- multiple school/district collaboration that would highlight asynchronous communication
- improved use of fluid learning teams
- addition of experts in the given field as contributors on the learning teams
- repeat the study with disengaged students.

The findings from this study will hopefully encourage further research on how student engagement can be fostered through the use of social networking tools. All (15 of 15) of the students requested that social networking tools be used in future units in the class and stated that they would like to see an expansion to other subject areas. This level of interest in students, while maintaining a level of content mastery equal to or greater than that of teacher-led classes, is encouraging and certainly warrants future consideration. Students believe that the tools used for social networking will be requirements in their future careers and stressed the importance of being able to use these tools in preparation for that future.

While the findings suggest many benefits in the use of social networking tools as an instructional method, there are indicators that point to the limitations of these results. The students in this study were from a small honors-level class. They all had computers and Internet access, and were relatively comfortable with mathematics and technology. The teacher-researcher as the technology integrator in the school was well versed in the technological tools and software and was able to identify and correct any possible technology-based issues.

Although the results of this study were very promising, a change in any of the aforementioned limitations could impact the results significantly. Students who are not comfortable with mathematics or technology may struggle to stay focused given more autonomy and freedom associated with this instructional approach. Additionally, given that the study was done 8 weeks into the school year, the change to a very different approach could account for some of the positive reaction due to the “newness” of the method and the movement away from the teacher-led classroom.

Students overwhelmingly (11 of 15) preferred synchronous over asynchronous communication. Therefore, situations that require asynchronous communication could hamper collaboration. Students who could not make synchronous communication sessions held by their group felt left out and chose not to contribute at that time. Students would point to the disconnect with asynchronous communication as Aiden (second focus group, December 6, 2012) said, “because of the varsity game in White Mountain, we didn’t get back until 10 o’clock and I figured out that everybody else had done it,” alluding to potential problems with the social approach. Students who lack motivation, as Aiden demonstrated in the previous example, would conceivably look for ways around work. Although this was an isolated example, a typically unmotivated student may not work to their potential given the freedom of the methods involving social networking tools.

There were two instances during the study in which individuals were not able to get online during evening hours to connect with their learning teams. On each of those occasions, the students were able to work the next day in school and able to get back online the following night. Situations where computer access is difficult or computer problems do not get fixed promptly could lead to further disconnect within the learning teams, which could diminish a

student's engagement with the content. A student is much less likely to want to use technology if there are problems with the technology, thereby limiting participation.

The introduction of social networking tools as an instructional method moves well away from a teacher-led classroom. Teachers who are more comfortable controlling the pace and direction of the class may struggle with the apparent "looseness" of this approach. Further, a teacher unfamiliar with social networking and/or technology in a more general sense would be at a significant disadvantage. The inability to troubleshoot and navigate the technology used would impede the implementation and could prevent the effort altogether.

### **Significance of the Study**

This study is important to the field of education because it reports the benefits of social networking as an instructional method to increase student engagement; a topic considered to be controversial by many. Given the relatively short history of social networking, there is very little, if any, research that addresses its use in high school classes. If we hope to prepare students to be participants in the global community as 21<sup>st</sup>-century learners, we must be willing to investigate any and all possible methods to increase student engagement and the 21<sup>st</sup>-century skill set that will be required. The participants in this study embraced the use of social networking during math class, began using the tools in other classes, and have talked at length about the aspects of social networking that will be part of their future.

The use of social networking tools in high school shows promise as a viable option as an instructional method to increase student engagement and motivation leading to an increase in academic achievement. Student autonomy and collaboration as by-products of the use of social networking tools may be key factors in the increase of engagement. Many important themes emerged from this study and open channels for future studies related to the findings. In order to

compete in a global future, the use of social networking tools in education must be taken into consideration.

This study was conducted using the theories of student engagement, online learning theory, and guided social constructivism and it was through the lenses of these theories that the many beneficial aspects of the implementation of social networking tools came to light. The results were consistent with what the theories suggest and led to a more thorough understanding of what possibilities may lay ahead for the use of social networking in education. Students continue to be taught in teacher-led classrooms with the teacher as a single point of reference offering only one way to look at learning. This educational method referred to as the *banking concept* of education by Paulo Freire (2003) has little or no place in the American high schools of the 21<sup>st</sup> century. The use of social networking tools can allow the teacher to help direct and mentor as students begin to learn to direct their own learning, to collaborate, and to increase learning outside the four walls of a classroom.

