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Walden University
2016

Abstract

Gender Differences, Learning Styles, and Participation in Higher Mathematics

by

Hilary E. Seifert

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Walden University

April 2016

Abstract

Students' lack of participation in higher-level mathematics courses is a pressing concern. In a small rural district in Alaska, many high school students elect to opt out of taking higher-level mathematics once the minimum requirement is reached. According to Bandura's self-efficacy construct, a learners' motivation is influenced by their self-beliefs and affect towards learning. Moreover, research on student learning experiences in mathematics suggests a gender difference, with girls preferring that less abstract conceptual knowledge be taught through hands-on activities. As mathematics instruction is traditionally taught through lecture and demonstration, both of which are preferences of the assimilator learning style, this study explored the role of learning styles in the lack of participation (particularly amongst girls) in higher-level mathematics. A mixed methods sequential explanatory design was used to explore the relationships among students' learning styles, participation in higher-level mathematics, and gender through a self-efficacy framework. Archival survey data were obtained for all high school students in the district (n = 63) and interviews were conducted with a subsample of students (n = 8) who volunteered to participate. Chi square analyses were performed on survey data to test for relationships between participation in higher-level mathematics, gender, and learning style. No significant relationships were found. Findings from the analysis of interview data indicated that students who opted not to take higher-level math had little knowledge of the importance of math as it relates to potential college and career options. A series of guidance lessons aimed at increasing awareness of the importance of math for future learning and potential career fields was created. This project study will promote social change by improving student awareness of, and achievement in, mathematics-related careers.

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Acknowledgments

I would like to thank my chair, Dr. Sarah Hough, my committee methodologist, Dr. Howard Moskowitz, and my URR, Dr. Vicki Underwood. To my husband, Michael, thank you for pushing me to be the best person I can be and for showing me how it feels to be truly cherished. Thank you to my daughter, Alexis, who brought the sunshine into my life, my sons, Matthew and Marcus, who taught me about patience and perseverance, my parents, Tom Franco and Vicki Kosthorst, always my biggest fans, my mother-in-law, Shirl Seifert, the calming force in so many people's lives and also to the ever-present voice in my head, the person who gave me the greatest impetus to complete my doctoral journey, my father-in-law, Dr. David Seifert. All of the support, love, and inspiration for my work came from having all of you in my life. I want to give my greatest thanks, appreciation, and faithful adulation to my higher power, God. It is only through Him that I have been blessed with this beautiful life. Thank you for the strength, perseverance, and will to see this journey through.

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Section 1: The Problem

Introduction

People learn in different ways. The way in which a person learns has a lasting impact on how learning is experienced over time. *Learning style* is referred to as the preferred means by which a person acquires and processes information in a learning situation (Kolb, 1984). It is based on individuals' learning strengths, weaknesses, and learning preferences (Kolb, 1985). Kolb's learning style theory integrates how individuals perceive and process information (Kolb, 1985). Kolb identified four learning styles. In the most general sense, Kolb interprets the range of perceptions in learning as the modes of concrete experience, as compared to abstract conceptualization, which emphasizes feeling and thinking. In addition, the ways in which learners process information range from the act of doing to that of watching, which Kolb interprets as active experimentation versus reflective observation. Kolb's four learning styles are then combined into different pairs of learning modes (i.e. diverging, assimilating, converging, and accommodating). Diverging individuals show imagination as problem solvers, while assimilating individuals are those who prefer to watch and to think. Converging individuals are more practical thinkers who tend to think and take action, while accommodating individuals are more practical hands-on learners. As learners are able to approach learning through the appropriate learning style, they are able to process information according to the way in which they prefer to learn.

Tomlinson (2009) offered support for the notion that teaching and learning according to a student's preferred mode of learning produces optimal achievement and the strongest feelings of self-efficacy toward learning for that student. For instance, according to Romanelli, Bird, and Ryan (2009), teaching and learning according to a person's learning style can augment the learning experience. Novice learners will show strong learning potential when lessons are purposefully reflective of their learning style (Tomlinson, 2008). The learners become more receptive to the learning experience when their learning styles are taken into consideration, and they will be more apt to take on novel learning experiences in the future (Tomlinson, 2008). Successful learning experiences contribute to the student's capacity to enter into further exploration of learning in their given field of study; success breeds success (Porthan, 2010). Therefore, past learning experiences create a framework for future learning.

When past experiences are not optimal, this can have an impact on future learning. Friedel (2006) emphasized that learning styles that are not aligned with instructional methods can negatively influence a student's ability to perform in an educational setting. Friedel investigated how teachers and students connect in learning environments with different modalities or have a mismatch in styles of learning. This mismatch of learning styles was found to make a difference with respect to students' overall achievement and performance (Friedel, 2006).

Furthermore, researchers have found that awareness of learning styles and choice of study strategy options are positively correlated to student achievement

(Hendry et al., 2005). Hendry et al. investigated how offering students different instructional options based on their learning styles affected learning outcomes in a positive way. The authors found that such offering had a significant effect on students' overall achievement. Conversely, Graf, Lan, Liu, and Kinshuk (2009) examined how students cope with the experience of having to learn when their learning style does not match that of the classroom instruction. They found that students had lower achievement when their learning environments did not match their learning styles. The authors advocate for adaptive instruction within the learning environment. According to Porthan (2010), students who endure incongruent learning experiences suffer from diminished self-efficacy for tackling novel learning experiences in the future. The evidence presented here illustrates the need for teaching and learning congruence.

Engaging students in a productive way that is conducive to their learning needs, may enhance their willingness to pursue future learning. According to Zelkowski (2010), a decline exists in the number of students across the United States opting to pursue advanced courses in math. This impacts high school students' future college options and career choices, as higher mathematics courses are required for many college majors (DeJarnette, 2012). In particular, data indicate a decline in female students pursuing math-related degrees (Hill, Corbett, & St. Rose, 2010). While boys and girls do tend to take approximately equivalent amounts of math and science in elementary through high school (Hyde, Lindberg, Linn, Ellis, & Williams, 2008), women declare pre-science technology engineering and math (STEM) majors and enter STEM-required college pre-major courses with less frequency than men. Women are also more likely to leave STEM fields once they have entered (Dweck, 2007). Indeed, even though women earn 58% of the total undergraduate degrees in this country, they account for only 20% of degree earners in the hard sciences and engineering (Hill et al., 2010). As women continue to decline in these fields, the gender differences across related STEM careers grow.

Some researchers purport that there are differences by which women and men self-assess their mathematics ability (Hill et al., 2010); that is, women's efficacy to do mathematics is lower than that of men even when ability between genders is comparable. A reason for this lack of efficacy in mathematics may be due to a mismatch between student learning styles and instruction in mathematics. For instance, most traditional high school math classes consist of lecture and seat work (Muro & Terry, 2007), an environment that according to Kolb's learning styles would suit the assimilator rather than the converger. In this study, I explore how learning style supports or constrains student participation in higher mathematics courses in high school.

Definition of the Problem

In the local setting, I perceived the lack of motivation in mathematics (as evidenced by the lack of course enrollment by students in advanced math courses) as an indication of students' unwillingness to challenge themselves in this content area. Once students have met the mathematics requirement for graduation, (i.e. they have taken three credits per semester over 3 years), they tend to avoid taking additional math courses even when multiple options are offered to them. In the past 3 years from 2009-2012, not a single student has enrolled in the common senior level or entry college-level advanced math courses of Calculus, College Algebra, or Trigonometry. In the study site, most students have only completed the minimum number of mathematics requirements to graduate. The minimum learning standard, as stated in district board policy, is comprised of three credits of math without specific levels delineated. In Table 1, I present archival data of course enrollments from 2009-2012. On average, 33% of seniors took mathematics their senior year of high school. The low proportion of students taking such math classes illustrates the problem that exists within the setting of this study.

Table 1

Numbers of Students Taking Advanced Math in Grade 12

Year	Graduates	Students enrolled in advanced math in Grade 12	Percentage
2012	40	13	35%
2011	26	9	35%
2010	14	4	29%
2009	22	7	32%

The problem of students opting not to continue their mathematics education beyond the minimum level presented a gap in practice at the local school environment.

The persistence of this problem would likely continue if not addressed, thus formulating the basis for the current study.

Rationale

Evidence of the Problem at the Local Level

Academic learning habits formulate how people approach learning. People learn best through particular methods (Gardner, 1999). In mathematics, the most prevalent methods are logical and sequential processes. Therefore, students who gravitate toward mathematical processes of learning tend to participate willingly and excel in that content (Kolb, 2007). However, most high school students are not aware of how they learn and why certain ways of learning resonate with them (Caprara et al., 2008). Students do not tend to reflect on the learning processes that are most productive for them. They simply learn and produce outcomes with little thought of the process itself. Therefore, developing a preference or aptitude toward certain methods of learning is not part of their cognizant efforts.

Teachers traditionally lecture in mathematics classes (Kolb, 2007). Formal presentation of math content is given, and students are expected to assimilate the information (Muro & Terry, 2007). Drawing on learning style theory (Kolb, 1984), I venture that assimilators tend to connect in the most conducive manner to traditional mathematics instruction. In this study, I explored the ways in which a person’s learning style (see Gardner, 1999) supports or constrains his or her participation in higher-level mathematics. I explored the association between learning style (as measured by the Kolb LSI [Kolb,1985]) and participation in higher mathematics courses (as measured by student enrollment in math courses in the target high school). I also interviewed current students to better understand how their experiences in current and prior mathematics classes have influenced their choices to pursue higher mathematics. Using study findings, I developed a project to help students. A student-centered approach was taken in the project development. Student driven objectives within the project offered the focus necessary to address the problem of student lack of participation in higher-level math.

Evidence of the Problem from the Professional Literature

Researchers in the social sciences have produced a plethora of articles and studies on learning styles. Through my review of this literature, I found evidence of a positive relationship between attitude and achievement in the content of mathematics due to the effects a student's beliefs and attitudes have on his or her achievement in that content. Orhun (2007) has shown that males possess more positive attitudes, more math confidence, and less anxiety in comparison to female students. Orhun investigated whether mathematical achievement and attitude towards math are contingent upon a student's professed preferential learning style and gender. The largest difference among males and females existed within the abstract conceptualization learning mode. Abstract conceptualization preferences are based on Kolb's (1984) theories that explain learning according to this preference as gravitating toward theoretical reading and studying alone. Orun (2007) found that 48% of females preferred the converging learning style, which is processing information through active experimentation, and perceiving information by thinking and doing. Novin, Arjomand, and Jourdan, (2003) used data from the Orhun study in their investigation of students pursuing the math-related fields of accounting, management, marketing, and business. The authors provided further evidence that females prefer learning through a converging learning style. Similarly, Montgomery and Groat (2000) provided further evidence that males preferred the assimilator learning style, which is learning best through lecture and demonstrations, relying on expert opinions, watching and thinking, and receiving detailed information. According to the findings of the Orhun study, female and male students have different learning styles, with females being more practical and active than their male counterparts, thus indicating the possibility of taking into account gender when studying differences in learning style.

Learning styles factor into learner behaviors. Romanelli et al. (2009) stated that novice learners show behaviors conducive to learning when lessons are tailored to their learning styles. They contend that independent learners must understand these behaviors in order to maximize their learning potential. Learning is thus generated in an atmosphere that triggers individual progress. When a student feels more comfortable in his or her learning, he or she will be more apt to take on continuing novel learning experiences (Romanelli et al., 2009). Therefore, students take on a more active role in their learning progression.

Continued research has addressed the association between academic achievement and learning style with many studies examining the student experience. According to current research, self-efficacy plays a significant part in student learning, along with academic continuance and overall achievement (Caprara et al., 2008). Choosing to continue to participate in mathematics beyond what is required, or choosing to stop learning mathematics altogether once the requirement was reached, was the critical element in the local setting of this study. In the current study, I explored learning style and self-efficacy in mathematics. I did so in an effort to illustrate the intermingling of learning style and the learning experience and how this experience impacts self-efficacy as evidenced by the choices students make in their progression in mathematics. By exploring this relationship, I hoped to expand on what is known about learning style, instruction and student performance.

Therefore, it is through the lens of Kolb's theory of learning that I began the foundation of my study. Kolb's theory of learning is grounded in the four discrete learning style categories that are encompassed in a four-stage learning cycle (Kolb, 1984). Each learner falls within one or more of these learning categories, which illustrate distinct traits that explain how they learn. Additionally, Bandura expounded upon the experience of learning further within his construct of self-efficacy. Self-efficacy is espoused within Bandura's educational theory, where he asserted that learners' motivation comes from their self-beliefs and affect towards the learning experience (Bandura, 1986).

However, when reviewing the literature, I was unable to find linkages between the work of Kolb and Bandura. Mindful of this gap in knowledge, I explored how the construct of learning style is linked to the learning experience. In doing so, I was able to gather information on how to optimize learning.

Definitions

Experiential learning theory (ELT): A systematic and cyclical theory comprised of four stages within the learning process. Kolb (1984) developed ELT as a broad, encompassing perspective of learning that focused on an individual's experience, perception, cognition, and behavior.

Learning styles: The four discrete learning styles, often called preferences, which are found within Kolb's (1984) four-phase learning cycle. Kolb contended that each person naturally prefers a particular learning style. The learning styles encompass feeling, thinking, doing, and watching to varying degrees depending on learner maturity (Kolb & Kolb, 2005).

Learning Style Inventory (LSI): A tool used to identify the four learning styles that are indicative of the four approaches to learning: diverging, assimilating, converging, and accommodating. Which learning style is preferred by an individual, is therefore contingent upon which of the four phases of the learning style cycle show dominance within the responses to the items in the inventory (Kolb & Kolb, 2005).

Self-efficacy: The building of self-confidence in learning new information as it relates to significant valuation for student progress and advancement (Bandura, 1986). The term self-efficacy, though abstract in nature, refers to a student's overall feelings toward capability to learn novel information readily and with ease. These feelings form the precursors to a learning episode and contribute to how learning occurs and the learner's experience. This psychological construct makes up part of the learner's unique experience.

Significance

Studying reasons why students choose not to participate in higher mathematics at the local setting was useful because it will allow for schools to take action to increase participation. This lack of participation in higher mathematics courses is an issue because graduates are therefore ill prepared for highly coveted fields of study involving mathematics including the STEM fields of science, technology, engineering and math. A solid college preparatory program is an essential element of creating twenty-first century high school graduates who are ready to meet the demands of post-secondary training and beyond.

The problem addressed in this study contributed to the universal setting by exploring students' learning styles and how these learning styles have enhanced or constrained their participation in advanced coursework in mathematics. Though this study took place in a small rural school setting, learner behaviors in a more general sense could be explored through the results of this study. The degree of transferability of this study to a greater population was illustrated by the fact that many students learn in similar ways, however, the sample size was far too small for generalizing purposes. This was a mixed methods design study and was comprised of descriptive statistical data as well as interview question response data of participants' experiences in taking math. These data allowed me to infer the similarity or discrepancy among the study group and individuals within the educational setting (Lodico, Spaulding, & Voegtle, 2010). Therefore, this design choice contributed to the significance of the study as an in-depth exploration of the student experience in learning math.

Guiding/Research Questions

According to Zelkowski (2010), there has been a marked decline in students across the country who opt to pursue advanced courses in math. In particular, there is a decline in female students pursuing math-related courses and degrees. The research on student learning in mathematics illustrates the presence of a gender difference among males and females with females preferring less abstract conceptual knowledge inquiry (Usher, 2009). However, most mathematics instruction is traditionally taught to the assimilator learning style through lecture and demonstration. In addition, at the college level it has been demonstrated that males and females have different learning styles in mathematics (Orhun, 2007). This contributes to the notion that not only is there an impact from learning style on students' abilities to make informed educational choices, but that this impact may differ between the genders.

The problem addressed in this project study was that students at the local site have not been choosing to take higher-level mathematics, possibly due to an incongruence between their learning styles and classroom instruction. Higher-level math is defined by the district as courses taken beyond Algebra II and standard math level is defined as math courses taken up through Algebra II. This study addressed the problem by exploring the ways in which student learning styles serve to enhance or constrain their choice to participate in mathematics.

The overarching question guiding this study is: How and in what ways do learning styles enhance or constrain students' decisions to take advanced courses in mathematics? The particular research questions addressed are:

RQ1: What are the learning styles of high school students in District R?

RQ2: Does a common learning style exist among students who were and who were not on-track to take higher math in high school?

$H_0$2: Learning style and students being on-track to take higher math are independent.

$H_1$2: Learning style and students being on-track to take higher math are not independent.

RQ3: Does a common learning style exist among students who do and do not take higher math in high school?

$H_0$3: Learning style and participation in higher math in high school are independent.

$H_1$3: Learning style and participation in higher math in high school are not independent.

RQ4: Does a common learning style exist between male and female participants?

$H_0$4: Learning style and gender are independent.

H_14: Learning style and gender are not independent.

RQ5: What do students at the study high school think about whether learning style impacts their decisions to take higher-level math in high school?

Review of the Literature

Learning Theory

The theoretical base and conceptual framework for this study stems from the works of Kolb and Bandura. Kolb's theory set out to establish four explicit learning styles that are founded upon a four-stage cycle of learning. Kolb contended that each person naturally prefers a particular learning style. Learning style is grounded in ELT and is founded upon the perception of learning from experience through the coordination of action and reflection with experience and abstraction (Passerelli & Kolb, 2009). Individuals develop within stages of learning moving from acquisition into integration. Junior high and high school students fall within the acquisition stage and have therefore not reached a level of interweaving each learning style, thus they are still at a rudimentary level of maturity in seamless learning. The learning styles encompass feeling, thinking, doing, and watching to varying degrees depending on learner maturity. ELT proposes that the concept of a learning style is not derived from the idea that it is a psychological trait of a person; therefore, it is not static. Instead it is a dynamic state deriving from a combination of interactions between the person and his or her environment (Passarelli et al., 2009).