### References

- Akers, R. L., Krohn, M. D., Lanza-Kaduce, L., & Radosevich, M. (1979). Social learning and deviant behavior: A specific test of a general theory. *American Sociological Review*, 44(4), 636-655.
- Ally, M. (2004). Foundations of educational theory for online learning. In T. Anderson & F. Elloumi (Eds.), *Theory and practice of online learning* (pp. 3-31). Athabasca: Athabasca University.
- American Psychological Association. (2010). *Publication manual of the American Psychological Association* (6th ed.). Washington, DC: American Psychological Association.
- Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology*, 84(3), 261-271. doi: 10.1037/0022-0663.84.3.261
- Anderson, T. (2004). Teaching in an online learning context. *Theory and practice of online learning*, 271-294.
- Anderson, T. (2004). Toward a theory of online learning. In T. Anderson & F. Elloumi (Eds.), *Theory and Practice of Online Learning* (pp. 33-60). Athabasca: Athabasca University.
- Appleton, J. J., Christenson, S. L., & Furlong, M. J. (2008). Student engagement with school: Critical conceptual and methodological issues of the construct. [Article]. *Psychology in the Schools*, 45(5), 369-386. doi: 10.1002/pits.20303
- Ball, D. L. (2003). Mathematical proficiency for all students: Toward a strategic research and development program in mathematics education. Santa Monica, CA: RAND Corporation.
- Battro, A. M. (2004). Digital skills, globalization, and education. In M. M. Suárez-Orozco & D. Qin-Hilliard (Eds.), *Globalization : culture and education in the new millennium* (pp. 78-96). Berkeley: University of California Press.

- Becker, H. (2000). Findings from the Teaching, Learning, and Computing Survey. *Educational and Policy Analysis Archives*, 8(15). Retrieved from <http://epaa.asu.edu/ojs/article/view/442>
- Blumenfeld, P. C., Kempler, T. M., & Krajcik, J. S. (2006). Motivation and Cognitive Engagement in Learning Environments. In R. K. Sawyer (Ed.), *The Cambridge handbook of the Learning Sciences* (pp. 475-488). New York: Cambridge University Press.
- boyd, d. m., & Ellison, N. B. (2008). Social Network Sites: Definition, History, and Scholarship. *Journal of Computer-Mediated Communication*, 13(1), 210-230. doi: 10.1111/j.1083-6101.2007.00393.x
- Brown, J. S., Collins, A., & Duguid, P. (1989). Situated Cognition and the Culture of Learning. *Educational Researcher*, 18(1), 32-42.
- Carey, D. A., Fennema, E., Carpenter, T. P., & Franke, M. L. (1995). Equity and mathematics education. In W. G. Secada, E. Fennema & L. Byrd Adajian (Eds.), *New directions for equity in mathematics education* (pp. 93-125). Cambridge ; New York, NY, USA: Cambridge University Press.
- Carini, R., Kuh, G., & Klein, S. (2006). Student engagement and student learning: Testing the linkages\*. *Research in Higher Education*, 47(1), 1-32. doi: 10.1007/s11162-005-8150-9
- Cassidy, S. (2004). Learning styles: An overview of theories, models, and measures. [Article]. *Educational Psychology*, 24(4), 419-444. doi: 10.1080/0144341042000228861
- Catalano, R. F., Berglund, M. L., Ryan, J. A. M., Lonczak, H. S., & Hawkins, J. D. (2004). Positive youth development in the United States: Research findings on evaluations of positive youth development programs. *The ANNALS of the American Academy of Political and Social Science*, 591(1), 98-124. doi: 10.1177/0002716203260102

- Cobb, P., & Yackel, E. (1998). A constructivist perspective on the culture of the mathematics classroom. In F. Seeger, J. Voigt & U. Waschescio (Eds.), *The culture of the mathematics classroom* (pp. 158-190). Cambridge ; New York: Cambridge University Press.
- Cousins, J. B., & Whitmore, E. (1998). Framing Participatory Evaluation. [Article]. *New Directions for Evaluation*(80), 20.
- Cramer, M., & Hayes, G. (2010). Acceptable use of technology in schools: Risks, policies, and promises. *Pervasive Computing, IEEE*, 9(3), 37-44.
- Creswell, J. W. (2007). *Qualitative inquiry & research design : choosing among five approaches* (2nd ed.). Thousand Oaks: Sage Publications.
- Creswell, J. W. (2009). *Research design : qualitative, quantitative, and mixed methods approaches* (3rd ed.). Thousand Oaks, Calif.: Sage Publications.
- Csikszentmihalyi, M., & Csikszentmihalyi, I. S. (1988). *Optimal experience : psychological studies of flow in consciousness*. Cambridge ; New York: Cambridge University Press.
- Cuban, L. (1986). *Teachers and machines : the classroom use of technology since 1920*. New York: Teachers College Press.
- Cuban, L. (2001). *Oversold and underused : computers in the classroom*. Cambridge, Mass.: Harvard University Press.
- Cuban, L. (2004). Assessing the 20-year impact of multiple intelligences on schooling. *Teachers College Record*, 106(1), 140-146. Retrieved from <http://www.tcrecord.org>
- Creates the Amy Hestir Student Protection Act and establishes the Task Force on the Prevention of Sexual Abuse of Children, 0248S.02T C.F.R. § 162.069 (2011).

- Dabbagh, N. (2010). The Instructional Design Knowledge Base. *George Mason University, Instructional Technology Program*. Retrieved June 7, 2010, from [http://classweb.gmu.edu/ndabbagh/Resources/IDKB/models\\_theories.htm](http://classweb.gmu.edu/ndabbagh/Resources/IDKB/models_theories.htm)
- Davis-Dorsey, J., Ross, S. M., & Morrison, G. R. (1991). The role of rewording and context personalization in the solving of mathematical word problems. *Journal of Educational Psychology, 83*(1), 61-68. doi: 10.1037/0022-0663.83.1.61
- Dede, C. (2007). Reinventing the Role of Information and Communications Technologies in Education. *Yearbook of the National Society for the Study of Education, 106*(2), 11-38.
- Dewey, J. (1902/2001). The child and the curriculum *The school and society & the child and the curriculum*. Mineola, New York: Dover Publications, INC.
- Dewey, J. (1916). Democracy and education Retrieved from <http://books.google.com/ebooks/reader?id=yGxIAAAAMAAJ&printsec=frontcover&output=reader&pg=GBS.PP1>
- Diaz, D. P., & Cartnal, R. B. (1999). Students' learning styles in two classes: Online distance learning and equivalent on-campus. *College Teaching, 47*(4), 130-135.
- Dunn, R. (1990). Rita Dunn answers questions on learning styles (Vol. 48, p. 15): Association for Supervision & Curriculum Development.
- Dunn, R., Beaudry, J. S., & Klavas, A. (1989). Survey of research on learning styles. [Article]. *Educational Leadership, 46*(6), 50.
- Dunn, R. S., Dunn, K. J., & Price, G. E. (1981). *Learning style inventory*: Price Systems.
- Edelson, D., Pea, R., & Gomez, L. (1996). Constructivism in the collaboratory. *Constructivist learning environments: Case studies in instructional design*, 151.

- Ertmer, P. A., & Newby, T. J. (1993). Behaviorism, Cognitivism, Constructivism: Comparing Critical Features from an Instructional Design Perspective. *Performance Improvement Quarterly*, 6(4), 50-72.
- Eysenck, H. J. (1998). *A new look intelligence*. New Brunswick, NJ: Transaction Publishers.
- Felder, R. M., & Silverman, L. K. (1988). Learning and teaching styles in engineering education. *Engineering Education*, 78(7), 8.
- Fraenkel, J. R., & Wallen, N. E. (2009). *How to design and evaluate research in education* (7th ed.). New York, NY: McGraw-Hill.
- Fredricks, J., Blumenfeld, P., & Paris, A. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, 74(1), 59.
- Freire, P. (2003). From Pedagogy of the Oppressed. In A. Darder, M. Baltodano & R. D. Torres (Eds.), *The critical pedagogy reader* (pp. 57-96). New York: RoutledgeFalmer.
- Friedman, T. L. (2007). *The world is flat : a brief history of the twenty-first century* (1st further updated and expanded hardcover ed.). New York: Farrar, Straus and Giroux.
- Garaway, G. B. (1995). Participatory evaluation. *Studies In Educational Evaluation*, 21(1), 85-102. doi: 10.1016/0191-491x(95)00007-h
- Gardner, H. (1983). *Frames of mind : the theory of multiple intelligences* (10th anniversary ed.). New York, NY: BasicBooks.
- Gardner, H. (2004). How education changes. In D. B. Qin-Hilliard (Ed.), *Globalization: culture and education in the new millennium* (pp. 235-258). Berkeley: University of California Press.
- Gardner, H. (Producer). (2008a, June 21). Big Ideas Lecture. *Big Ideas*. Retrieved from [http://www.tvo.org/podcasts/bi/audio/BI\\_Full\\_20080621\\_HGardner\\_0x0\\_40k.mp3](http://www.tvo.org/podcasts/bi/audio/BI_Full_20080621_HGardner_0x0_40k.mp3)