Kolb (1984) identified four learning styles in his experiential learning cycle. The cycle includes concrete experience, in which the learner actively experiences a learning session; reflective observation, in which the learner purposefully reflects back on the episode; abstract conceptualization, in which the learner tries to grasp what was observed; and active experimentation, in which the learner is actively formulating a plan to test the new model for future learning experiences (Kolb, 1984). The corresponding learning styles match these learning cycle stages. The styles are: assimilators, who are optimal learners when offered logical theories; convergers, who are individuals whose strongest learning is accompanied with practical applications of novel information; accommodators, who are students who need hands-on experiences to attach learning to; and divergers, who are learners who learn best when afforded the opportunity to observe and collect a variety of information related to the new concept (Kolb, 1984).

Much of ELT has focused on the idea of learning style as determined by the Kolb Learning Style Inventory (LSI; Kolb, 2007). Individuals who take the LSI to assess learning style are often led to the development and use of multiple learning modes. Learners tend to accommodate to either improve an overtly weak learning mode or to foster a mode that is specifically important for the immediate learning task (Passarelli et al., 2009). According to Kolb & Kolb (2009), there is an increasingly profound amount of evidence that indicates that the metacognitive processes of individuals have a distinct effect on their ability to cohesively learn from and through experience.

Bandura is known as one of the most prominent theorists of social cognitive theory. The construct of self-efficacy grew out of this theory, offering an explanation of human behavior in learning that illustrates how a person's proximal determinants of motivation stem from their processes of beliefs and feelings towards the learning experience (Bandura, 1986). Self-efficacy is a psychological phenomenon that occurs in a learner's perceptions of confidence in his or her capability to be successful in a learning task. Increasing self-efficacy in ways such as vicarious learning lend support to the learners' feelings of success in learning thus building confidence in perceptions of capability (Bandura, 2008a). It is through this theory that the construct of self-efficacy surfaced as an optimal condition for learning to take place readily and with internal learner motivations driving the experience in a positive direction. Interrelated with the construct of self-efficacy lies learning identity. Over time as a learner builds confidence in his or her learning orientation or learning style, optimal learning experiences are fostered (Passerelli et al., 2009).

Both foundational theories provide the grounding for this research study. The study of personal attributes as explained in these theories offered the backdrop for the purpose of this research. Studying learner characteristics and how they impact learning outcomes was the premise of this study. In the current study, the exploration of learning style in relation to student choices in math coursework was the focal point.

According to Bandura, the construct of self-efficacy is a person's feeling of potential for accomplishment in novel tasks; it is what allows a person to tackle a challenge with motivations of mastery, instead of avoidance and viewing a challenge as a threat (Bandura, 1994). Increased feelings of self-efficacy are then conducive to student advancement as the students bring with them an internal acceptance of potential failure and a resiliency to persist in their learning. Based on the theory of self-efficacy, the current study investigated how student choices contributed to the overall feelings of confidence for the learner.

Within the current body of research there lies strong support for the notion that personal learner attributes contribute to enhanced learning experiences. Learning style preferences and modalities of learning are supported by a long history of research that indicates individual nuances of the learner contribute to the way information is received, perceived, and retained. It is by tapping into this individualized response and transfer aspect of the person that learning takes place in the most optimal fashion (Kolb, 1984).

Instruction and Learning Potential

Romanelli et al. (2009) espoused the tenets of learning preferences used as a source of information that focuses teaching strategies to augment the learning experience so that varied learners from diverse backgrounds receive instruction that matches their preferences. It is offered that learning style categorizing instruments may offer a way to identify and use this aspect of students' learning. This study contributed to the identification of learning styles through use of a structured instrument affording students a method of self-knowledge of learning style. Additionally, Kolb and Yeganeh (2011) spoke of this as building in learner metacognition through the use of the LSI instrument.

Utilizing a perspective of multiple ways of learning is also valuable for the identification and delivery of instruction for gifted students (Kuo, Maker, & Hu, 2010). In this way, students do not have to fit into a specified mold, but rather their learning can be explained in ways that describe them on a broader scale according to their uniqueness. Using varied learner preferences is a means to an end in the age of high-stakes testing

(Rushton & Juola-Rushton, 2008). Using methods to dissect the learner's mechanism for receiving information and formulating a plan to use instructional strategies that will accommodate for that mechanism offers a more beneficial means to impart learning (Bostrom & Lassen, 2006).

The ELT model is set up as two polarized means of experiencing the world around us: concrete experience (CE) and abstract conceptualization (AC). There are also two opposite modes of taking that experience and transforming it into meaning known as reflective observation (RO) and active experimentation (AE) identified by Kolb and Kolb (2011). According to Kolb and Kolb, learning efficacy is greatly improved when individuals can gain mastery in interpreting experiences through all four facets of the learning cycle. Thus in approaching learning in a deliberate way, learning can be approached with mindfulness (Yeganeh & Kolb, 2009). Metacognition, knowing yourself as a learner, mindfulness, focusing on direct and present experience, and deliberate practice are all intrinsically positive aspects of the optimal learning experience (Kolb & Yeganeh, 2011).

This premise leads to a parallel construct of learning style preferences that served as the impetus for the work of Tomlinson on differentiated instruction. According to Tomlinson (2008) differentiation allows students to not only grasp content, but also to formulate their own identities as learners. Creating learning profiles made up of learner attributes contributes to student achievement (Tomlinson, 2009). It is through individualized profiles of student learning styles and preferences that a program of study can be designed to accommodate the needs of every single student through the same lens that he or she uses to filter the world (Tomlinson, 2009). Offering differing delivery methods of content, process, and product affords students an optimal learning environment (Levy, 2008).

Student Participation and Self-Efficacy in Math

Delving into the current research supporting Bandura's self-efficacy construct, one finds that the idea of self-concept as a learner is an important aspect in successful educational achievement. In an extended longitudinal study, Caprara et al. (2008) found that perceptions of self-efficacy contribute to how a student learns in a self-regulated format and is predictive of academic continuance and overall achievement, decreasing the likelihood of drop-out tendencies. This research suggested that heightened self-actualized feelings of personal capacity to learn builds a sense of confidence in a learner, therefore fostering a will and motivation to stay in school and continue the educational cycle. This continuation effect is especially informative for the current study in that it contributes to the argument that self-efficacy builds student confidence in learning advancement and continuation.

Bandura (2008c) spoke of this construct as being an agent of action, the *agentic* perspective, indicating that personal motivations drive ambition and initiative to learn. Being the driver of one's endeavors is a precursor to academic success. The agentic self is derived from cognitive self-regulation that enables a person to visualize futures based on the present situation. Additionally, the agentic self assigns priority based on personal values in which a person can construct, evaluate, and adapt to actions, which allows the person to anticipate outcomes while overcoming obstacles (Bandura, 2008a). It is through the ideal of free will that the social cognitive theorist derives that through individual action there is the capacity of personal influence over a situation (Bandura, 2008b). Through the agentic self, a person has "four properties of human agency including: intentionality, forethought, self-reactiveness, and self-reflectiveness" (Bandura, 2008b, p. 18). It is through these properties that a learner can reason and interpret a situation for optimal return.

High self-efficacy factors have been found to produce marked academic results. Diseth's (2011) correlational analysis showed a strong relationship between variables of motivation and learning strategies, resulting in subsequent higher academic achievement. Walker, Greene, and Mansell (2006) supported a consistent correlational relationship among motivational factors, self-efficacy, and academic achievement; Ferla, Valcke, and Yonghong (2009) also indicated a strong relationship between academic self-concept and academic self-efficacy. Therefore, a solid background to support a correlation between self-efficacy and achievement is present in the literature.

Zelkowski (2010) found that the number of students in America decreased with regard to those who chose to pursue higher-level math courses in preparation for majors in science, technology, and mathematics. Zelkowski's study shows evidence of the current study's problem, which is a decrease or lack of enrollment in higher-level math coursework in high school. In addition, the National Mathematics Advisory Panel (2008) contended that because of an increase in retirees within the technology and science fields, there will be a void due to the decrease of students majoring in such fields. This phenomenon is significant to explore at the secondary level to find the reason behind the trend. In the current study, I investigated a possible precursor to this decline by exploring student choices in mathematics coursework. Chouinard and Roy (2008) have studied affective variables as they relate to math performance. It was their intention to show that by examining such variables, the contribution of those affective variables to positive achievement could be put into action in curriculum decision-making. The results showed that motivation dropped in mathematics during high school, most pronounced between Grade 9 and Grade 11. Additionally, Chouinard and Roy (2008) illustrated a convergence among genders rather than a differentiation. Hutt (2007) implemented a course in learning how to learn focused on changing students' academic identity in math from one of anxious inferiority to one of confident self-efficacy that produced positive results. The results showed evidence that learning was positively promoted when experiential course elements were in place such as teachers' conscious focus on the unconscious processes in the learning environment coupled with self-reflections and self-talk of students pertaining to their learning experiences (Hutt, 2007).

Students' attitudes towards math are compounding factors that may be contributing to a negative effect on performance and choices to continue in this content area. Allensworth, Nomi, Montgomery, and Lee (2009) studied Chicago Public Schools' mandate of Algebra I for all incoming ninth graders. An increase in failure rates among those ninth graders who were being studied was found to be a direct result of learning without supports in place. Those supports offer students a mechanism of avoidance of failure that could later resurface when students are called upon to choose more advanced math courses in the future. Based on past failure, students may be less likely to take those academic risks in the area of mathematics (Porthan, 2010).

Student attitudes towards math were investigated in a study by Martino and Zan (2010), in which support was developed in relation to a multidimensional model describing student attitudes towards mathematics. The model incorporated students' emotional dispositions in regard to math and their perspectives and confidence in math. This study illustrated that as early as middle school, students begin to develop their negative attitudes and emotions associated with math (Martino & Zan, 2010). Hannula (2006) concluded that there is an intricate framework of emotions, associations, expectations, and values that factor into student attitudes that may in fact negatively affect a student's self-concept in math even for a student with an otherwise strong self-concept. According to Nordell (2009), this negative attitude can also impact self-regulation skills in students. Self-regulation skills are those that control a student's work habits and engagement in learning as a whole. Self-regulation comprises the processes that learners use to initiate and prolong the thoughts, behaviors, and feelings used to reach learning aims (Ramdass & Zimmerman, 2008). Kitsantas, Cheema, and Ware (2011) stated that helping students to generate self-regulatory skills builds self-efficacy to take on additional academic tasks. Therefore, in establishing strong self-regulatory skills one would conclude that self-efficacy would then solidify and lead the learner to continue to seek out novel academic tasks in the future.

In as much as strong self-regulation contributes to positive self-efficacy, the lack thereof may cause students to develop diminished engagement in that subject, thus impairing their decision-making related to that subject. Amirali (2010) conducted a study that indicated a strong affinity for math as well as solid positive attitudes and low levels of anxiety over math related to prior learning experiences. The author attributed this to positive early experiences in school. The counter argument is that negative early experiences will produce the result of a negative attitude about math accompanied by high math anxiety. As previously noted by Nordell (2009), students who were not given the appropriate supports were thrust into an episode of learning that was not optimal, thus creating a negative outlook on the subject and subsequent courses related to that subject. Pajares (1996) reviewed the literature on self-efficacy in academic settings and found that the construct of self-efficacy was a more likely predictor of initiative to take advanced mathematics courses than was previous math achievement.

Confidence and motivation are known to be key factors contributing to attitudes toward a particular subject area (Nordell, 2009). In 2006, the Programme for International Student Assessment (PISA) compared students' confidence in accomplishing difficult tasks in mathematics using a self-efficacy index. The results indicated a correlation between self-efficacy and achievement in mathematics (Programme for International Student Assessment, 2006). According to Shaffer (2009), motivation shows significant impact on learning and motivation is directly linked to self-efficacy factors. In a more recent Fleischman, Hopstock, Pelczar, and Shelley (2010) study, PISA indicated that students reported internal motivation as contributing to their interest in building mathematical skills for their later success. Thus, internal mechanisms at work within students factor into their engagement in establishing the tools necessary for success in a given area. Attitude and motivation can therefore instill a willingness to grow skills within the learner (Nordell, 2009).

Gender Differences

Yet another mitigating factor is that particular students' often have miscalculated inaccuracies about their ability in a given area. Students, predominantly females, often hold unrealistically low self-efficacy beliefs, which impact learning far more than lack of ability in math (Ramdass & Zimmerman, 2008). This miscalculation is known as errors in calibration or in the metacognitive perception of one's personal performance (Schunk & Pajares, 2004).

According to Ramdass and Zimmerman (2008) gender was not significantly related to calibration, but rather it did show that gender correlated with self-evaluation, indicating that boys rated their performance in a more optimal fashion than girls. Also in relation to gender differences, Orhun (2007) found that there are particular learning modes that are preferred by female and male students that reflect their attitudes toward mathematics. Learning modes are described by Kolb (1984) as the way individuals interpret the potential options when encountering a novel event. The Orhun study showed evidence of a significant difference between attitudes towards math and the four learning modes identified by female and male students. Females predominantly tended to prefer the converger learning style, with favorable abilities in AC and AE. Males tended to prefer the assimilator learning style with favorability towards AC and RO. Thus, Orhun was able to conclude that females and males have distinctive and varying learning styles. Orhun's findings lend support to the current study to take into account effects of gender on learning in math in accordance with a learning style and self-efficacy focus.

Ozgen and Bindak (2011) found significant differences within individuals' self-efficacy in regard to literacy in math tasks reflective of gender, class, school type, and education of parents. In terms of the gender differences, males had far more positive results than females in math literacy self-efficacy levels. This finding is supported by the 2003 PISA survey that placed math literacy self-efficacy beliefs of females as much lower than males (Organization for Economic Co-Operation and Development, 2003). In addition, it was noted by the Organization for Economic Co-Operation and Development that students with high math self-efficacy are expected to make choices and to participate in math classes more regularly.

Ross, Scott, and Bruce (2012) conducted a study of self-efficacy among 996 middle school students and showed that differing beliefs continued between genders throughout schooling even when differences in achievement bordered zero. Ross et al. (2012) explored the gap in confidence in relation to knowledge of fractions among males and females. Through a multivariate analysis of variance of all affect variables, Ross et al. (2012) found that "when pre- and post-test achievement were repeated measures and gender was a between-subject factor that there was a statistically significant main effect with an achievement-gender interaction that slightly favored males" (Ross et al., 2012, p. 286). Using this multivariate analysis of variables, the findings were that males had higher positive scores on self-belief scales as compared with females. Math self-efficacy tended to be higher for males, while their fear that they might fail was lower than their female counterparts. The contributions of this study show that even with less than a 1% variance in knowledge of fractions, gender differences in self-beliefs were statistically significant and of meaningful size (Ross et al., 2012).

Weinberg, Basile, and Albright (2011) used the expectancy value model as the framework of a study with 336 middle school students to delve into students' motivation toward mathematics and science. Overall interest in math increased after completion of an experiential learning program. However, the importance of math on students' self-concept showed a decline, with gender differences surfacing showing males with greater gains than females.

Usher and Pajares (2006) explained that experiences of mastery and those categorized as social persuasion illustrated the most pronounced indicators of academic self-efficacy for girls, and in turn, experiences of mastery and those labeled as vicarious experiences proved to be the most pronounced indicators of self-efficacy in boys. Thus, by using these various methods of enhancing students' efficacy beliefs, the greatest learning outcome can be reached (Kitsantas et al., 2011). Additionally, Usher (2009) conducted a qualitative study using interviews conducted among teachers and parents of middle school students pertaining to their children's performance in math. Both teachers and parents reported that they were more inclined to interpret the performance of girls as an attribute of their hard work, while they expressed surprise that boys' performance was so high in relation to their lack of work. Usher concluded that messages from parents and teachers given to students may be intrinsically affecting students' self-efficacy beliefs.

The influence of extrinsic perceptions on the student belief system is profound. The expectancy-value model postulates that social factors, for instance others' beliefs and behaviors, have an influential affect on personal factors, for instance gender self-schemata and how gender roles are perceived (Eccles & Wigfield, 2002). According to Eccles and Wigfield (2002), a mother's beliefs about her children's capabilities have a stronger predictive value for math achievement than the children's actual grades in math. Therefore, other people's expectations have been shown to influence motivation. This lends credence to the existing math gap between males and females in that the socialization and emerging self-concepts related to specific gender abilities in boys and girls formulate at a very young age (Steffens, Jelenec, & Noack, 2010). Steffens et al. (2010) reported that this self-concept has shown more influence over math achievement and subsequent course selections than math grades themselves.

Math gender-stereotypes are one of the leading culprits in this phenomenon. As early as elementary school, far before high school or college, there exist disparities in math and science aspirations for young female students when compared to their male counterparts (Riegle-Crumb, Moore, & Ramos-Wada, 2010). When Riegle-Crumb et al. (2010) studied this lower self-concept for women, it was found to be a poignant factor in the gender differences found in college choices and was linked to enjoyment level for that content. Lovelace (2006) showed that factors of enjoyment and positive affect provide attitudes that are crucial to keeping students interested in pursuing the fields of math and science. According to the National Academy of Sciences (NAS), there is a growing concern for recruiting females in the STEM fields with the rising need in a historically white male dominated field (NAS, 2007, 2010). STEM fields are much more male-oriented fields that women and people of color have a much lower inclination to enter (Campbell, Deines, & Morrison, 2000). Riegle-Crumb et al. found that females of all races remain less likely than males to find a future career in math appealing.

Steffens et al. (2010) contended that these decisions related to avoidance of math-related career fields are made during the school-age years. In this 2010 study, the sample included several elementary schools as well as intermediate schools and college-track high schools. Students were asked about their math self-concept, math intentions, school grades, and gender stereotypes. Math gender stereotypes were evidenced in girls as young as 9 years of age. Female adolescents also indicated implicit stereotypes that exceeded that of boys. At this early age, girls were already leaning toward an affinity in another content area (German) over math, whereas boys had no such developed affinity at this age. "Math gender stereotypes predicted both implicit and explicit math concepts, enrollment preferences, and school grades for girls showing diminished girls' commitment to math related fields" (Steffens et al., 2010, p. 957).