- Gardner, H. (2008b, January 13, 2008). *Five minds for the future*. Paper presented at the Ecolint Meeting, Geneva.
- Gates, B. (2005). Talk presented at the National Summit on High Schools *What's wrong with U.S. high schools-- and how can we make them better*. Washington, DC, USA.
- Gawler, M. (2005). Useful tools for engaging young people in participatory evaluation. In U. C. C. R. Office (Ed.), (p. 42). Geneva, Switzerland.
- Glassman, M. (2001). Dewey and Vygotsky: Society, experience, and inquiry in educational practice. *Educational Researcher*, 30(4), 3-14.
- Google, I. (2011). Google for Educators. Retrieved December 18, 2011, from [http://www.google.com/educators/p\\_docs.html](http://www.google.com/educators/p_docs.html)
- Goos, M., Galbraith, P., & Renshaw, P. (2002). Socially Mediated Metacognition: Creating Collaborative Zones of Proximal Development in Small Group Problem Solving. *Educational Studies in Mathematics*, 49(2), 193-223.
- Greene, J. C. (1986). *Participatory evaluation and the evaluation of social programs: Lessons learned from the field*. Paper presented at the Annual Meeting of the American Educational Research Association San Francisco, CA. Paper retrieved from
- Gunawardena, C., Hermans, M. B., Sanchez, D., Richmond, C., Bohley, M., & Tuttle, R. (2009). A theoretical framework for building online communities of practice with social networking tools. *Educational Media International*, 46(1), 3-16.
- Hadjoannou, X. (2007). Bringing the background to the foreground: What do classroom environments that support authentic discussions look like? *American Educational Research Journal*, 44(2), 370-399. doi: 10.3102/0002831207302173

- Heaton, B. (2011). Missouri Governor signs law repealing teacher social media restrictions. Retrieved January 10, 2011, from [www.govtech.com/e-government/Missouri-Governor-Signs-Law-Repealing-Teacher-Social-Media-Restrictions.html](http://www.govtech.com/e-government/Missouri-Governor-Signs-Law-Repealing-Teacher-Social-Media-Restrictions.html)
- Hemmi, A., Bayne, S., & Land, R. (2009). The appropriation and repurposing of social technologies in higher education. [Article]. *Journal of Computer Assisted Learning*, 25(1), 19-30. doi: 10.1111/j.1365-2729.2008.00306.x
- Howard, B. C. (1996). *Cognitive engagement in cooperative learning*. Paper presented at the Annual Meeting of the Eastern Educational Research Association, Boston, MA.
- Huang, H. (2002). Toward constructivism for adult learners in online learning environments. *British Journal of Educational Technology*, 33(1), 27-37.
- Hughes, J. A. (2004). Supporting the online learner. In T. Anderson & F. Elloumi (Eds.), *Theory and Practice of Online Learning* (pp. 367-384). Athabasca: Athabasca University.
- Hurst, D., & Thomas, j. (2008). Developing Team Skills and Accomplishing Team Projects Online. In T. Anderson (Ed.), *The theory and practice of online learning* (2nd ed., pp. xii, 472 p.). Edmonton: AU Press.
- Junco, R., Heiberger, G., & Loken, E. (2010). The effect of Twitter on college student engagement and grades. *Journal of Computer Assisted Learning*, 1-14. doi: 10.1111/j.1365-2729.2010.00387.x
- Kanevsky, L., & Keighley, T. (2003). To produce or not to produce? Understanding boredom and the honor in underachievement.(On Gifted Students in School). *Roeper Review*, 26(1), 20(29).

- Kayes, D. (2005). Internal validity and reliability of Kolb's learning style inventory version 3 (1999). *Journal of Business and Psychology*, 20(2), 249-257. doi: 10.1007/s10869-005-8262-4
- Kelly, F. S., McCain, T., & Jukes, I. (2009). *Teaching the digital generation*. Thousand Oaks: Corwin Press.
- Klem, A. M., & Connell, J. P. (2004). Relationships matter: Linking teacher support to student engagement and achievement. *Journal of School Health*, 74(7), 262-273. doi: 10.1111/j.1746-1561.2004.tb08283.x
- Kolb, D. A. (1984). *Experiential learning : experience as the source of learning and development*. Englewood Cliffs, N.J.: Prentice-Hall.
- Krueger, R. A. (1998). *Developing questions for focus groups* (Vol. 3). Thousand Oaks, CA: Sage Publications.
- Lampert, M., & Blunk, M. L. (1998). *Talking mathematics in school : Studies of teaching and learning*. Cambridge, U.K. ; New York: Cambridge University Press.
- Lange, P. G. (2007). Publicly Private and Privately Public: Social Networking on YouTube. [Article]. *Journal of Computer-Mediated Communication*, 13(1), 361-380. doi: 10.1111/j.1083-6101.2007.00400.x
- Lapadat, J. (2002). Written interaction: A key component in online learning. *Journal of Computer-Mediated Communication*, 7(4), 21-23.
- Leadbeater, C. (2004). *Personalisation through participation: A new script for public services*. London: Demos.

- Lee, J., & Shute, V. J. (2010). Personal and social-contextual factors in K–12 academic performance: An integrative perspective on student learning. *Educational Psychologist*, 45(3), 185-202.
- Lee, V. E., & Smith, J. B. (1999). Social Support and Achievement for Young Adolescents in Chicago: The Role of School Academic Press. *American Educational Research Journal*, 36(4), 907-945. doi: 10.3102/00028312036004907
- Lenhart, A., Madden, M., Smith, A., Purcell, K., Zickuhr, K., & Rainie, L. (2011). Teens, kindness and cruelty on social networking sites. In P. R. Center (Ed.), *Pew Internet and American Life Project* (p. 86). Washington, DC.
- Lohmann, J. (2009). *Public Alternative School Practice: Creating Spaces for Reengagement and Reconnection*. Ed.D. Dissertation, Harvard University, Boston, MA.
- Machi, L. A., & McEvoy, B. T. (2009). *The literature review: Six steps to success*. Thousand Oaks, Calif.: Corwin Press.
- Madden, M., & Zickuhr, K. (2011). 65% of online adults use social networking sites. In P. R. Center (Ed.), *Pew Internet and American Life Project* (p. 14). Washington, DC.
- Malone, T. W., & Laubacher, R. J. (Producer). (1998, September 1). Harvard Business Review Article. *Harvard Business Review*. Retrieved from <http://harvardbusiness.org/product/dawn-of-the-e-lance-economy/an/98508-PDF-ENG>
- Maxwell, J. A. (2005). *Qualitative research design : an interactive approach* (2nd ed.). Thousand Oaks, CA: Sage Publications.
- Mayes, T. (2006). Theoretical perspectives on interactivity in e-learning. In C. Juwah (Ed.), *Interactions in online education : implications for theory and practice* (pp. xv, 256 p.). London ; New York: Routledge.

- Mazer, J. P., Murphy, R. E., & Simonds, C. J. (2007). I'll see you on "Facebook": The effects of computer-mediated teacher self-disclosure on student motivation, affective learning, and classroom climate. [Article]. *Communication Education, 56*(1), 1-17. doi: 10.1080/03634520601009710
- Mikulas, W. L., & Vodanovich, S. J. (1993). The essence of boredom. [Article]. *Psychological Record, 43*(1), 3.
- Molnar, A. R. (1997). Computers in education: A brief history. *T.H.E. Journal, 24*(11), 63-68. Retrieved from <http://thejournal.com/articles/1997/06/01/computers-in-education-a-brief-history.aspx>
- Moore, J. C., Sener, J., & Fetzner, M. (2009). Getting better: ALN and student success. [Article]. *Journal of Asynchronous Learning Networks, 13*(3), 85-114.
- Mosher, R., & MacGowan, B. (1985). Assessing student engagement in secondary schools: Alternative conceptions, strategies of assessing and instruments: University of Wisconsin Research and Development Center.
- National Center for Education Statistics. (2010). Number and internet access of instructional computers and rooms in public schools, by selected school characteristics: Selected years, 1995 through 2008. Washington, DC.
- National Research Council (U.S.) and Institute of Medicine (U.S.) Committee on Increasing High School Students' Engagement and Motivation to Learn. (2004). *Engaging schools: Fostering high school students' motivation to learn*. Washington, D.C.: National Academies Press.
- National School Boards Association. (2007). Creating and connecting: Research and guidelines on online social and educational networking.