With that lack of commitment to math comes a lack of motivation to participate in math courses, as evidenced by Eccles & Wingfield (2002) in the expectancy value model. Leaper, Farkas, and Spears Brown (2012) investigated the tenet that elements of a social and personal nature would independently predict motivation. Controlling for all other variables including ethnicity and grade, social and personal aspects did indeed predict motivation in girls. Additionally, it was found that girls' motivation was negatively and significantly correlated to pressure coming from parents. The aspects that did prove to increase motivation in girls were perceived peer support and enhanced gender equality beliefs. In the current study, this element of perception of support and gender equality will facilitate the direction of the study project. In addition, Siegle and McCoach (2007) found that the correct educational strategies were conducive to increasing math literacy self-efficacy beliefs, thus supporting the fact that these constructs of self-efficacy are not static, but rather can be changed and improved. The findings of Siegle and McCoach support the need for the current study's focus on gender differences embodied within the constructs of learning style and self-efficacy.

Implications

This research explored the significance of students' learning styles and made this connection for educators as an essential element in instructing students to promote optimal learning. Sharing this information with teachers is beneficial as it broadens their understanding about how their students learn and how to help them gain the most out of every learning experience. Building students' self-confidence in learning new information is of significant value for student progress and advancement, thereby supporting this inner psychology of learning, known as self-efficacy, and contributing to the overall positive episodes a student will experience in his or her education (Bandura, 1986).

Summary

The key components of this study were founded on the idea that there is a connection between learning styles and self-efficacy that impacts student coursework advancement choices in the area of mathematics. The problem that was addressed was the lack of learning through advanced coursework in the mathematics content area.

Through this study of learning preferences and learner experiences, I was able to explore the student potential to achieve optimal learning outcomes. I addressed the elements of learning related to learning style and self-efficacy. As students make choices to participate in advanced mathematics courses, they are also learning the implications of those choices in regard to optimizing future learning potential.

Section 2: The Methodology

Introduction

The problem within the local setting was the lack of student enrollment in higher mathematics. In order to address this problem, I explored the relationship between learning styles, participation in higher mathematics, and gender in the content of mathematics through a mixed methods study. The methodology used to conduct this exploration is described in detail below.

Research Design and Approach

A mixed methods design was used in this study. Mixed methods design is a methodology in which one type of data (in this case, quantitative data) provides a basis for the researcher in collecting another type of data (in this case, qualitative data; Lodico et al., 2010). My rationale for using a mixed methods design was to gain both an understanding of the types of learning styles that students have and the ways in which those styles vary between genders and whether students participate in higher-level math courses. I also wanted to gain an in-depth understanding of the factors that may have constrained or enhanced participants' course taking in mathematics. In particular, I placed the qualitative focus on how learning style mismatch may have factored into students' experiences in school.

By collecting and analyzing two types of data, I was able to answer my primary research question, which was, how, and in what ways do learning styles enhance or constrain students' decisions to take advanced courses in mathematics? I also asked the following sub-questions:

RQ1: What are the learning styles of high school students in District R?

RQ2: Does a common learning style exist among students who were and who were not on-track to take higher math in high school?

$H_0 2$: Learning style and students being on-track to take higher math are independent.

$H_1 2$: Learning style and students being on-track to take higher math are not independent.

RQ3: Does a common learning style exist among students who do and do not take higher math in high school?

$H_0 3$: Learning style and participation in higher math in high school are independent.

$H_1 3$: Learning style and participation in higher math in high school are not independent.

RQ4: Does a common learning style exist between male and female participants?

$H_0 4$: Learning style and gender are independent.

$H_1 4$: Learning style and gender are not independent.

RQ5: What do students at the study high school think about whether learning style impacts their decisions to take higher-level math in high school?

I addressed the research questions by analyzing and integrating both quantitative and qualitative data. First, I collected and analyzed quantitative data, which included student responses to Kolb's Learning Style Inventory (Kolb, 2007) and records of courses that students had taken. Next, I collected and analyzed qualitative interview data based on initial findings from the first data phase (Creswell, 2009). I considered my mixed method study sequential as it used the initial findings from the quantitative analysis to guide the collection and interpretation of the qualitative data. Qualitative data that I collected were then used to interpret and connect the quantitative results. I integrated the mixed methods data at both the analysis and interpretation phases.

I used the mixed methods design because it was logically derived from the nature of the problem. The problem called for an initial understanding and quantification of all students' learning styles. This was followed by an exploration of the ways in which students perceive the connection between taking higher-level mathematics courses, their learning style, and other educational factors. Because I believed that quantitative data would not be sufficient to explain why students' learning styles or other factors may have affected their course taking outcomes, I also used qualitative data to offer a more detailed and rich overall descriptive and explanatory picture of the students' current and past experience. By delving into qualitative data through interviews, I was able to explore the students' experiences in mathematics in light of their particular learning styles and participation in higher mathematics courses. Having such data, I was able to gauge the factors that have contributed to students' math course choices.

Setting and Sample

The local setting for this research study was a small, rural school district (School District R), which is located approximately 700 miles south of Anchorage, Alaska on the Aleutian chain of the western coast of Alaska. Approximately 200 students are enrolled in this district. The schools that participated are part of School District R. The majority of families in this area live in commercial fishing communities. This is a typical demographic of a rural school for this region of the state. The communities that populate this school district range in number from approximately 100-900 people.

My study population consisted of School District R Senior High School students in Grades 9-12, all of whom had taken a math course during the 2013-2014 school year. This population was comprised of 65 students aged 14-18, which included 15 seniors, 15 juniors, 15 sophomores, and 20 freshmen. The gender breakdown was 35 females and 30 males. The sample size of 65 was relatively small due to the size of the schools. Demographics of this population were largely homogenous between two ethnic groups comprised of Caucasians and Aleut Alaska Natives. The socioeconomic status of the families in this school district is middle to high with an average of less than 10% of students qualifying for free and reduced lunch, according to School District R enrollment.

Quantitative data that I used were comprised of students' LSI scores, gender, grade level, and math courses taken. From the full sample, I asked for volunteers to participate during the qualitative, open-ended interview phase. The sampling of the interview participants was done purposefully within the high school population to try to ensure an equal balance of male and female participants and included only those students whose parents signed informed consent. Purposeful sampling was used seeking a balance among the variables of gender, grade level, and math courses taken. All students from the population whose parents or guardians had signed consent forms had an equal chance of selection for the qualitative, interview phase. I intended to obtain data from an equal number of male and female students across all grade levels (9-12) in higher-level math courses (beyond Algebra II) and standard math courses (up through Algebra II).

Data Collection

Quantitative Sequence

The district administered the Kolb LSI for the purposes of having a deeper knowledge of students' learning needs. I approached the district to request access to the LSI data to explore this aspect of student learning further within my doctoral study. I gained permission from the superintendent to do so. I was given de-identified student data for School District R Senior High School students in Grades 9-12, all of whom had taken a math course during the 2013-2014 school year. Data consisted of the participants' learning styles responses, gender, grade level, and courses taken in mathematics during their high school years from 2010 to 2014. Participants for the qualitative phase were selected via purposeful sampling from those students whose parents had given consent for them to be interviewed. I was able to obtain an equal number of male (n = 4) and female (n = 4) interview participants in higher-level math (beyond Algebra II) or standard math groupings (up through Algebra II). Though I was able to obtain data from an equal number of male and female students, I was not able to obtain an equal number in higher-level math courses and standard math courses among Grades 9-12 due to an insufficient number of signed consent forms received.

Once I obtained informed consents from parents for interview participants, students' de-identified LSI scores, grade, gender, and math enrollment were relinked to their identity by the district so that I could use their data in the interview. Additionally, each of these eight interview participants signed a student assent form before being interviewed. I informed participants that they could opt out of the interviews at any point. In the parent consent and student assent letters, I outlined this opt out process.

I received the student data in a de-identified format, which meant that students' data were anonymous. I saved the de-identified data in a password protected electronic file and on a back-up hard drive housed in a locked filing cabinet to maintain confidentiality. I received the raw scores for the LSI 12-item, forced-choice inventory. The LSI provides a system of ranking one's personal preferences according to the four modes of the learning cycle (Kolb & Kolb, 2005). In addition to these raw scores, I had access to an Excel spreadsheet, which I obtained from the district with numbered, de-identified student data including gender, grade level, and their history of high school math courses. By receiving the data in a de-identified format of numbering each student, the data received was anonymous. Students in Grades 9, 10, 11, and 12, had taken 1-4 years of math courses. I obtained math enrollment data for students in Grades 9-12 for the 2014-2015 school year from the school district.

Instrumentation. The LSI was used to measure participant learning styles (Kolb & Kolb, 2005). It follows three design parameters: brief and straightforward, response based on learning situations, and predictive of behavior consistent with ELT. The LSI consists of 12 forced-choice items; for each the respondent must choose from the four learning style modes and assign each sentence's relative alignment with his or her preferred methods of learning (Kolb & Kolb, 2005). This is known as a forced-choice format in which the respondent must choose from the four learning style modes and assign each sentences' relative alignment with his or her preferred methods of learning.

The Kolb LSI was founded in ELT. In Kolb's learning style theory, knowledge is created by the learner through experience and can be thought of as a four stage cycle that the learner experiences in the following manner: "immediate concrete experience informs observation and reflection followed by these observations being assimilated into a theory from which new applications for action can be formulated, and these new applications then guide learners in their actions to create new experiences" (Kolb & Kolb, 2005, p. 2). Throughout the learning process, a person can make use of different learning modes depending on their perceptions and interpretations of learning events. Concrete experience is learning through experiencing. Delving into learning as a new experience describes concrete experience. Reflective observation uses reflections in learning. Being reflective, and observing the world from a range of perspectives is learning through reflective observation. Abstract conceptualization focuses the learning on thinking. Generating new concepts grounded in observations and taking them further into logical understanding is abstract conceptualization as a learner. Active experimentation incorporates learning through doing. Going from theories to making informed decisions to solve problems encompasses active experimentation as a learner (Kolb, 1984). The other variables combine to make two scores that measure preferences of the individual. This measure of preferences represents Kolb's ELT model. Abstractness may be preferred over concreteness as well as action may be favored over reflection. ELT's focus is therefore placed on what is called a learning style, which is the favored approach an individual takes to learning, thus categorizing individuals as diverging, assimilating, converging, and accommodating (Kolb, 1984).

The patterns of LSI scores surface to show an individual's dominant abilities to learn. Diverging style has dominant strengths in the areas of concrete experience and reflective observation indicative of individuals who have the optimal ability of looking at concrete situations from varying perspectives. Individuals with a diverging learning style possess broad interests and are drawn to the activity of gathering information. These individuals are interested in people; they have bold imaginations coupled with astute emotional responses. Those of the diverging learning style are interested in different cultures and the arts. In structured learning circumstances, diverging styles want to work in groups, can listen without bias, and are open to receiving feedback. Individuals with assimilating style have strong learning abilities in the areas of abstract conceptualization and reflective observation. They are adept at understanding a broad range of knowledge and organizing it using brevity and logic. Assimilating types are not as interested in people as they are in ideas and abstract concepts. Generally, they gravitate toward the importance of a theory having logical soundness rather than practical value. In formal learning scenarios, this style focuses best when presented with readings, lectures, analytical models, and reasoning tasks. The converging style possesses strengths in abstract conceptualization and active experimentation. Therefore, they are best suited for jobs that require practicality for ideas and theories. They have the ability to solve problems by finding solutions. Their preferences include technical tasks and problems instead of social ones. In formal learning settings, this learning style prefers to experiment with new ideas, simulations, experiments, and practical work. Learners with an accommodating style have concrete experience and active experimentation as their strongest learning abilities, learning primarily through hands-on experiences. They tend to rely on their intuition instead of reasoning through the logic of the situation. In real-time learning situations, the accommodating type has a desire to work cooperatively with others, to set objectives to reach, and to test different perspectives on completing a task (Kolb & Kolb, 2005).

According to ELT, learning style is not a static state, but rather it is a changeable state that is founded from an individual's preferences with regard to the "dialectics of experiencing/conceptualizing and acting/reflecting" (Kolb & Kolb, 2005, p. 2). As such, "ELT is a holistic, dynamic, and dialectic theory of learning" (p. 4) with the four ways of learning being dependent upon one another as the learner responds to novel learning situations (Kolb & Kolb, 2005). AC-CE and AE-RO are conversely related; therefore, the choosing of one pole forces the action of not choosing the opposite pole. Therefore, according to ELT, learning experiences are based on the learner's ability to resolve conflicts between the learning modes, thus the learning style assessment process requires a parallel resolution in the choice of one's preferential learning approach to particular scenarios. According to Kolb's foundational theory, individuals make choices that can determine how they will interpret events in their lives, and those interpretations influence their future choices when similar scenarios occur. In this way people create how they will respond to events through the choices they make based on past interpretations that comprise their life's experiences (Kolb, 1984).

Reliability and validity of the Kolb LSI. Norms for the LSI are based on a total sample of 6,977 valid LSI scores from previous LSI users. These norms are used to convert LSI raw scores to percentile scores, which is performed with the purpose of having scale comparability with individual LSI scores and to define cut scores for defining learning style types (Baron, 1996). Cronbach's alpha coefficient for seven different studies of the randomized Kolb's LSI 3.1 were used to report internal consistency reliability. The results indicated that the Kolb's LSI 3.1 scales show good internal consistency reliability among various populations (Veres, Sims, & Locklear, 1991). Two test-retest studies have been published for the randomized format of the LSI 3.1 version. Veres et al. (1991) had participants complete the LSI three times over 8-week time periods with replication groups and found test-retest correlations far exceeding .9 in all cases. It was shown via the Kappa coefficients that very few individuals change their learning style type from one administration of the LSI to another. Ruble and Stout (1991) found that after administering the LSI twice to 253 undergraduate and graduate business students reliability averaged .54 for the six LSI scales and that Kappa coefficient was .36, with 47% change in learning style reported. Though there is a discrepancy among the studies, the test-retest coefficients range from moderate to excellent (Kolb & Kolb, 2005).

Validity of the LSI is based on studies that evidence the internal validity including correlational and factor analysis studies. The relationship between the ELT and the LSI has been empirically tested. The first was a first-order correlation matrix comprised of the six LSI scales. The second was a factor analysis of the four primary scales and the inventory items themselves (Kolb & Kolb, 2005). Correlation studies of the LSI show the critical scale intercorrelations for the normative sample and subsamples. The correlations between AC-CE and between AE-RO are significant, however low. Low correlations exist between RO and between AC-CE, but correlations between AE and between AC-CE are much higher. Respectively low correlations of AC with AE-RO exist, but with CE the correlations are much higher. As assumed, the correlation between AC and CE and between AE and RO are highly negatively correlated (Kolb & Kolb, 2005).

There have been 17 published factor analysis studies of the LSI-2. These studies have examined different types of samples and have used varying extraction and rotation methods and criteria for interpreting the findings (Kolb & Kolb, 2005). According to ELT, it is predicted that factor analysis procedures would produce two polarized factors, that between AC and CE and that between AE and RO as poles. Based on the findings, the percent of variance by the two factors was about equal in all analyses performed, with a total of 70-75% variance (Kolb & Kolb, 2005).

Qualitative Sequence

I interviewed participants after school hours in a private conference room. I backed up interview audiotapes on a computer and external hard drive that was stored in a locked filing cabinet. As a high priority in my research, I held secure maintenance of the data.

Participant recruitment. I mailed all possible participants an informed parental consent permission document to their home addresses. The purpose of this letter was to explain the study and was dated for return in one week with parental consent signed if the parents chose to have their student participate in the interview phase of the study. This signed consent was to be mailed back to me in the stamped return envelope enclosed. Eight parents gave permission for their child to participate. The learning styles of the eight students who were interviewed are shown in Table 2.

Table 2

Demographics of the Qualitative Interviewees

	Female	Male
Accommodating	1 (Grade 9)	
	3 (Grade 11)	2 (Grade 11)
Assimilating	0	1 (Grade 9)
Converging	0	0
Diverging	0	1 (Grade 11)

The interviewees were comprised of students in Grades 9-12. Therefore, higher-level math status was not accessible for all interview participants due to the number of years completed in high school; instead only those in Grades 11 and 12 had higher-level math participation data to be collected. Of the interviewees who were in Grade 11 or 12, there were three females, one of whom took higher-level math (accommodating type) and two who did not take higher-level math (accommodating types); there were three males, one of whom took higher-level math (diverging type) and two who did not take higher-level math (accommodating types).

Individual interviews. Conducting individual interviews with participants afforded me an opportunity to obtain an in-depth narrative of the students' experience in relation to their choices toward learning in mathematics. Interview questions are included in Appendix B and were designed to start a conversation with the participant about their learning style in mathematics using the context of the mathematics courses they had taken or were currently taking. An example of a coded interview transcription is included in Appendix C. The interviews took approximately 30-40 minutes per student. The interview format was open-ended to forge a discussion and lead the participant to elaborate on his or her experiences in an in-depth, detailed manner. Each interview was audiotaped and later transcribed and analyzed by me. However, during the coding analysis process, the interview transcripts were also shared with my committee chair. I completed validation of interview transcriptions through member checking that entailed select participants taking the time necessary to read over the transcribed interview responses and affirming the accuracy of the transcribed statements. This process was completed via email. One female and one male interviewee were given their transcribed interviews and were asked to read and check the transcriptions for accuracy. No errors in accuracy were indicated.