- National School Boards Association. (2011). NSBA Legal Clips. Retrieved August 4 2011, from <http://legalclips.nsba.org/?p=3175>
- Newman, R. S. (2008). Adaptive and nonadaptive help seeking with peer harassment: An integrative perspective of coping and self-regulation. [Article]. *Educational Psychologist*, 43(1), 1-15.
- O'Connor, M. C. (1998). Can we trace the "efficacy of social constructivism"? *Review of Research in Education*, 23(1998), 47.
- Papert, S. (1984). Trying to predict the future. *Popular Computing*, 3(Mid October), 30-44.
- Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning styles. *Psychological Science in the Public Interest*, 9(3), 105-119. doi: 10.1111/j.1539-6053.2009.01038.x
- Persell, C. H. (2004). Using focused web-based discussions to enhance student engagement and deep understanding. *Teaching Sociology*, 32(1), 61-78. doi: 10.1177/0092055x0403200107
- Petraglia, J. (1998). The real world on a short leash: The (mis) application of constructivism to the design of educational technology. *Educational Technology Research and Development*, 46(3), 53-65. doi: 10.1007/bf02299761
- Pike, G., & Kuh, G. (2005). A typology of student engagement for American colleges and universities. *Research in Higher Education*, 46(2), 185-209. doi: citeulike-article-id:92733
- Pink, D. (2006). *A whole new mind*. New York: Riverhead Books.
- Pintrich, P. R. (2000). The Role of Goal Orientation in Self-Regulated Learning. In M. Boekaerts, P. R. Pintrich & M. Zeider (Eds.), *Handbook of self-regulation* (pp. xxix, 783 p.). San Diego, Calif.: Academic Press.

- Popkewitz, T. S. (1998). Dewey, Vygotsky, and the social administration of the individual: Constructivist pedagogy as systems of ideas in historical spaces. *American Educational Research Journal*, 35(4), 535-570.
- Porto, S. (2004). Sample Rubric for Grading Online Conference Participation (p. Rubric for online participation). Adelphi, MD: University of Maryland University College.
- Prawat, R. S. (1992). Teachers' beliefs about teaching and learning: A constructivist perspective. *American Journal of Education*, 100(3), 354-395.
- Raider-Roth, M. B. (2005). *Trusting what you know : the high stakes of classroom relationships* (1st ed.). San Francisco: Jossey-Bass.
- Reflections on the 2008 AECT Definitions of the Field. (2008). *TechTrends*, 52(1), 24-25. doi: 10.1007/s11528-008-0108-2
- Reiser, R. (2001). A history of instructional design and technology: Part I: A history of instructional media. *Educational Technology Research and Development*, 49(1), 53-64. doi: 10.1007/bf02504506
- Robinson, K. (2006). *Schools kill creativity*. Paper presented at the TED, Monterrey, CA.
- Ross, J. L., & Schulz, R. A. (1999). Using the world wide web to accommodate diverse learning styles. *College Teaching*, 47(4), 123-129.
- Saettler, L. P. (2005). *The evolution of American educational technology* (3rd ed.). Mahwah, N.J.: L. Erlbaum Associates.
- Saldaña, J. (2009). *The coding manual for qualitative researchers*. Los Angeles, Calif.: Sage.
- Salomon, G., & Perkins, D. N. (1998). Individual and social aspects of learning. *Review of Research in Education*, 23, 24.

- Schoenfeld, A. H. (2004). The math wars. *Educational Policy*, 18(1), 253-286. doi: 10.1177/0895904803260042
- Schroeder, C. C. (1993). New students: New learning styles. *Change*, 25(5), 21-26.
- Seidman, I. (2006). *Interviewing as qualitative research : a guide for researchers in education and the social sciences* (3rd ed.). New York: Teachers College Press.
- SETDA. (2008). Science, technology, engineering and math (p. 19).
- Shernoff, D. J., Csikszentmihalyi, M., Schneider, B., & Shernoff, E. (2003). Student engagement in high school classrooms from the perspective of flow theory. *School Psychology Quarterly*, 18(2). doi: 10.1521/scpq.18.2.158.21860
- Shirley, D. (2011). The Fourth Way of technology and change. *Journal of Educational Change*, 12(2), 187-209. doi: 10.1007/s10833-011-9164-z
- Sivan, E. (1986). Motivation in social constructivist theory. [Article]. *Educational Psychologist*, 21(3), 209.
- Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom: Reciprocal effects of teacher behavior and student engagement across the school year. *Journal of Educational Psychology*, 85(4), 571-581. doi: 10.1037/0022-0663.85.4.571
- Stringer, E. T. (2007). *Action research* (3rd ed.). Los Angeles: Sage Publications.
- Stumpf, S. A., & Freedman, R. D. (1981). The learning style inventory: Still less than meets the eye. *The Academy of Management Review*, 6(2), 297-299.
- Tapscott, D. (2009). *Grown up digital : how the net generation is changing your world*. New York: McGraw-Hill.