Researcher-Participant Working Relationship

Although I am currently an employee within the district for this research study, I was able to conduct this research with students whom I did not directly teach. My role is that of Director of Special Education. I do not have day-to-day contact with either the students or the math teachers of District R who administered the LSI. I was able to establish a relationship of unbiased trust and genuine, nonthreatening inquiry. In my experience as a school counselor and teacher, I am able to establish a sense of ease and rapport with students readily based on my professional training, thus offering an environment conducive to gathering qualitative data that are valid.

Data Analysis

I was given the quantitative data from District R in spreadsheet form. The spreadsheet included the raw LSI scores for each of the 12 items on the LSI along with grade level, gender, and math enrollment history. To answer RQ 1: What are learning styles of high school students in District R, students at School District R took a short 12-item questionnaire (LSI-3) that asked them to rank four sentence endings that correspond to the four learning modes; this produced the raw scores for the LSI 12-item forced choice inventory. I converted the raw scores into the four learning style modes by adding the item raw scores as follows:

1A + 2C + 3D + 4A + 5A + 6C + 7B + 8D + 9B + 10B + 11A + 12B = Concrete Experience (CE); 1D + 2A + 3C + 4C + 5B + 6A + 7A + 8C + 9A + 10A + 11B + 12C = Reflective Observation (RO); 1B + 2B + 3A + 4D + 5C + 6D + 7C + 8B + 9D + 10D + 11C + 12A = Abstract Conceptualization (AC); 1C + 2D + 3B + 4B

+ 5D + 6B + 7D + 8A + 9C + 10C + 11D + 12D = Active Experimentation (AE). The raw scoring procedure produced the learning mode scores that were then calculated according to the learning style type. Next, using these learning styles modes, each participant's learning style type was defined as follows: the cut point for the AC-CE is +7 and the cut point for the AE-RO scale is +6; the Accommodating type is defined as an AC-CE raw score <=7 and an AE-RO score >=7, the Diverging type by AC-CE <=7 and AE-RO <=6, the Converging type by AC-CE >=8 and AE-RO >=7, and the Assimilating type by AC-CE >=8 and AE-RO <=6. (Kolb & Kolb, 2005, p. 14)

I began scoring by adding the raw scores from the LSI questions that corresponded to each of the four learning style modes: CE, RO, AC, and AE. Then I subtracted the total AC score from the total CE score, producing a difference. In order to be categorized as an accommodating type or a diverging type, the cut score was +7. In order to be categorized as a converging type or an assimilating type, the score must have been equal to or greater than 8. I subtracted the total AE score from the total RO score, with a cut point of +6. Therefore, in order to be categorized as an assimilating type or a diverging type, the difference of the AE-RO must have been equal to or less than 6. In order to be categorized as an accommodating type or a converging type, the AE-RO difference must have been equal to or greater than 7 (Kolb & Kolb, 2005).

To address RQ 2: Does a common learning style exist among students who were and who were not on-track to take higher math in high school; I created the variable on-track for higher math and assigned the value "1" if the participant had taken Algebra and

Geometry during their freshman and sophomore years in high school and "0" otherwise. Next, I ran a crosstab analysis in SPSS to determine the frequencies of participants with each learning style across the variables assigned as on-track for higher math. Using the resulting table, I ran a 2x4 chi square test of independence to see if differences in learning styles existed between those students who were on-track to take higher mathematics and those who were not. According to Creswell (2009), the chi square test is an appropriate choice when the nature of the research question is to test whether a relationship exists between two categorical variables.

To address RQ 3: Does a common learning style exist among students who do and do not take higher math in high school; I created a variable from the mathematics course taking data obtained from the district. I could only obtain these data for students in Grade 11 and Grade 12 who had completed or were currently in Year 4 of high school. I created the variable higher math to equal "1" if the Grade 11 or 12 participant had taken Algebra II or higher by the end of the senior school year and "0" otherwise. Next, I ran a crosstab analysis in SPSS to determine the frequencies of participants with each learning style across the variables, assigned as higher math taken. Using the resulting table, I ran a 2x4 chi square test of independence on each of these sets of data to see if differences in learning styles occurred between those that actually took higher mathematics in high school.

To address RQ 4: Does a common learning style exist between male and female participants; I ran a crosstab analysis in SPSS to determine the frequencies of female and male participants within each learning style. Again, I ran a chi square test of independence to see if differences in learning styles occurred between genders.

To address RQ5: What do students at the study high school think about whether learning style impacts their decisions to take higher-level math in high school; I generated qualitative data from interviews with a portion of the sample and I quantified the narrative data that I gathered by creating codes and themes, then I counted the number of times these codes occurred within the data. When analyzing the interview data, I chose to use word phrases rather than single word coding for the first cycle of the analysis. In this way, I was able to identify possible themes surfacing within the interview transcript. I color-coded the words generated from the first transcript with highlighted text, grouping them according to my initial descriptive codes. Through analyzing the data, I identified themes and then I tallied the occurrences for the sample participants. I used themes and code frequencies to quantify the qualitative data so that I was able to draw conclusions based on the occurrence of common themes that surfaced among the interviewees. A theme is an outcome of coding, categorization, and analytic reflection (Saldana, 2012).

Protection of Participants' Rights

The participants in this study were children ages 14-18 years old. I upheld their rights and respected and protected their privacies throughout the research. I obtained the necessary Walden IRB approval, as well as the School District R superintendent approval for this research. Interview participants' parents were informed and provided written consent to sign, which was granted prior to any data collection. This consent was inclusive of the use of their student's LSI data, the collection of additional data, and their participation in the interviews. No students were put at risk of any harm either psychologically or physically. I afforded students the right to opt out of the qualitative phase of the study at any time prior to the beginning of the study, during the study, or before completion of the study. I outlined this within the student assent and parent consent letters. I honored confidentiality throughout the data gathering and through the analysis and reporting of results of the study. I adhered to all ethical standards set forth as a Walden doctoral student.

Mixed Methods Results

Quantitative Findings

RQ1: What are the learning styles of high school students in District R?

The learning styles of the 63 participants were plotted on a scatterplot using Excel. Presented in Figure 1, the scatterplot shows the quadrant in which each participant fell according to the scoring specifications and cut points for the four types of learning styles: accommodating, diverging, converging, and assimilating.

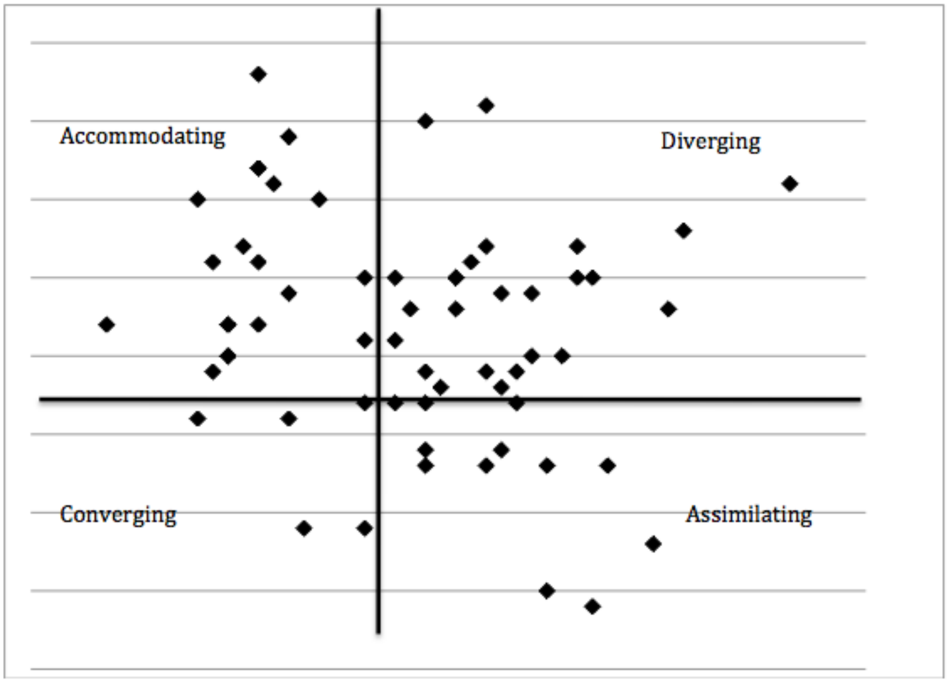

Figure 1. Learning styles of high school students at School District R

As can be seen in Figure 1, the accommodating and diverging learning styles were dominant at School District R. The scatterplot shows the distribution of learning style types with a total of 19 accommodating learning style type and 24 diverging learning style type student classifications respectively as the most prevalent. The assimilating learning style type distribution followed with 16 students and the converging learning style was the one seen the least frequently with only four participants in this category. Visually from the scatterplot one can gather that three of the four learning styles seem to be fairly equally distributed among the participants, while the converging type is quite low in frequency. Depicted in Figure 2 is the percentage of participants within each learning style.

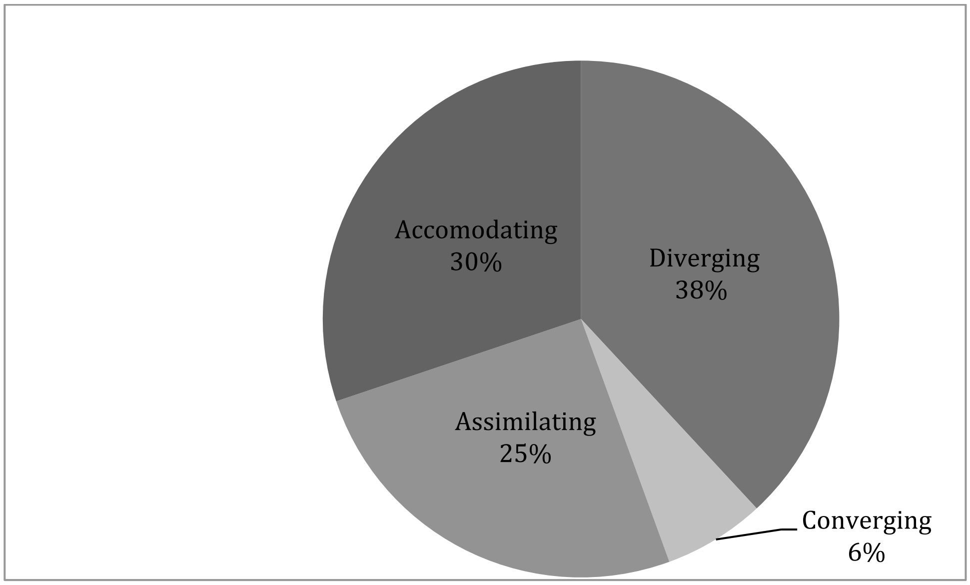

Figure 2. Percentage of participants within each learning style

As seen in Figure 2, the pie chart illustrates the learning style type distribution of participants. This is an alternative visual showing the frequency of distribution of the participants according to their learning style, as determined by the Kolb LSI in terms of percentages. Clearly, the converging type contains the outliers within the sample.

RQ2: Does a common learning style exist among students who were and who were not on-track to take higher math in high school?

$H_0$2: Learning style and students being on-track to take higher math are independent.

$H_1$2: Learning style and students being on-track to take higher math are not independent.

On-track learners were defined as those students who took Algebra and Geometry in the first two years of high school, which would allow them to have the possibility of taking higher-level math beyond Algebra II in high school. For those students whose on-track variable was "0" meaning they did not take Algebra and Geometry in the first two years of high school, there were 28 students disaggregated into learning styles of seven accommodating, seven assimilating, one converging, and 13 diverging. For students who were given a "1", those students who did participate in Algebra and Geometry in the first two years of high school, their learning styles disaggregated to 12 accommodating, nine assimilating, three converging, and 11 diverging (see Table 3).

Table 3

On-Track Math Participation and Learning Style Crosstab

	Accommodating	Assimilating	Converging	Diverging
0	25%	25%	4%	46%
1	34%	26%	9%	31%
% of Total Population	30%	25%	6%	38%

0 = Students who did not take Algebra and Geometry in the first two years of high school
1 = Students who took Algebra and Geometry in the first two years of high school

I performed a chi square test of independence to test whether there was a significant relationship between learning styles and being on-track to take higher-level mathematics in high school. The chi square analysis is a statistical test utilized as one way to determine whether or not there is a statistical relationship between two variables. All chi square analyses that I performed are included in Appendix D. A cross-classification table (Table 3) is used to obtain the expected number of cases under the assumption of no relationship between the variables (Lodico et al., 2010). The relationship between these variables was not significant, χ^2 (2, n = 63) = 1.979, p = .577, hence the null hypothesis was not rejected and I concluded that learning styles and being on-track for higher-level mathematics in high school were independent.

RQ3: Does a common learning style exist among students who do and do not take higher math in high school?

$H_0$3: Learning style and participation in higher math in high school are independent.

$H_1$3: Learning style and participation in higher math in high school are not independent.

I could only gauge higher math participation by analyzing the math participation choices of those in Grades 11 and 12, as they were the only grade levels who have completed or were in Year 4 of high school. Therefore, I used select cases including only those in Grades 11 and 12 in my analysis in this chi square test of independence with an $n = 27$. I categorized students with a label of 0, 1, or 2. To be categorized with a (1), the student must have completed Algebra II and to be categorized with a (2), the student must have been taking or have taken Advanced Math. A zero was for students who had not taken either Algebra II or Advanced Math, of whom there were five students. Of the remaining 22 students, there were 15 students who had taken Algebra II, and their learning styles were: seven accommodating, three assimilating, two converging, and three diverging. Seven students were categorized as a (2), haven taken Advanced Math, and their learning styles were: two accommodating, one assimilating, zero converging, and four diverging. These data are represented in Table 4.

Table 4

Higher Math and Learning Style Crosstab

	Accommodating	Assimilating	Converging	Diverging
0	40%	0%	0%	60%
1	47%	20%	13%	20%
2	29%	14%	0%	57%

0 = Students who have not taken Algebra II or Advanced Math
1 = Students who have taken Algebra II
2 = Students who have taken Advanced Math

I performed a chi square test of independence to examine the relationship between higher math participation and learning style, χ^2 (2, n = 27) = 5.65, p = .464. Since the relationship between the variables was not significant, the null hypothesis could not be rejected and I concluded that learning styles and participation in higher-level mathematics in high school were independent.

RQ4: Does a common learning style exist between male and female participants?

$H_0$4: Learning style and gender are independent.

$H_1$4: Learning style and gender are not independent.

The results showed that 30% of participants were identified within the accommodating type with a breakdown of 12 (36%) females and seven (23%) males. Assimilating type results showed 25% of the total population separated out as seven (21%) females and nine (30%) males. According to the converging type the results showed only 6% of the total population; disaggregated it was one (3%) female and three (10%) males. Finally, the diverging type calculated at the highest percentage of 38% of the population with 13 (39%) females and 11 (37%) male. These data are represented in Table 5.

Table 5

Learning Style and Gender Crosstab

	Accommodating	Assimilating	Converging	Diverging
Female	36%	21%	3%	39%
Male	23%	30%	10%	37%

I performed a chi square test of independence to examine the relationship between learning style and gender, $\chi^2(2, n = 63) = 2.595, p = .458$. Since the relationship between gender and learning styles was not significant, I concluded that learning styles and gender were independent. Though the relationship was not found to be statistically significant, in reviewing the data, I determined that there does appear to be a slight difference in the numbers of females and males within the learning style categories. As shown in Table 5, there were a higher number of females than males in the accommodating type (12 females versus seven males). Additionally, in the converging type, there was only one female to three males. In the assimilating and the diverging type there was a difference of two less females in the assimilating type and two more females in the diverging type.

The learning style category containing the most participants was accommodating and diverging. Accommodating type learners need hands-on experiences to attach to novel learning episodes. Diverging type learners need the opportunity to observe and collect information in relation to the new concept to make the learning salient (Kolb, 1984). Mathematics content is predominantly taught in a lecture type instructional style, often times founded upon logical theories and demonstration (Usher, 2009). According to Kolb, learners who prefer learning based upon logical theories are categorized as assimilators, the next highest type among the participants in School District R. I used this tenet to inform the next facet of data analysis that I explored, which were higher-level math choices among the student participants.

In exploring the learning style type data and its link to higher-level math choices, it is challenging to draw clear-cut conclusions based on gender or learning style type. Of the Grade 11 and 12 students who chose to take higher level math [10 (37%)] there were three (30%) females who fell into the accommodating type and zero males; one (10%) female and three (30%) males who scored as the diverging type; zero females and one (10%) males within the converging type; and zero females and two (20%) males in the assimilating type. The highest number of females in higher-level math was categorized as accommodating and the highest number of males in higher-level math were categorized as diverging. This illustrates no consistency among students who chose to take higher-level math and gender.

When looking at the converse of those who chose not to participate in higher math in high school [17 (63%)], there were 10 (59%) females and seven (41%) males who disaggregated as follows: five (29%) females and three (18%) males were accommodating; four (24%) females and two (12%) males were diverging; one (6%) female and zero males were converging; and zero females and two (12%) males were assimilators. Again, there does not appear to be any consistency among genders and the decision to take higher-level math.

However, according to the research, the most common learning style type for those learners who would tend to gravitate toward traditional mathematics instruction, the assimilators, surfaced within the data as two males who chose to participate in higher-level math and two males who chose not to participate in higher-level math. There were no assimilator type learners among the Grade 11 and 12 female participants at all, whether they chose to take higher level math or not. Again, the data do not clearly delineate conclusive evidence to support a learning style type that is indicative of those who chose to participate in higher-level mathematics. In fact, the study data shows that the dominant learning styles among the participants were accommodating and diverging. These learning style types typically do not show an affinity for traditional mathematics type of instruction. Additionally, among those students who chose to take higher-level math, there does not appear to be any clear findings to suggest that learning style type has an influence on mathematics choices.

Qualitative Findings

I comprised the next phase of data collection and analysis as the qualitative interview portion of the study that I completed with the purpose of examining the perspectives of high school students with regard to their math learning experiences. I generated the qualitative data from 30-minute audio taped interviews of purposefully selected students whose parents returned signed consent forms. The rate of return for the signed consent forms was quite low with only eight (12%) of the 63 forms coming back to me with parent signatures allowing for participation in the interview phase of the study. Of those returned, there was an even split of four (50%) females and four (50%) males. Through this equal balance of genders, though small in numbers, I was able to create the necessary gender balance that I was seeking in my purposeful sampling. Participant demographic information describing the interview subsample is shown in Table 6.

Table 6

Demographics of Participants in the Qualitative Interview Phase

	Female	Male
Accommodating	1 (Grade 9)	
	3 (Grade 11)	2 (Grade 11)
Assimilating	0	1 (Grade 9)
Converging	0	0
Diverging	0	1 (Grade 11)

Of the participants who were interviewed there were two in Grade 9 and six in Grade 11. Due to the fact that those students in Grade 9 were only one year into their high school career, I was unable to determine their higher-level math choices. However, students in Grade 11 were further along in their course taking experiences in high school, therefore their higher-level math course taking choices were identified from the quantitative data with previous and current course enrollment data supplied within the Excel spreadsheet I was given from the school district. Illustrated in Table 7 is the learning style designation of the Grade 11 interviewees having taken or not taken higher-level math according to learning style type.

Table 7

Grade 11 Participants' Learning Style and Math Course Taking Choices

	Female				Male			
	Accomm.	Assim.	Converg.	Diverg.	Accomm.	Assim.	Converg.	Diverg.
Higher	1	0	0	0	0	0	0	1
No Higher	2	0	0	0	2	0	0	0

RQ5: What do students at the study high school think about whether learning style impacts their decisions to take higher-level math in high school?

I answered the qualitative interview component of this study through RQ5. The first cluster of interview questions related to the students' perceptions of themselves as a student and as a learner of math. Using Question 1, I asked the students what type of student they thought they were, and using Question 3, I asked the students about their learning style. All eight of the participants perceived themselves as "good" students. For example, participant F1 stated, "I get good grades. I have a high GPA." Participant M1 in turn shared, "I work hard in my classes to get straight As if I can." These types of statements continued with the remaining six participants expressing sentiments of achievement and accomplishment in academics. When I asked about their learning style as it related to their LSI determination from the quantitative phase of the research, most students agreed with their designation and gave examples of how they learn in ways indicative of their respective learning style. For example, participant F2, an accommodating type who should have an affinity for learning by doing, indicated the following:

> Yeah because he'll give us a problem and I'll do it and if I get it wrong he will show me how to do it and then I will have it. And if I don't I will just keep trying to do it. Then after awhile I get it and then if another student asks me for help I will know how to help them and show them how to do the problem.

Also an accommodating type participant M1 stated,

> But if you give me the materials to figure it out, I usually can do it well just on my own even. I like to figure things out by doing them myself. So even if you teach me in another way, I still like to do it my own way. Some of the ways that the teacher gives me to do it, I can understand it, but then I like to do it by my own methods so that I can figure out short-cuts. Teachers who let me do it my way kind of visually and with my hands you know like manipulatives and stuff, those teachers are the best kind.

Through this statement this student illustrated his ability to use his learning style despite teacher behaviors and capitalize on the learning style modes of acquiring novel information. Also in line with this statement was the fact that F3, another accommodating type, indicated that she had a less than effective teacher, but that she was an active participant in her learning. She stated, "I learned most of it myself from the book." Her hands-on, active learning style type assisted her in creating a means for self-taught learning to take place. Additionally, F3 had a very salient statement that linked her learning in math to the hands-on experiences she had with welding. She said, "I like to learn things by doing them. That's how I learned to weld and math is like that too. In fact, that is the only way I learned anything last year from just doing it myself, trial and error." Therefore, despite the teacher, the student was still able to learn by "teaching herself" and using hands-on connections to other learning, in this case welding. However, when I asked why she chose not to take higher-level math, even though she was on track to do so, her response was, "Maybe I should have, but I don't want to take math in college, so I guess it doesn't really matter." I deemed this as a possible indicator of a need for awareness and understanding of the importance of taking math and in pointing out the obvious which was that she had already figured out that it was important through her connection between math and welding.

All participants similarly offered responses of the preference of active learning by doing reflective of learning through participating actively in their learning. The students' perspectives on their optimal learning mode and affinity towards particular types of teaching methods that support that learning mode were supported through this commonality. Another aspect that was reiterated by several accommodating types in particular was a high level of personal perseverance to "get it." Participant F3, a female accommodating type, offered, "Just keep doing it until it works," when she was talking about solving math problems. Participant F2 also had an iteration of persistence when she stated, "And if I don't [get it] I will just keep trying to do it."

The second cluster of interview questions was related to math courses taken (Question 2) and the type of math instruction the students had experienced in the past (Question 4). Of the eight participants, I determined that five were on-track for higher math meaning they had taken Algebra and Geometry in their first two years of high school. One participant was not considered on-track as he had taken Pre-Algebra and Algebra in his first two years of high school, and the remaining two participants were only in Grade 9, thus I was unable to make a determination of on-track status for higher math. In relationship to the way the students learned, all of them (six out of six who were accommodating type) agreed with the learning style of hands-on learner and learning by doing as their optimal method for learning. Among the other two interviewees, both of whom were males, there was one who was designated as an assimilating type, learning by way of lectures and demonstrations and the other a diverging type, a learner through observation. They were both able to relate to their learning style and how it works with their optimal learning methods. Despite the learning style designation of the participants, all eight considered learning by doing a way in which they learn preferentially, as each of them responded with at least one comment related to the code for learning by doing and how a teacher had either used this method and it made a positive impact or did not use this style and it made the alternate negative impact. Also, according to the category of higher-level math choices, the only interviewees who chose to take higher-level math were one female, an accommodating type, and one male, a diverging type. Neither of them would be indicative of the preferred math learner, which according to the research is the assimilating type, those who prefer logical theory and learning by way of lectures and demonstrations (Kolb, 2005). Delving further into the data, one can also assert that on-track status for taking higher-level math was also not a predictive precursor to choosing to take higher-level math. Of the five participants who were categorized as on-track (having taken Algebra and Geometry in their first two years of high school), only two of those students actually chose to take higher-level math their senior year.

Through the use of the last cluster of interview questions including Question 5 (pertaining to how confident in math the students felt they were) and Question 6 (their math course taking choices), the students' feelings of self-efficacy, or lack thereof, and also their choices to take or not take advanced math were illustrated. Students showed evidence of a high level of self-efficacy in math. Six out of eight participants stated that they were confident in their math ability. The two who did not say they were confident still indicated a positive stance. Participant M2, a Grade 9 participant whose learning style was assimilating type was "in the middle" and participant F3, an on-track Grade 11 individual who chose not to take higher math and whose learning style type was accommodating was "Okay, I guess." These sentiments, especially in the case of the female, on-track participant could illustrate a lack of self-efficacy contributing to the student opting out of advanced math course taking. M2 also indicated in a previous answer that he did not like it when the teacher did the problem in a different way than the book showed. This possible inflexibility in learning methods could also be an indicative trait of a student who may not take risks in learning novel tasks, such as the novel tasks that are presented to students in advanced math classes. However, as someone in Grade 9, M2 did not afford me a look into on-track or higher-level math status. The others ranged from "pretty confident" (participants M1, M3, F1, and F2) to "very confident" (participants M4 and F4). The two who indicated "very confident" were also the two students who opted to take higher-level mathematics during their senior year (Advanced Math.) Even though almost all of the upper classmen interviewed (five out of six in Grade 11) were on-track to take higher math in high school, only two of those five actually opted to do so.

Both of those students stated that their decision to take higher-level math was due to their internal motivation to do so, not necessarily academic achievement or teacher experiences. Participant F4 stated the following:

> I think its important to have a full load your senior year. Lots of kids take it easy their senior year, but I don't think that is very smart. You need to take as many hard classes as possible so when you go off to college you are ready for the really tough stuff. I didn't even really think of not taking math, I just signed up for the next math class offered. I am a good math student and the higher math I'm able to take the better I can still become. There are only a few of us in there, but I don't care.

Though her statements indicated a completely intrinsic urge to take higher-level math, earlier statements in her interview illustrated a strong impact on her math efficacy from prior learning experiences. She stated, "I learn things by doing. Isn't that the best way? If you just watch someone you will never learn it, you have to try it yourself I think." She also stated very positive experiences with her past teachers with no negative comments, which was different from some of the other participants who clearly had negative experiences. Participant M4 stated this, “I just want to be prepared in college I guess. I don’t know if I will major in anything that requires much math, but I figured I’m good at math and I might as well be prepared for it.” Again, I can deduce that he does not attribute his choices to a particular affinity for teaching strategies he has experienced, but in earlier questions he described other external factors that may have also contributed to his decision making process. He stated, “We are always observing our teachers doing things and then trying to imitate them.” This brings his reflective statement in line with his learning style of diverging. He related his learning experiences in a cohesive way, indicating that his learning style and his preferential learning methods are aligned.

However, one interesting commonality between those two participants who chose to take higher-level math was their assertions of personal intellectual and/or ability capacity. Participant M4 stated, “Well, I’m pretty smart. I have a high GPA. I would say I am smarter than most.” Also worth mentioning was a statement from the other higher-level math student, participant F4, I feel good about my abilities in math.” Though F2 was only in Grade 9, she gave a predictive statement that she plans to “keep taking it (math) all my four years of high school.” F2 also expressed confidence in her math abilities, thus fueling her intentions to take higher-level math in high school. These statements provided a strong theme that supports the linkage of confidence in math and intentionality to take higher-level math.

A compelling argument from participant M1 illustrated a false self-efficacy in math despite performance to the contrary. M1 stated,

> In fact, the funny part was that my teachers would share the previous year's testing and I actually found out that my reading and writing was higher than my math, but I always thought my math was my best subject. Math was actually one of my lower scores. I mean I was still proficient, but I was higher in reading and writing than math.

As an accommodating type, M1 expressed his affinity for solving problems with his own methods, through drawings, and through multiple means. As an active learner, M1 seemed to develop a grandiose sense of his own mathematics ability when in actuality he was a stronger reading and writing performer. This was an interesting point to support learning through ones learning style despite performance data to the contrary because of apparent heightened self-efficacy. Another schema that was presented for learning was the use of prior learning to grasp current learning. Again, it was participant M1 who said, "So I was able to go back and use some of the things I learned previously and my background knowledge in math to do well in this class." This particular participant appeared to have multiple mechanisms for learning both through active experiences and also through the psychological construct of self-efficacy. Informed by these findings, I began to formulate the direction of a project that would enhance student utilization of their learning styles and building their self-confidence and the importance of achieving math tasks.

Coding of qualitative data. Within the first round of coding, I was able to produce the following descriptive codes: *grades, college plans, self-efficacy feelings-positive, self-efficacy feelings-negative, doing, testing, personal effort*. I explained these codes as: phrases pertaining to grades earned, phrases reflective of college plans, positive self-efficacy feelings, negative self-efficacy feelings, tasks related to doing, tasks related to testing, and tasks related to personal effort. Following the second interview transcript analysis, I added supplemental descriptive codes: *listening, instruction,* and *homework*. To further explain, I generated the following descriptors to illustrate the codes: tasks related to listening, phrases pertaining to style of instruction, and tasks related to homework. Within the completion of the remaining transcriptions (3-8), I added the last descriptive codes to the coding process: *ability*, *what learned, qualifier, usefulness, real-life,* and *satisfaction*. To elaborate on these codes, I defined the terms as: student self-reported ability level, understandability of the subject, math learning tasks, qualifying statements, math being important or unimportant, usefulness of math, real-life applications of math, and levels of satisfaction with performance in math. Shown in Table 8 are the initial coding cycle results.

Table 8

Categories Based on Qualitative Analysis Coding

Category	Code	Example	Frequency
Personal Performance	Grades	"I get good grades in math."	7
	Ability level	"I am good at math."	7
	Testing	"I do well on math tests."	5
	Personal effort	"I work hard in math."	6
Self-efficacy feelings-positive	Satisfaction	"I've always been good at math."	5
	College plans	"I plan to attend college."	2
	Good	"I like math."	8
	Qualifier-important	"I use math outside of class."	5
Self-efficacy feelings-negative	Hard	"Math is hard to understand."	2
	Qualifier-unimportant	"I don't see why I should take more math."	4
Instruction	Style	"The teacher is hard to understand."	2
	Listening	"Math is boring lectures."	2
	Doing	"I like math that I can do hands-on."	7
	Learning tasks	"I thought learning math in this way was important."	3
	Understandability	"Math doesn't always make sense to me."	4
Application	Usefulness	"I won't use this math."	3
	Real-life connection	"I can use this math in my everyday life."	5

In the analysis of these qualitative data, the next phase of coding that I performed was the movement from codes to categories. Using coding analyses aligned with the processes prescribed by Saldana (2008), I developed the data descriptors that were initially coded and then expanded into broader headings. Therefore, the following categories described in Table 9 were derived from the descriptive codes that were generated from the interview transcripts. As with all coding processes, there were times when codes were supplanted by other codes, relabeled, or even dropped, along with data being rearranged and reclassified into different or new categories (Saldana, 2008). The current research data followed along these guidelines as I found different categories that more clearly represented particular codes from the first and second phases of encoding the data. The first two rounds of coding were comprised of the initial coding, that developed the descriptive codes, and the second round that formulated the categories under which the codes would fall. Afterwards, I completed a third round of coding to infuse more specificity into my terminology offering clarity to the descriptors of the students' common experiences.

Table 9

Categories Based on Qualitative Analysis Coding-Third Round

Category	Code	Description of Code Example
Personal Performance	Grades	"I get good grades in math."
	Ability level	"I am good at math."
	Testing	"I do well on math tests."
	Personal effort	"I work hard in math."
	College plans	"I plan to go to college."
Self-efficacy feelings-positive	Satisfaction	"I've always been good at math."
	Good	"I like math."
Self-efficacy feelings-negative	Behind	"If you get too far behind math is hard."
Instruction	Style	"The teacher is hard to understand."
	Listening	"Math is boring lectures."
	Doing	"I like math that I can do hands-on."
	Learning tasks	"I thought learning math in this way was important."
	Understandability	"Math doesn't always make sense to me."
Application	Usefulness	"I won't use this math."
	Real-life connection	"I use math to figure things out other times in my life."
	Qualifier-important	"I can use this math in my everyday life."
	Qualifier-unimportant	"It doesn't matter if I don't take math."

The next stage of the qualitative analysis process was drawing connections from the data to establish overarching themes once the codes were pooled together resulting in common concepts. The themes that emerged were: achievement efficacy and teacher experience, as shown in Table 10.

Table 10

Themes Generated from Qualitative Coding

Categories	Personal Performance	Self-efficacy-positive	Self-efficacy-negative	Instruction	Application
Codes	Grades Ability level Testing Personal effort College plans	Satisfaction Good	Behind	Style Listening Doing Learning tasks Understandability	Usefulness Real-life connection Qualifier-important Qualifier-unimportant
Theme Designation	Theme 1	Theme 1	Theme 1	Theme 2	Theme 2
Theme Name	Achievement Efficacy			Teacher Experience	

The theme of achievement efficacy was a compilation of the codes in the categories for personal performance and self-efficacy positive and negative. This theme embodied the common codes among the interviewees' comments that explain the students' experiences based on their past learning related to their perceived achievement in math. Confidence and achievement in math coincide, leading to the formulation of this theme. The theme of teacher experience was comprised of the codes in the categories for instruction and application, both of which reflect the students' experiences with learning through the framework of their past teachers. From the students' perspectives, how they learned was directly related to how they were taught. The student learning experience was impacted by the methods used in their math instruction. From the students' perspective, the teaching itself was a critical component of how they experienced their math learning. Student perceptions of math and their learning experience were directly linked to the teacher they had in the past. Respectively, the most commonly repeated statements were reflective of overall positive self-efficacy in math. All eight participants, females and males, offered statements that were coded in the category of achievement efficacy. The participants had a very positive perspective on their achievements in math and their abilities to perform in this subject. There were six out of the eight participants, three females and three males, who deemed their past experiences with their math teachers as having had an impact on both their performance and their math choices. Some of the experiences were positive and some negative, but the past experiences still played a role in their decisions regarding math course taking choices. Based on past experiences of students and feelings related to their performance and instruction in math, the students demonstrated this influence as having a strong impact on their current math perspectives and choices. I found this to be the case almost equally among males and females across interviewees and almost equally represented across the two major themes. Quantified in Table 11 is the frequency with which female and male participants generated statements reflective of the two major themes in the analysis.

Table 11

Participant Qualitative Theme Frequency by Gender

Theme	Frequency theme generated	
	Female	Male
1 Achievement Efficacy	4	4
2 Teacher Experience	3	3

I used the integration of the qualitative data into themes and frequencies of how many participants mentioned the specific theme to illustrate the dominant student perspectives of student achievement efficacy and student experience with math teacher instructional practices. Each of these themes constituted approximately half of the comments among the participants, thus indicating that each of these themes held an equal impact on the student experience. How the students experienced math as a content area, the level of confidence in their performance and achievement, and their overall feelings towards their ability to perform math tasks comprised the dominant theme, occurring a total of 42 times within the interview data among all eight participants who offered responses within this theme. This contributed to the view that math self-efficacy has a strong impact on student perspectives of math learning and ultimately has a significant impact on the student decision-making process in considering whether or not to take math beyond what is required. The students expressed that their past feelings of self-efficacy were a pivotal factor in seeking more advanced math choices. If they had highly positive self-efficacy in math, they were in turn moved to pursue more advanced math levels. For example, participant F4, who chose to take Advanced Math her senior year stated, “I am a good math student and the higher math I’m able to take the better I can still become.” The one other participant interviewed who chose to take Advanced Math was M4 and he stated, “I just want to be prepared in college I guess. I don’t know if I will major in anything that requires much math, but I figured I’m good at math and I might as well be prepared for it.” Both of these interview statements show evidence of self-efficacy in math achievement playing a role in student decision-making towards taking higher-level math. In other words, positive past performance and achievement, and therefore heightened confidence in math or high self-efficacy, were strong predictive factors in their decisions to take on novel tasks in math and ultimately to take a higher-level math course.