- Toppo, G. (2011, July 25, 2011). Web restrictions draw ire of some educators. *USA Today Education*. Retrieved August 11, 2011, from [http://www.usatoday.com/news/education/2011-07-25-banned-websites-school\\_n.htm](http://www.usatoday.com/news/education/2011-07-25-banned-websites-school_n.htm)
- Trilling, B., Fadel, C., & Partnership for 21st Century Skills. (2009). *21st century skills: Learning for life in our times* (1st ed.). San Francisco: Jossey-Bass.
- Von Glasersfeld, E. (1984). An introduction to radical constructivism. *The invented reality*, 17-40.
- Vygotsky, L. S. (1978). *Mind in society: Development of higher psychological processes*: Harvard University Press.
- Wenger, E. (2000). Communities of practice and social learning systems. *Organization*, 7(2), 225-246. doi: 10.1177/135050840072002
- Wenger, E., McDermott, R. A., & Snyder, W. (2002). *Cultivating communities of practice : a guide to managing knowledge*. Boston, Mass.: Harvard Business School Press.
- Wheeler, S., Yeomans, P., & Wheeler, D. (2008). The good, the bad and the wiki: Evaluating student-generated content for collaborative learning. [Article]. *British Journal of Educational Technology*, 39(6), 987-995. doi: 10.1111/j.1467-8535.2007.00799.x
- Yu, A. Y., Tian, S. W., Vogel, D., & Chi-Wai Kwok, R. (2010). Can learning be virtually boosted? An investigation of online social networking impacts. *Computers & Education*, 55(4), 1494-1503. doi: DOI: 10.1016/j.compedu.2010.06.015
- Zhao, Y. (2009). *Catching up or leading the way : American education in the age of globalization*. Alexandria, Va.: ASCD.
- Zukoski, A., & Luluquisen, M. (2002). Participatory evaluation. What is it? Why do it? What are the challenges? *Community Based Public Health Policy Practices*, Apr(5), 6.

## Appendix A

### Introductory Survey

The use of this pre-study survey will be used to determine students' background in the use of social networking tools, their comfort level with technology, and their basic feelings of engagement in previous math classes.

How confident are you in your math abilities?

- five-point Likert scale from *not confident* to *very confident*

How much do you like math?

- five-point Likert scale from *do not like at all* to *love it*

In what ways have you used social networking? (Choose all that apply.)

- for fun

- for school

- at work

- I haven't used social networking before

How comfortable are you with technology?

- five-point Likert scale from extremely uncomfortable to extremely comfortable

How do you learn best? (Choose all that apply.)

- Taught from teacher using notes

- Self-directed (teach yourself)

- Working alone

- Working with one partner

- Working in groups

Other: (please specify)

**Appendix B****Focus Group Questions (Midway and Final)**

**Focus Group Questions (after 1st unit)** - Each question should be answered with specific examples. (NOTE: When students have exhausted their commentary, the teacher will refer to specific uses of the social networking tool in various activities employed in the classroom to gain specified comments on each activity and the use of the social networking tool in that activity).

What did you like about the use of social networking tools for our math unit?

What didn't you like about the use of social networking tools for our math unit?

What should be changed about the approach that we used?

What should be kept the same or slightly adjusted?

Do you think that these methods helped you learn? How or why?

Is there anything else that you would like to add?

**Focus Group Questions (end of final unit)** - Each question should be answered with specific examples. NOTE: When students have exhausted their commentary, the teacher will refer to specific uses of the social networking tool in various activities employed in the classroom to gain specified comments on each activity and the use of the social networking tool in that activity).

What did you like about the use of social networking tools for this particular math unit?

What didn't you like about the use of social networking tools in this particular math unit?

Do you think the social networking tool was used better for your learning in this math unit in comparison to the last math unit? And, if so, how so?

Do you think the social networking tool was not used better for your learning in this math unit in comparison to the last math unit? And, if so, how so?

What should be changed about the approach that we used?

What should be kept the same or slightly adjusted?

Do you think that these methods helped you learn? How or why?

Is there anything else that you would like to add?

**Focus Group Questions (final reflection use of social network tool across both math units) -**

Each question should be answered with specific examples.