Almost equally as important to the students were the perspectives they expressed in relation to the instructional practices, teacher pedagogy, and math tasks they were asked to perform. The theme of teacher experience arose 37 times among the interviewees, occurring among six of the eight participants of whom there were three females and three males who illustrated this theme in their responses. How the math content was taught was almost as equally important an impact on student decisions to take higher-level math as achievement efficacy. If the students felt the instruction was appropriate to their needs, including learning that was adaptive to their learning style, they were as a whole more apt to want to continue with their math progression. In most cases, the interviewees had an affinity for active experimentation or hands-on learning, because six out of the eight participants were the accommodating type. While speaking of a teacher who really had an impact on her learning, F1 stated that, "She did more hands-on stuff that helped us learn more." As an accommodating learner type, F1 illustrated in her statement how the teacher can tap that learning style and have a solid impact. Another case in point of this concept was participant M1 who stated,

> I like to figure things out by doing them myself. So even if you teach me in another way, I still like to do it my own way. Some of the ways that the teacher gives me to do it, I can understand it, but then I like to do it by my own methods so that I can figure out short-cuts. Teachers who let me do it my way kind of visually and with my hands you know like manipulatives and stuff, those teachers are the best kind.

In other words, though the students did not have a clear understanding of what type of learner they were prior to the study, they were quite clear on what type of learning they had the strongest aptitude for and ability to grasp the content through. Thus, learning style and teacher capability in tapping that learning style did in fact impact the students' willingness to take more courses in math at a higher level and with a higher level of satisfaction. In contrast, this concept of teacher experience can also have a negative impact as in the case of participant F3. She stated the following, "I couldn't stand the teacher. I think that's why I am not taking math this year. He was terrible. He would assign problems and we would do them. That's about it." I determined that this comment succinctly evidenced the fact that a teacher can have a long and strong impact on student course taking preferences for the future, not just in a productive manner, but also in a way that could hamper future math experiences.

Trustworthiness. Within the mixed methods design of this study, I chose a sequential method with the quantitative data as the initial data collection followed by the qualitative interview data used to potentially validate the findings of the prior collected quantitative data. However, in this case the quantitative data did not support the initial research questions being explored in that learning style would have an impact on higher-level math course choices and also that gender would be a factor impacting the course choices as well. These research questions were not supported by the quantitative data. Therefore, the goal of a sequential mixed methods design of one set of data acting as a mechanism to build and validate the other set of data was not accomplished in this case since one did not validate the other. By using triangulation of the multiple sources of data, the data should be able to explain the findings. However, I did not find what I had originally thought which was that learning style and gender would be significant factors in student course choice decision-making in math. The quantitative data did not support the idea that learning style and gender would be factors that enhance or constrain students' decisions to take higher-level math. Therefore, the qualitative interview data acted as a mechanism to explain the failure of results to support the hypotheses of the study. The qualitative data provided information regarding the precursors for whether a student chose to take higher-level math or not. The common themes that emerged indicated that prior learning experiences and high self-efficacy in math were the impetus to take higher-level math. In turn, the data also indicated a lack of awareness of the fact that math is an integral component in many post-secondary fields, thus I gained valuable information that drove the direction I chose to take in the project that followed.

In order to support the validation of interview data, transcriptions were subject to member checking that entailed select participants taking the necessary time to read over the transcribed interview responses and affirming the accuracy of the transcribed statements. I completed this via email. One female and one male interviewee were given their transcribed interviews and were asked to read and check the transcriptions for accuracy. Only one returned the email with affirmation of the accuracy of the data. The participant indicated that no errors were found in the accuracy of the transcribed data.

I furthered confirmability in an inquiry audit where not only I performed the data analysis and wrote up the findings, but also my chair assisted me in the doctoral process thus solidifying the degree of neutrality upon which the findings were based. As the coding of themes was taking place, several rounds of coding transpired through the direction and assistance of my chair to formulate the common themes based on the qualitative responses given by the respondents. The process was not dictated by my assumptions or solely by my independent interpretations. Therefore, with these validations in place for trustworthiness of the qualitative data, there are grounds for the study's potential transferability. There is possible transferability of this study to relate the themes as a common experience among students beyond the local setting, making it applicable in other settings as well.

Conclusion

The student perspectives that were gained through the qualitative portion of this study contained the most salient evidence of the student learning experience in math. Though the quantitative data did not indicate statistically significant differences between students with varying learning styles across genders, the qualitative interview data allowed me to delve further into the students' math learning experiences and how these experiences impacted their choices to either take higher-level math or not to take higher-level math.

The consistent themes that surfaced through the qualitative coding analysis were a focus on students' abilities to tap their preferential learning modes, using their optimal learning methods; the secondary focus on students' feelings of overall confidence in their math performance; and their awareness of the importance of math learning concepts for their future. Teacher strategies that were aligned with the students' learning style preferences produced positive math learning episodes. Participants who had past experiences with math instruction that allowed them to participate in their learning in ways that were conducive to their learning styles had overall positive experiences. These past positive experiences led them to go on to seek continued math courses or at least to perceive math as a content area in which they could succeed in.

Self-efficacy was by far the most prominent theme that surfaced. Students whose perceptions of their abilities in math were high, in-turn viewed math as a subject in which they could succeed, and would be willing to take on in the future. Strong confidence in math was a precursor to future performance and future choices to take higher-level math for the two students who did choose Advanced Math. Though confidence in math did not necessarily predict the choice to take higher-level math in all participants, both of the participants who chose to take higher-level math exhibited a very high self-confidence in math. Self-efficacy in math seemed to be a necessity for the higher-level math choice.

For those who chose not to take higher-level math and who also had a high self-efficacy in math, their choice was due to a low self-awareness of the importance of taking math toward meeting future goals or due to past experiences with ineffective teachers and instructional practices misaligned with their learning preferences. Therefore, it could be said that the existence of self-efficacy in math did not make a difference in choosing to take higher-level math according to this participant sample. Possibly a more critical element was that of the lack of awareness of the importance of math to continued education in a variety of other fields.

Therefore, as I proceeded into the project phase of my doctoral study, I was compelled to address the main tenets that were brought forth from the data analyses. Addressing the need for students to use their optimal learning modes and to foster student self-efficacy in math, coupled with awareness of the importance of continued math learning, were the primary areas outlined in the project. Optimizing learning through student learning style preferences was one area upon which the project was focused in order to support student learning through the most conducive methods necessary to produce effective learning experiences. Bolstering confidence in math performance was the other area that the project addressed; this was done to solidify the necessary self-efficacy in math that would support the continuation of math learning in the future. Finally, awareness of the various uses and importance of math throughout future educational studies was the element that focused the direction of the project. Building this awareness piece into the educational experiences of students was a pivotal tenet addressed in the project to bolster informed decision-making processes with regard to math choices among students.

Section 3: The Project

Introduction

The problem addressed in this study was the lack of continued participation by students in mathematics beyond the minimum requirements for high school graduation at School District R. According to historical data from 2009-2012, an average of 33% of high school seniors opted to take advanced mathematics courses in their fourth year of secondary school. Their doing so compromises their postsecondary college major options (Milgram, 2011). Students who leave high school unprepared to take college level mathematics courses is concerning. As students decide on majors and career aspirations, a deficiency in mathematics may cause limitations to the goals that develop in the latter years of their education (Hannula, 2006). It is critically important to raise student awareness of the potential pitfalls of ceasing their math progression which will inevitably shrink the pool of quality candidates prepared to pursue STEM careers (Mahoney, 2010). Through early, concerted efforts in schools, this limitation in math advancement can be addressed and help math continuation to flourish (Burton, 2010).

I conducted a mixed methods study to obtain the information needed to address the problem of lack of participation in advanced math in high school. By focusing on enhancing the students' mathematical experiences in high school and therefore their achievement, it is my hope that their future potential to seek out math-related options will be positively influenced. The results of the study indicated that students do not have a high awareness of their optimal learning methods and how to capitalize on those learning preferences. I also identified students' best learning experiences and how those have shaped their course decision-making process. This section is comprised of the project description, goals, and rationale. It is followed by an extensive literature review that links the project to the current research and theory that supports its foundation. I go on to explain my proposal for implementation, a project evaluation, and future implications for change.

Description and Goals

In this project study, I addressed the problem of students' lack of participation in advanced math in a local high school. I analyzed scores from the LSI and conducted qualitative interviews with students to better understand students' math course taking experiences. According to my data, neither their learning style nor their gender had a significant effect on students' choices to take higher-level mathematics in high school. However, I found that certain students shared common experiences, beliefs, and feelings, which led them to make similar choices in their math course taking patterns. Students who chose to take higher- level math courses in high school held similar positive self-efficacy beliefs and shared common experiences. However, those who chose not to take advanced math also shared some of those parallel beliefs and experiences as well. The most critical and common theme that arose among the participants was that of a lack of awareness of the importance of math and its significance to future aspirations. The participants did not realize that choosing not to take higher-level math courses could have a negative impact on their postsecondary plans. For the most part, students had a high level of self-confidence in their math efficacy and had many positive past experiences with math instruction. However, they still are not likely to take optional upper-level math courses. For instance, among those who liked and felt strong efficacy for math, only two students chose to take advanced math in their senior year. Students who did not participate in higher-level math relayed information that indicated that they did not view math as important for their future, and that they did not feel that it mattered whether or not they took more or less math in high school. For example, when asked why he chose not to take math in the senior year, one male student responded with, "I just didn't need anymore math." Another female participant responded to the same question with this answer, "Maybe I should have, but I don't want to take math in college so I guess it doesn't really matter." In general, the participant responses echoed the same theme of a lack of awareness of the importance of math and the significance of math advancement to pursuing postsecondary options. In addition, the study revealed themes related to the students' attitudes and beliefs regarding math instruction and their lack of awareness of the necessity to capitalize on their opportunities to master math skills beyond what is required to graduate.

Based on my findings, I designed a set of sequential guidance lessons for students at the middle school level precluded by teacher professional development as an implementation guide (Appendix A). By training teachers to implement the lessons, both teachers and students build the relationship necessary to fully invest in the process of raising math awareness. These lessons involved guidance counseling paired with on-going lessons designed to coach students on strategies to better optimize their learning. Through differentiated methods that are in tune to varied learning styles within the mathematics classroom, students will also be able to link this learning to possible future educational goals. The goal of this project was to build a foundation for math learning from the middle school grades to hopefully carry through into the secondary levels. The intent was to solidify motivation through enjoyment for learning math along with strong self-efficacy in performing math tasks, while also building a solid understanding of how math plays into every career.

An additional project aim was to increase students' level of enjoyment in math and also build their level of motivation for course continuation. With increased enjoyment, students will have increased motivation to seek math in future endeavors (Amirali, 2010). The guidance counseling will build student awareness of the importance of math instruction. By showing students how to tap into their varying and preferred learning styles, they can become advocates for their own optimal learning environment. Student satisfaction stemming from optimal math learning experiences will therefore motivate students to make choices to take future math related courses (Elam, Donham, & Solomon, 2012). As students have more positive experiences learning mathematics, they will be more likely to choose to continue math learning in the future (Burton, 2010).

To promote positive experiences in math, a variety of approaches, including the use of technology such as iPads and interactive math curricula will be implemented. It will be critical to allow students' active participation in the learning of math versus a stagnant or passive approach. Using the district's current Apple One-to-One program, students will learn ways to use hands-on strategies of learning, including a variety of active daily learning tasks and academic games within the math curriculum. Increasing awareness of STEM field careers will be of particular focus; however, the link of math to all career fields, including social sciences and the arts will also be introduced to students. This will include cross-curricular connections illustrated between secondary mathematics classes and career and technical classes such as welding, computer science, and culinary arts. By building real-world connections to math learning, students will be able to draw links to their math learning and the significance of building those skills to optimize future learning. STEM career awareness will be emphasized in both genders, but especially in females. Programs that build this awareness and knowledge will be brought into the classrooms to promote STEM learning for students in the classroom and to solidify the impact math learning has on a variety of fields and careers of the future.

The student guidance lessons provide students with an awareness of the importance of learning math and lay the groundwork necessary to solidify students' understanding of the significance of taking higher-level math in high school upon their potential future college and career options. The student guidance lessons were composed of four sessions per year beginning in Grade 7. They cover various topics focusing on learning attributes or preferences, optimal math instructional methods, and real world connections between math and careers; with all of these components in place, the overarching premise of bolstering math confidence and fueling the awareness of the importance of math to their future will be the main aims of the project. These lessons will occur in Grades 7 and 8. The sessions will be completed in sequence as per grade level to focus on the following: learning attributes and capitalizing on learning preferences within instructional methods; math enjoyment and motivation; linking math to the real world, including STEM field awareness; and course choice guidance. The topics for the student guidance sessions were identified through the interpretation of the research findings from this study and current research explored within the literature review.

The student guidance lessons were developed to include specific ways to build awareness of the importance of math and to guide students to use their self-knowledge and understanding of math instruction. The lessons would help to illustrate to students the importance of developing their math skills to reach their future goals. By coaching students on how to use their learning style to their advantage in learning new material, students will be able to gain more confidence in math learning. In doing so, students learn how to capitalize on learning in math in a positive way. Student motivation for future learning in the area of mathematics and the potential for future careers involving math skills may be positively impacted. By adapting instruction and by cultivating experiences for students according to their varied learning needs, the content of math can be viewed in a more positive way. Students may begin to see the possible options for math in their future goals and aspirations. With this understanding, students will gain confidence in what they can achieve in the content of math and what they need to do to be proactive in making the decisions that will enhance, not constrain, their possible options for the future.

Rationale

Student guidance lessons coupled with a teacher professional development component were created for the project based on the results of the study. I chose guidance counseling for students as the project genre for two reasons. First, one of the most salient qualitative findings in my study was that students who chose not to take higher-level math made that choice because they were unaware of the importance and necessity of mathematics in their future career and college choices. The student guidance lessons provide students with an early understanding of why mathematics learning is critical to their future choices within and beyond high school. Secondly, the lessons incorporate the types of activities that will help students become active participants in their mathematics learning. I created the teacher professional development component to provide teachers with appropriate training, support, and preparation to deliver the lessons.

Stated more specifically, the student guidance lessons that I created for this project study support students in their mathematics learning by providing early interventions that help students develop an understanding of their own learning preferences, and at the same time connect for students the importance of continued mathematics learning in order to grow the skills they will likely find necessary later in life to pursue most any field of study. These guidance lessons included numerous instructional methods in order to fully address diverse student learning, and the critical linkages between classroom learning and real world application of math-related skills and competencies.

The problem I addressed in this study was the fact that secondary students are opting not to take higher-level math courses in high school. Instead students reach the minimum level of math required to graduate and then stop their progression in math. In the study I investigated the possible relationship between learning style and student choices to take or not take higher-level math in high school. Though I found that learning style and course taking patterns were not significantly related in the quantitative analysis, the qualitative interview data revealed the recurring themes of past learning experiences, feelings towards mathematics learning, and awareness of the importance of mathematics. Each rendered a solid impact on student choices in math and also in their learning in general. The themes of achievement and self-efficacy were made up of how instructional practices in math were perceived by students, with the most commonly occurring theme being positive math achievement efficacy. Achievement efficacy was comprised of academic achievement coupled with confidence in math with both concepts being directly linked to how students learned from math teachers in the past. Therefore, I found a compelling argument that there was a need for guidance counseling for students that was focused on student awareness of their learning. The design of a differentiated and multi-modal approach to learning new concepts in math could link student perceptions of math to real world possibilities for their future.

The students in School District R did not have a school guidance counselor and have never been provided any support in their development as learners or in their overall preparedness to pursue their postsecondary goals. Most students suffer from complete naivety when it comes to their learning and how they can become active learners who are able to optimize their learning potential and take the initiative to prepare themselves for all possible avenues of study in the future. This project provided a proactive approach to addressing School District R's problem of lack of participation in higher-level math in high school by providing students with the knowledge and understanding of their learning and exposure to the importance of math in their overall learning experience. By using the student guidance lessons for my project, students will be given support from their teachers to optimize their math learning and achievement thus increasing the likelihood that they will opt to participate in enhanced math opportunities. This will address School District R's current problem by increasing the number of students who opt to take higher-level math through their senior year.

Review of the Literature

This literature review is a synthesis of current research that supports the development of the project of this study. The project is a sequence of guidance lessons couple with a teacher professional development component. The guidance lessons provide an early intervention for students to aid in their understanding of learning in math and its impact on future learning pursuits.

I utilized research journals from EBSCOHOST and Sage for this literature review. The databases that I searched included: ERIC, Academic Search Complete, Education Research Complete, and Teacher Reference Center. These search venues were used to locate literature related to student guidance in mathematics, active learning in mathematics and self-efficacy in mathematics. Key search terms used for this review of literature were: *students and mathematics achievement, mathematics and self-efficacy, mathematics instruction, learning and mathematics, student achievement and teaching math, STEM instruction, gender and mathematics, technology and mathematics instruction, and guidance and math careers.*

Active Mathematics Instruction

Although student success in mathematics is critical, not only to obtain college admittance but in understanding and determining career choices, the traditional mathematics curriculum does not meet all students learning needs. "Mathematical capability is a key determinant of productivity in the 21st century" (Vigdor, 2013, p. 42). This being the case, then mathematical capability should be a top priority. Pre-collegiate mathematical aptitude matters in that Math Scholastic Aptitude Test scores predict higher financial earning among adults (Hill et al., 2010). The criticism brought forth upon the United States regarding the lessened level of mathematics competitiveness among United States students as compared to their international counterparts is compelling. The National Mathematics Advisory Panel has gone so far as to say that mathematics education is broken and must be fixed (Grady, Watkins, & Montalvo, 2012). The United States Department of Education (2008) attested in their annual report, that math instruction should be varied in that it should be neither exclusively student-centered nor teacher-directed in order to increase math achievement. Improving mathematics instruction as a means to increasing math achievement in our nation is viewed as an area of special national need (Gottfried, Marcoulides, Gottfried, & Oliver, 2013). However, the traditional formalist approach, which is foundationally a procedural based curriculum based on the emphasis of a series of logically arranged facts, skills, and procedures repeated overtime until perfected, is the historical standard and still the standard practice for mathematics instruction in many schools (Grady et al., 2012). With this being the standard delivery method most often used, the outcomes gained are not always optimal due to varying learners receiving this instruction. Vigdor (2013) stated, "America's lagging mathematics performance reflects a basic failure to understand the benefits of adapting the curriculum to meet the varying instructional needs of students" (p. 42).

Notable in a study by Grady et al. (2012), there was evidence for the use of instructional strategies that are conducive to optimal math learning as a means to promote positive learning experiences for students. Grady found that the constructivist platform for math instruction showed equal gains to traditionally taught students; thus, allowing for instructional variance is supported. Though one approach did not show significant favorability over the other, those who were exposed to the constructivist approach produced great gains using Every Day Mathematics. Every Day Mathematics is a constructivist curriculum that allows students to have an active process in their learning versus the traditional lecturing of direct instruction. The constructivist theory of instruction contends that knowledge is not received in a passive manner, but rather it is reinforced and solidified through cognition that is adaptive and related to how the experiential world is organized as schema (Von Glaserfeld, 1989).

The constructivist theory goes hand-in-hand with Kolb's ELT, which states that learning occurs through experiencing novel information and actively participating in the process of turning new information from abstract to concrete cognition (Kolb, 1984). Hands-on, active participation in learning math has produced strong learning outcomes. The use of hands-on activities, including mathematical processing that involves placing numbers on a number line and the alignment of mapping numbers onto space indicating an understanding of symbols and meaning through academic games, is an intervention tool that has shown strong results for students (Kucian et al., 2011). Sasanguie, Van den Bussche, and Reynvoet (2012) found that cultural exposure to hands-on activities aids in predicting longitudinal mathematics achievement. Number sense, the precursor skill for later math development, was studied by Sasanguie et al. among a group of first graders who were given cultural exposure or opportunities for hands-on expression of basic number processing tasks. The results showed that decision processes, specifically decisions on symbolic numbers coupled with adequate mapping of numbers into space, were the greatest predictors of individual differences on later math achievement (Sasanguie et al., 2012). Thus, mathematics competence is related to efficient symbolic decision-making, which can be equated to culturally determined processing that highlights the importance of formal learning episodes (such as classroom activities) and informal learning episodes (such as number board games). Support of the active learning approach to math instruction is the paramount conclusion to be drawn.

Math Self-Efficacy and Math Enjoyment

Ramirez, Gunderson, Levine, and Beilock (2013) contributed to the growing body of evidence in the field of education about the importance of taking into account both cognitive and affective factors in recognizing the nuances of students' academic achievement. As espoused from the social cognitive theory of Bandura (1986), the construct of self-efficacy relates to a person's perceptions of confidence in his or her capabilities to perform learning tasks. Thus, it would stand to reason that enjoying math and feeling competence in math contribute to individuals' motivation to take on novel math tasks without reserve. "Academic self-concept is generally conceptualized as students' beliefs of their own domain-specific and/or global academic capabilities" (Pinxten, Marsh, De Fraine, Van den Noortgate, & Van Damme, 2014, p. 153). The researchers go on to make a clear distinction between perceptions of competence or academic self-concept and affective responses, for example the feeling of enjoyment. Pinxten et al. (2014) conducted a study of 4,724 students in Grades 3-7 aimed at understanding the variant effects of both enjoyment and competence beliefs regarding math and how this impacts math achievement and efforts given to math tasks. Their results offered the following findings, "math competence beliefs had a positive effect on math achievement and negative effects on perceived math effort expenditure and also that math enjoyment had a positive effect on subsequent perceived effort expenditure and math competence beliefs" (Pinxten et al., 2014, p. 165). Important implications of this study are for teachers to focus on and work toward expanding academic self-concept and achievement for long-term learning. Though Pinxten et al. (2014) found that compared to the significant positive impact math self-concept had on math achievement, that improving students' achievement through enjoyment showed far less of an increase. However, it should still be noted that previous levels of math enjoyment show positive connections to students' math self-concept, which can be extended to indicate a desire to attain further achievement in math. Therefore, creating a desirable experience in math would likely increase the enjoyment factor of learning math. The approach described is a potentially viable indirect strategy to enhance math achievement especially in the early elementary years. As a whole, this study presents the overall tenet that there is a substantial correlation between math enjoyment and math self-concept that leads to enhanced math achievement.

Conversely in the arena of negative self-efficacy, Ramirez et al. (2013) found the potential of math anxiety to negatively impact children's math achievement as early as the primary Grades 1 and 2. It is significant to call attention to the fact that feelings of self-efficacy are a critical piece in predicting later math achievement. Addressing this construct at an early age is a notable precautionary intervention to help bolster later math achievement.

In several additional studies, correlations were drawn between competence beliefs and achievement, and that competence beliefs have a much higher correlation to achievement than enjoyment. For example, in a study by Arens, Yeung, Craven, and Hasselhorn (2011) it was found that for competence beliefs, there were correlations of .61 and .63 with achievement; however, for enjoyment the correlations were .37 and .33. Therefore, from this study one could surmise that feeling confident in one's capabilities in math is more relative to one's performance than enjoyment of math. However, it was found when exploring levels of enjoyment and educational aims that correlations were markedly higher than those between perceptions of competence and educational aims with correlations of .27 to .49 and .49 to .70 respectively (Marsh et al., 2012). This indicates that math enjoyment shows a stronger relationship to furthering math pursuits than perceived competence does (Marsh et al.). However, as stated in the Pinxten et al. (2014) study, early enjoyment leads to a heightened self-concept, which in turn sparks the rise in math achievement. Therefore, when looking at the precursors to the goal of math achievement, enjoyment of the subject lays the groundwork for later competency beliefs fueling achievement overall.

Early Math Guidance Intervention

In a study by Rowan-Kenyon, Swan, and Creager (2012), the authors investigated the tenet that preliminary experiences with positive support and encouragement in math-related work have a strong impact in either expanding or narrowing students' math interest level. This study focused on students in Grades 5, 7, and 9. The findings indicated the importance of strategies such as group work and extrinsic motivational factors such as an enhancement to broadening interest in math. The role of conceptualized supports and engagement levels were evidenced to be of high impact on student interest in math. Group-work itself was deemed as a very strong factor in building math mastery skills, thus fostering higher math self-efficacy and interest to continue in math pursuits. According to Rowan-Kenyon et al. (2012), experiences impact choices both early in childhood and later on into adolescence, including career decisions into adulthood; therefore it is key to enact early intervention as a critical component to student development.

A preliminary study conducted by Ting et al. (2012) lends support to this argument. The authors' study on middle school career education programming was found to increase interests in studying the sciences, thus increasing knowledge, skills, and awareness in those areas. All of this renders a high level of satisfaction among the students. The students were taught how to use the DISCOVER program, which is offered as a career exploration precursor to the ACT from American College Testing. Other career activities that students participated in included summer camps that involved visits to geoscience agencies, science and technology museums, and discussions with science career professionals. Additionally, students began to create a career plan and engaged in career group meetings with role models and mentors in the field. The study found that all of these activities did have a positive impact on students' interests and skills in the sciences, and also began to build the career-planning component into the students' repertoire of learning. Another example of summer camp opportunities was described by Massiha (2011). It was a discovery camp that infused hands-on activities coupled with opportunities to see how these learning experiences relate to the construction and operation of real world engineered systems. The summer program Gear Up focuses on developing relationships with students and colleges to begin encouraging postsecondary pursuits. The program focuses on encouraging students to aim for high grades, providing an increased awareness and understanding of how the sciences work, and building an understanding of how the STEM fields differ. Overall student response to the camps was positive and was shown to increase engagement (Massiha, 2011).

As a mechanism to understand students' perceptions of careers in the math and sciences, it is essential to know if those perceptions align with what is true and accurate regarding careers in those fields. "Student perceptions of science-oriented careers and scientists have been shown to be largely inaccurate" (Wyss & Watson, 2013, p. 54). Massiha (2011) also contended that though the United States has a dramatic shortage of engineers and technologists, unfortunately students suffer from a lack of awareness of these fields thus hampering their potential entry into them. Wyss and Watson formulated an instructional design and development process developed to offer students more accurate information for science-oriented careers. Through the use of technology by way of podcasts and video interviews with STEM professionals, students gained exposure to accurate information to begin to formulate a more true to life understanding of the STEM professions. The Wyss and Watson study had the purpose of investigating whether or not exposure through technology had an impact on students' understanding of STEM fields, thus allowing them to make more informed judgments about STEM careers at the crucial developmental time of middle school. Wyss and Watson (2013) conducted a pilot study that contained a survey of students' STEM career interests before and after viewing the videos; statistical analysis indicated that the videos did increase students' interest in STEM careers from pretest to posttest.

One of the other areas where early intervention is key is through the foundational perspectives of mathematics, which may promote an increase in the number of females entering into the STEM fields. Mason (2010) stated, "Our economy is increasingly dependent on workers skilled in advanced technology, but at each education level, from K-12 onward, structural barriers discourage women from entering into the challenging, and much higher paid, fields of science, technology, engineering, and math" (para. 4). According to a survey conducted by E-Poll Market Research, only 8% of girls were aiming to seek a career in engineering (National Engineering Week Foundation, 2010). Milgram (2011) stated,

> Women and girls need to see female role models in the workplace that look like them—over and over again. They need to receive the message that women can

work in STEM careers and be successful and fulfilled in their work life while still having a personal life, and they need to receive this message repeatedly. (p. 5)

To address this problem, programs such as Girls Excited about Engineering, Mathematics, and Computer Science (GE2McS) are set up to bolster girls' engagement and excitement about technology and engineering, encourage them to participate in high school and college courses related to those fields, and increase their awareness of potential careers within these fields (Milgram, 2011). Postworkshop surveys indicated that the girls responded with an average of 4.34 on a 5-point scale of satisfaction in regards to the experience (Lawrence & Mancuso, 2012). Longitudinal data evidenced that 18.6% of GE2McS participants actively pursued engineering as their college major, which is much higher as compared to the national average of 8% (National Engineers Week Foundation, 2010).

It is essential to provide early intervention of the awareness of the significance of math learning toward future potential career fields, while also continuing these efforts into high school in order to afford students the opportunity to take the advanced math and science coursework necessary to pursue degrees in these fields. Roadblocks exist if students do not have the foundational coursework to take courses in the math and science majors. Many avenues are open to students in high school including, Advanced Placement courses or teacher-designed programs to build math and science skills and aptitudes. According to Sadler, Sonnert, Hazari, and Thi, (2014), the amount of science or math that is taken in high school is positively linked with significant increases in the interest in STEM careers later on. The major outcomes of taking advanced coursework in the math and sciences is offering a head start on college, providing an easier time in learning STEM-related content in college, and increasing STEM interest and persistence toward a STEM career. In a study conducted by Sadler et al. (2014), the authors found evidence to suggest that students who take advanced math (Calculus) or the continuation of another year of chemistry or physics have a significantly increased interest in STEM careers, over their counterparts who do not choose this option. This study supported the claim that participation in advanced math and science coursework in high school was a strong factor as a precursor to math or science continuation and possible entry into STEM fields.

Math Motivation

Contributing to any type of academic continuance choices is motivation. "The influence of motivation in all areas of instruction, including the teaching and learning of math, is well-known in the literature" (Gasco & Villarroel, 2013, p.86). One area that is of special interest is that of academic intrinsic motivation, defined as "the enjoyment of school learning characterized by an orientation toward mastery, curiosity, persistence in learning challenging and novel tasks" (Gottfried et al., 2013, p. 69). In the case of academic intrinsic motivation in math, those with higher levels of math motivation and attitudes show significantly higher math achievement scores in both grades and test scores (O'Dwyer, 2005). The converse expectation, therefore, is that a developmental decline in math motivation and achievement relates negatively to the continuance of advanced coursework and attainment in higher education (Gottfried et al., 2013). Stated simply, students who have low levels of motivation in math are less likely to take more advanced coursework in math. In the Gottfried et al. (2013) study, math intrinsic motivation was assessed with a 26-item inventory that provided for measurement of academic intrinsic motivation. Math achievement was assessed yearly with ages 9-17 on the Woodcock-Johnson Psycho-Educational Battery; students' high school transcripts were analyzed to ascertain math courses taken as well. Across this long-term longitudinal framework of 20 years, there were dual declines in math intrinsic motivation and achievement related to the construct of math course accomplishments, which in turn played a role in future adult educational attainment. The results suggested that math intrinsic motivation provides impetus to take advanced math coursework, and that this motivation is present as early as middle elementary school. Most importantly, students with low math intrinsic motivation evidenced an on-going reduction in enjoyment and an inherent and progressive loss of pleasure in the learning process, resulting in the lack of positive outcomes in math into adulthood (Gottfried et al., 2013).

According to Gottfried et al. (2013), declining motivational and achievement pathways begin very early on in a child's schooling, therefore waiting until high school to intervene is not an option and schools need to be proactive in their approach to motivating the math learner in the earlier years. Burton (2010) stated that empowering students to grow in their mathematical thinking in the primary grades, especially focusing on Grades K-3, is a key mechanism to lock in meaningful mathematics experiences. Activities such as the use of daily data can be useful and can also be extended by creating graphs and writing number sentences from data. Problems should relate to children's daily lives and their background knowledge so that relevance and connectedness is a focal strategy. “Math games encourage children to improve logical thinking skills and work on procedural knowledge of operations” (Burton, 2010, p. 95). Through strategies such as daily data, number of the day, peer problem solving, math games, and dynamic groups, teachers can encourage excitement and interest in math and have a positive impact on future motivation to seek continuation in math (Burton, 2010).

According to Gasco and Villarroel (2013), academic achievement is significantly affected by a student’s motivation toward learning and his or her participation in the learning process itself. One of the most holistic models of motivation in the area of mathematics, the expectancy-value theory, has declared that beliefs pertaining to value and the reality of imminent success are intuitively parallel to the amount of effort spent on math tasks (Wigfield & Eccles, 2000). Expectancy-value theory aligns highly with the construct of self-efficacy espoused in the social cognitive theory of Bandura (1997), in that, “The choice, constancy and performance of individuals can be explained through one’s perception of one’s capacity to carry out a new task and the value that individuals assign to their own activity” (Wigfield & Eccles, 2000, p. 75). In the Gasco and Villarroel study, support was found for the theory that students who use algebraic methods to solve problems tend to be more motivated to learn math, and as such it is possible that a higher motivation in math in turn encourages the use of more advanced mathematical strategies in future problem solving tasks. This has implications for ensuring that mastery of algebraic methodology is in place in high school. The researchers also drew connections between students being able to solve or approach problems correctly with appropriate algebraic solutions and having a higher degree of motivation in math, "specifically with task-valuations and expectations of self-efficacy" (Glasco & Villarroel, 2013, p. 98). This study lends evidence to the strengthening of solid foundational mathematics skills that will in turn bolster achievement and build motivation for continued math task performance.

Technology Integration in Math

Technology integration is of high priority in many schools across the nation to raise the bar for leading students into the 21st century. Using computers to enhance mathematics instruction is becoming a strong argument according to many studies. For example Khan and Slavitt (2013) stated, "Innovative online resources are playing an integral role in reimaging education in a way that promotes engagement and empowerment by building more individualized, mastery-based, and interactive learning venues that foster creativity and collaboration" (p. 31).

According to Maloy, Edwards, and Anderson (2010), strategies of using a combination of computer-based activities, learning games, and students' creative writing of math problems produced a beneficial student learning outcome, with 70% of students improving their performance from pretest to posttest. The program tested in the Maloy et al. (2010) study, 4MALITY, uses a mechanism of "hints" (p. 83) to use suggestions and strategies focusing on problem solving steps and learning style preferences. The problem solving hints are linked to a virtual coach that embodies the point of view of each problem. This way of compartmentalizing math into categories provides a method of organizing information for students, taking the broader information into a more focused perspective. The learning styles cover the following four categories: explaining, computing operations, test-taking and problem solving, and appealing to the visual aspects of computation (Maloy et al., 2010). These varied methods of illustrating one's performance proficiencies allows for students to have more than one linear approach to math. Among the 125 fourth graders in this study, there was a mean gain of 25.5% from pretest to posttest. There were actually 36 students who showed a 40% gain. The difference between the pretests and posttests was found to be statistically highly significant ($p < .01$;Maloy et al., 2010). This study demonstrated the need to diversify approaches to teaching math.

Another such program that reinforces the ideal of providing computer-based tutorials is Khan Academy in which students are able to use online resources to learn math at their own pace. A charter school in San Jose, California put this approach into practice by setting up a physical environment that affords students variety in learning activities to enhance their learning. Everything in the classroom make-up looks atypical; there are kids at stations, working in groups, collaborating with peers, and for the most part not in the traditional classroom configuration. Khan Academy has been piloted as the new way to teach math in which students are given access to 3,500 videos and "in many cases students use math exercises, a series of practice problems that weave a narrative from basic arithmetic through calculus in order to refine math skills, remediate, or race ahead" (Khan & Slavitt, 2013, p. 29). Again, just as in the 4MALITY program, students are taken through math exercises using step-by-step hints, accompanied by related videos and immediate feedback. Both students and teachers are able to access real-time reports to be able to gauge progress on the spot. This affords a more individualized and focused methodology for teaching math (Khan & Slavitt, 2013). "Giving students access to data about their progress empowers them; it helps them learn to interpret charts and develop action plans to bridge their knowledge gaps" (Khan & Slavitt, 2013, p. 30). Ninth graders in Summit San Jose School illustrated how when uninterrupted learning takes place, each individual will seek the guidance by way of their own learning preference that works for them whether that is a Khan Academy video, one-on-one attention from the teacher, or collaboration with a peer. This method of teaching shows a way to re-envision how math is taught.