As you think back to the past couple of units that we used social networking tools, did you enjoy the different approach?

Do you think that we should continue to use this type of instruction? If so, with what frequency?

As you think back to both units, do you think that these methods helped you learn?

Focus Group Questions (end of final unit) continued

In what way can you see yourself using social networking tools outside of this class for educational purposes?

If you had one minute to talk to your other teachers about these methods, what would you say?

**Appendix C**

**Classroom Observation Rubric**

Rating: Scale of 1-10 with 10 being the best rating

Student \_\_\_\_\_

Date \_\_\_\_\_

**Category of Engagement                      Rating                      Comments**

Behavioral		
On-task		
On-time		
Persistence		
Emotional		
Interest		
Reaction to surroundings		
Flow		
Cognitive		
Response to challenges		
Psychological investment		
Strategic depth		

Clarification of terms:

Flow is a conceptualization of investment in learning or emotional engagement coined by Csikszentmihalyi (1988) and will be used as a subjective measure as suggested by Fredricks et al. (2004).

Strategic depth represents more mental effort, more connection among ideas and metacognitive strategies. (Adapted from Fredricks et al. (2004). )

**Appendix D****Online Participation/Observation Rubric**

The following rubric was adapted from a sample rubric from Dr. Stella Porto (2004).

<b>Criteria</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
Significance	The posts are meaningful a majority of the time and add to the discussion.	The posts are meaningful a good number of times and usually add to the discussion.	The posts are sometimes meaningful, but seldom add to the discussion.	The posts are seldom meaningful and hardly ever add to the discussion.
Timeliness	The student always posts his/her contributions in a timely fashion.	The student usually posts his/her contributions in a timely fashion.	The student sometimes posts his/her contributions in a timely fashion.	The student hardly ever posts his/her contributions in a timely fashion.
Frequency	Student participates in more than 80% of the available sessions.	Student participates in between 70% and 80% of the available sessions.	Student participates in between 60% and 70% of the available sessions.	Student participates in less than 60% of the available sessions.
Intensity	In sessions where the student participates, the contributions are numerous. Student takes a leading role.	In sessions where the student participates, the contributions are average to slightly above average. Student sometimes takes a leading role.	In sessions where the student participates, the contributions are below average to slightly less than average. Student rarely takes a leading role.	In sessions where the student participates, the contributions are well below average. Student virtually never takes a leading role.
Collaborative	Student is clearly collaborative with others and promotes high spirits and a can-do attitude.	Student is often times collaborative with others and sometimes promotes high spirits and a can-do attitude.	Student is sometimes collaborative with others and occasionally promotes high spirits and a can-do attitude.	Student is rarely collaborative with others and hardly ever promotes high spirits and a can-do attitude.

**Appendix E****Initial Online Participation Rubric for Student Input**

Collaborative Work Skills : Online self/peer assessment

<b>CATEGORY</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
Quality of Work	Provides work of the highest quality.	Provides high quality work.	Provides work that occasionally needs to be checked/redone by other group members to ensure quality.	Provides work that usually needs to be checked/redone by others to ensure quality.
Contributions	Routinely provides useful ideas when participating in the group and in classroom discussion. A definite leader who contributes a lot of effort.	Usually provides useful ideas when participating in the group and in classroom discussion. A strong group member who tries hard!	Sometimes provides useful ideas when participating in the group and in classroom discussion. A satisfactory group member who does what is required.	Rarely provides useful ideas when participating in the group and in classroom discussion. May refuse to participate.
Focus on the task	Consistently stays focused on the task and what needs to be done. Very self-directed.	Focuses on the task and what needs to be done most of the time. Other group members can count on this person.	Focuses on the task and what needs to be done some of the time. Other group members must sometimes nag, prod, and remind to keep this person on-task.	Rarely focuses on the task and what needs to be done. Lets others do the work.
Working with Others	Almost always listens to, shares with, and supports the efforts of others. Tries to keep people working well together.	Usually listens to, shares with, and supports the efforts of others. Does not cause "waves" in the group.	Often listens to, shares with, and supports the efforts of others, but sometimes is not a good team member.	Rarely listens to, shares with, and supports the efforts of others. Often is not a good team player.
Monitors Group Effectiveness	Routinely monitors the effectiveness of the group, and makes suggestions to make it more effective.	Routinely monitors the effectiveness of the group and works to make the group more effective.	Occasionally monitors the effectiveness of the group and works to make the group more effective.	Rarely monitors the effectiveness of the group and does not work to make it more effective.