In an empirical study performed by Kim and Chang (2010b), the effects of computer use on mathematical performance was explored, with a focus on the special population group of English Language Learner (ELL) students. Through cross-sectional analyses, this study found that computer use for various purposes showed significantly positive effects for English-speaking students from four racial groups: Caucasian, Hispanic, African American, and Asian. An important finding was that "computer use for math was associated with a reduced gap in math performance between native English-speakers and ELL students" (Kim & Chang, 2010b, p. 302). Computer use for math class in particular and for various other purposes had a positive effect on performance (Kim & Chang, 2010b). In a follow up study Kim and Chang (2010a), where math achievement of differing student groups was examined, one of which contained the linguistic group of ELLs, again math achievement was increased specifically after the use of daily math games as a teaching strategy. Delen and Bulut (2011) concurred that the direct and indirect effect of information and computer technology (ICT) at school should be taken into consideration among educators due to its positive impact on students' abilities to read and use information on computer screens. The results of the Delen and Bulut study illustrated that when students are exposed to ICT both in their home and at school, that this illustrated a high predictive value of performance in math and science.

According to O'Brien and Scharber (2010), "Many students in the 21st century operate portable music players, handheld gaming devices, and cell phones" on a regular basis making mobile technology "second nature to many students," but in most cases "these devices are not readily available in schools" (p. 600). In fact, the iPad in particular is a visionary tool that is predicted to hold a vital position in 21st century learning if students are able to learn to properly use its potential (Banister, 2010). The consensus of many parents is that computer games are considered a waste of time; however, in actuality, they have shown to have a positive effect on children's cognitive development (Hemlen, 2011). Berk (2010) found that iPad learning was effective in bolstering academic success, especially for teaching mathematics. Computer games in particular have shown to increase math achievement. According to Kim and Chang (2010a), who performed a study examining the effects of computer games on math performance among students of varying linguistic and gender groups, this was the case, with one essential caveat. In the case of the gender group, males who played computer games were associated with higher achievement in math in comparison to females. However, generic beneficial effects of computer games for both genders were reported by Annetta, Mangrum, Holmes, Collazo, and Cheng (2009). Yet the caveat to computer game play is the amount of time spent playing those games. Annetta et al. (2009) found that males play video games for an average of 2.1 hours per day, and that those males illustrate low math performance trends. However, males who chose to spend time playing computer games on occasion, anywhere from one time per month to twice a week, performed higher than males who did not participate in such play. Thus, the implication for educators is that finding the optimal frequency of computer game play is key to gaining the desired outcome.

Gender Gap in Math

The gender gap has been perceived to be a real and present divide between males and females in the content of mathematics. "The achievement gap refers to a persistent advantage of males over females in student achievement in mathematics that begins in the early years and continues into high school and postsecondary education" (Ross et al., 2012, p. 278). Yet, as evidenced by Kim and Chang (2010a), this may not necessarily be the case in all scenarios. As noted in the article, *The Myth of Pink and Blue Brains* by Eliot (2010), there is no neurological link to a gender gap existing in the brains of males and females. Neuroscientists have found there to be very few identifiable differences between boys' and girls' brains. However, Eliot points out that on average they do differ in "self-regulatory behaviors, with girls showing a better ability to sit still, pay attention, delay gratification, and organize a take-home folder" (Eliot, 2010, p. 32). Yet, according to the National Assessment of Educational Progress (NAEP) testing, results every year since 1971 show that males outperform females in math (U.S. Department of Education, 2005). Similarly on the Program for International Student Assessment (PISA), the same gender gap exists (Else-Quest, Hyde, & Linn, 2010). However, a recent analysis of PISA data attested that "higher female performance correlates with higher levels of gender equity suggesting that environmental factors have a significant impact in the generation of this gender gap" (Eliot, 2010, p. 33). Looking at how girls and boys develop in childhood, one can observe that girls typically "spend more time talking, drawing, and role-playing in relational ways, while boys typically spend more time moving, targeting, building and role-playing as heroes" (Eliot, 2010, p. 34), thus contributing to the notion they are hardwired from the start. Yet, each respectively is being environmentally differentiated into typical roles with consequences for cognitive and emotional functioning later on in life (Eliot, 2010). Cvencek, Meltzoff, and Greenwald (2011) call this *social knowledge*, of which there are three areas within social cognition involved:

> The first is the association between *math* and *boy* or *girl* or the *math-gender stereotype*, the second involves *gender identity* which is the association of *me* with either *boy* or *girl*, and the third is the *math self-concept* or the association between *self* and *math*. (p. 766)

Only 25% of boys report reading as one of their favorite activities, while in comparison 45% of girls report reading as a favorite activity (Organization for Economic Cooperation and Development, 2010). It was suggested by Eliot (2010), that since the childhood environment is dominantly controlled by the adults within it, both parents and teachers need to be cognizant of their gender neutral capacities by avoiding stereotyping, strengthening spatial awareness for girls, engaging boys with words, and treating biases seriously. Spatial awareness was an area of special concern in the Else-Quest et al. (2010) meta-analysis indicating that space/shape on the PISA scores showed consistency with the previously established evidence of gender differences in the spatial skills of mental rotation. This indicates a neglect for the teaching of spatial skills in schools. In a study by Uttal, Hand, and Newcombe (2009), there was an indication that the increased use of computer games could be a means for closing that gap among genders with increased play of computer games that involve those mental rotations.

In the Cvencek et al. (2011) study, 247 children (126 girls and 121 boys) in Grades 1-5 were tested with "math-gender stereotype measures created for this study administered as two Likert-scale questions with images from Harter and Pike's (1984) Pictorial Scale" (p. 768). The scale asked which gender they believed possessed the particular attribute described. The researchers found the existence of a pervasive gender stereotype was present among elementary students, as was the case in previous research on adults. Cvenek et al. indicated that girls showed lower identification with math than boys when they stated, "This suggests that the math-gender stereotype develops early and differentially influences boys' versus girls' self-identification with math prior to ages at which differences in math achievement emerge" (p. 773). This finding has implications for educators in that identification and awareness of cultural stereotypes and gender roles that create these influences on the genders is a critical area for improvement, not only in schools, but also in our society as a whole.

In a meta-analysis performed by Else-Quest et al. (2010), using the most recent data from TIMSS and PISA, there was a high level of gender differences found in mathematics achievement, attitudes, and affect. The areas of pronounced difference were consistent with previous research, one of which was mentioned previously, that of spatial intelligence. Another such consistent finding was that of boys' feelings of greater confidence and less anxiety over their math capabilities and that they were more personally motivated to do well in math in comparison to their gender counterparts. In fact, the largest mean effect sizes were in the categories of math self-concept and self-efficacy among males, scoring one-third of a standard deviation higher than the females (Else-Quest et al., 2010). It was notable that overall differences in math achievement were not shown to be significant among the genders. This would indicate support for the fact that neurologically, females and males have no identifiable differences; they have the same likelihood of developing math intelligence. The actual source of the differences in math achievement are therefore, found within their environmental exposure to gender stereotypical activities and cultural biases that frame male and female interpretation of their math self-concept. It is essential to draw from this study that females will perform comparably to males when they are encouraged to do so and offered the necessary tools and resources.

Particular female attributes tend to increase the likelihood of their success in mathematics. "Researchers have studied the issue of gender differences in math achievement, especially among highly able females" (O'Shea, Heilbronner, & Reis, 2010, p. 235). With exposure to observable female role models excelling in math, girls have the capacity to achieve in a parallel fashion to boys (Else-Quest et al., 2010). According to O'Shea et al., there are certain identifiable qualities of women who have attained high achievement levels in math. This premise was studied in a qualitative study with a purposeful sampling of female high school students who were labeled as academically gifted, having scored above the 95th percentile on the quantitative section of the SAT Math. Five commonalities surfaced within the findings: the participants had heightened aptitudes of quantitative skills and leadership; the girls were extremely involved at school; they were from homes that placed a high value on education (math especially); they had certain social-emotional traits that allowed them to succeed inside the classroom as well as outside of the classroom setting; and they had high quality instruction in their school. Though intelligence was also a factor that came into play in that all of the girls had well-above average IQs (130-145), the other remaining factors were all extrinsic in nature. This study provides a strong argument that the environmental factors of experience, exposure, and observations are comparably as important in designing the ideal candidate to excel in the math fields as raw intelligence. Implications of this study suggest that educators and parents are key figures in promoting strengths in mathematically talented females through “positive psychosocial factors such as a view of math as positive and useful, a style that encourages the attribution of success to talent, and confidence and persistence in tasks” (O’Shea et al., 2010, p. 235).

Ross et al. (2012) investigated research questions regarding the extent to which patterns in achievement between genders, specifically on fraction tasks, match patterns in self-beliefs about math learning. Ross et al. furthered their investigation to focus on how much the relationship between self-beliefs and achievement on fraction tasks is dictated by a student’s gender. The first finding was that there was not a statistically significant difference between males and females, resulting in a variance of less than 1% in knowledge of fractions. However, along the same lines as the Else-Quest et al. (2010)

study, there did exist a statistically significant difference between males and females in the area of self-beliefs, including the constructs of self-efficacy and fear of failure. Females exhibited less confidence than males about their math performance abilities, even though miniscule performance differences existed between them. Ross et al. suggested strategies to reduce the confidence gap, one of which was to show continued efforts to make math attractive to females. Included in this effort was exposure to female math role models. Additionally efforts were made to increase female likelihood of interpreting their performance accurately, which would likely reduce the discrepancy of their actual performance and their self-evaluations of their abilities. Finally, providing recognition from teachers was used as a strategy since respect and admiration from teachers is a stronger predictor of female confidence than males (Ross et al., 2012). The tenet that extrinsic factors have a strong impact on female self-concept is well documented within the literature and should not be neglected in addressing the gender gap.

STEM Education

Our global economy has shifted to the point that there is a high need for employable individuals in the STEM fields (National Science Board, 2010). Recent concern over the fact that there are increasingly lower numbers of students pursuing those STEM-related degrees has been documented by DeJarnette (2012). In fact, the National Science Board (2010) anticipates an imminent shortfall of workers in the STEM fields in the United States in the foreseeable future. "The United States currently ranks 20th among nations in the proportion of 24-year-olds who earn degrees in natural science or engineering" (p. 61), which has gained acute attention in that the United States is not educating enough practitioners in the STEM fields to sustain our position as a leader in innovation and discovery (Zhe, Doverspike, Zhao, Lam & Menzemer, 2010).

One of the ways to combat this growing concern is to encourage early exposure of students to the STEM fields in school. Roth and Eijck (2010) completed a study on lifelong learning as it relates to science and stated that schools need to focus more on STEM processes and less on specific content so that they are better preparing students for the real world of science. The interweaving of theses fields that comprise STEM is the means by which students will make the connections between what they learn inside of the classroom and what they will need to attain many jobs outside of the school walls. Wai, Lubinski, Benbow and Steiger (2010) echoed this claim by saying that there is a need to stimulate intrinsic motivation and achievement in STEM academic areas in childhood to provide early routes for entry into STEM-related careers.

Programs such as the STEM Summer Bridge Program that are based on the premise that students need to be engaged in STEM education before they enter into postsecondary education are beginning to build a connection and bridge high school learning and college pursuits (Zhe et al., 2010). Among the students in the 33 high schools who participated in these 10-week multidisciplinary research activities, 100% of the 21 seniors chose to continue on to college and 86% (18) chose to major in a STEM field. One theme that emerged from the focus groups was that the experience had enhanced the students' level of confidence in STEM majors and independent research and that exposure to the problem solving research projects had motivated them to consider a career in STEM (Zhe et al., 2010). Another such program, called eXtra Technology, Engineering, Education, Mathematics, and Science (X-TEENS) was initiated to grow interest in STEM fields with a focus on engineering among underrepresented students from economically disadvantaged school districts. The program was comprised of a summer session that would be focused on collaborative hands-on activities, tours within the industry, and relationships with career professionals with a focus on what is necessary to be successful in STEM fields. The participants were chosen based on their interest and perceived potential in a STEM field. In particular, the demographic make-up included 45% females with the design purpose of raising awareness about the field of engineering, which as a major produced only 18% of its graduates of the female gender (American Society for Engineering Education [ASEE], 2009; O'Sullivan & Cochran, 2009). At the end of the program the participants were given a Test of Science-Related Attitudes (TOSRA) survey. The results indicated that 98% of the students had favorable attitudes towards the experience and how it enhanced their interest towards STEM related careers (Elam et al., 2012).

Akin to what surfaced in many of the previous studies, one of the specific concerns for the STEM fields is the low enrollment of females into this arena. Though in many career fields women are very steadily reaching parity with men, they still remain in the minority among the STEM fields (O'Shea et al., 2010). Many schools of thought exist on the causes of this discrepancy; most of them fall into one of the following categories: beliefs about learning, usefulness of math, school factors, or home factors. In the area of beliefs about learning, studies have shown that women attribute their success in learning in such content areas as math to effort and luck, while males attribute their success to ability (Dweck, 1999, 2007). Because of this view, women often feel threatened in math and do not view it as vitally important to their futures, which in turn diminishes their motivation to pursue STEM fields. School and home factors may contribute to the biases towards how girls and boys learn in stereotypical ways (O'Shea et al., 2010). It is compelling to point out that a study by Mahoney (2010) revealed that though not statistically significant, an unexpectedly intriguing result was brought forth through an instrument used to measure attitudes toward STEM. This instruction showed that males did not have a more positive attitude about STEM content areas of science and math. This indicates that males and females do not show a significant difference in regards to their attitudes for these two specific content areas. Therein lies the hope for an increase of females in those fields if nurtured in the appropriate way.

How can we predict who will succeed in the STEM fields? Achievement motivation is one aspect that may factor into this equation. Achievement motivation is defined as the inclination of a person to seek to achieve (Kuyper, Van der Werf, & Lubbers, 2000). Therefore, it would stand to reason that individuals who have a high achievement motivation in the STEM fields would be driven to pursue these fields to attain a personal level of achievement. Achievement motivation stems from achievement itself. Past achievement breeds a need to pursue future opportunities to achieve, fueling motivation (Porthan, 2010). There certainly is the element of raw mathematical ability that would factor into attainment in a math-related field. In the case of the O'Shea et al. (2010) study, the female participants had notably high IQs and scored higher on the SAT

Math (700-799) versus the SAT Verbal (less than 700). This would indicate a strong intelligence in math among those individuals. As indicated in the Korpershoek, Kuyper, vanderWerf, and Bosker (2011) study of students in upper secondary school and their choices for their Final School Examination (FSE), those who chose to take the exam in the fields best suited to prepare them for science-oriented higher education, that of advanced mathematics, chemistry, and physics were predominantly male, numbering only 720 of the 6,033 surveyed. Those who were girls did evidence previously high math achievement. However, the findings of this study do indicate that the combination of advanced math, chemistry, and physics might deter girls more than boys from choosing STEM fields in the future.

The issue of balancing the scales of gender equity in the STEM fields, coupled with building the field itself, is an on-going quest within our nation. Building a bridge into the STEM fields begins in the early foundational years. Educators must continue to provide exposure and opportunities for STEM field awareness for interest to grow.

Postsecondary Attainment

University major selection tends to follow a group of parallel predictive elements: background factors such as gender, socioeconomic status, achievement, and academic self-concept (Parker et al., 2012). Women are now equally as likely to enter college; however, there still remains a gap in some science fields, especially those that are math-intensive (Camp, Gilleland, Pearson & Putten, 2009). The research consistently shows that one of the greatest predictors of major choice is math achievement and that equally, if not more significant as a predictive aspect, is the idea that self-beliefs drive postschool destinations (Parker et al., 2012). Parker et al. (2012) found that self-concept is an important predictor of post-high-school outcomes and that math self-concept, in particular, was a positive predictor of some majors and negative predictor of others. Therefore, if an individual has an academic sense of self that is weighted towards mathematics over verbal skills, he or she will seek to realize this potential by choosing a math-intensive major. Thus, the findings suggest that in order to increase the number of university students pursuing math majors, interventions should target general-level academic achievement and self-concept, which is directly related to experiences and psychological processes occurring during school (Parker et al., 2012).

In a study by Domene, Socholotiuk, and Woitowicz (2011), it was revealed that among 380 participants enrolled in postsecondary education programs, career outcome expectations and occupational aspirations had a strong impact on academic motivation. Students pursuing careers in science, technology, or math had much higher academic motivation than students pursuing other career paths. The results showed a connection between career-related cognitions and academic motivation in postsecondary pursuits. Therefore, the study implied that the function of career outcome perspectives in the development of young adults might be a worthwhile intervention to increase student engagement and to support postsecondary majors, and ultimately career attainment goals (Domene et al., 2011). In looking at postsecondary attainment, it is important to note the connection of classroom learning with the outside world as an integral factor. Students need to be able to perceive what they are doing in the classroom as vital and valuable to what they will do when they leave school. Morgan, Parr, and Fuhrman (2011) said, "Teacher collaboration has shown to be a very important aspect" (p. 78) when describing this aim in that the cross-curricular model of instruction can bridge learning to real-world career aspirations.

Implementation

As the study concluded, it became evident that a specific plan for implementing the student guidance lessons by developing the sequential lesson plans was necessary. Students need to be afforded the opportunity to gain awareness of their optimal learning preferences, especially in regard to math, and to begin to bridge their learning with the outside world of work through lessons designed to guide this learning. The students in School District R could benefit from the guidance provided in this project as a means of becoming more aware of themselves as learners and of the many connections between the learning of math content and the pursuit of numerous career avenues after they graduate. The student guidance lessons need to be a part of the education of all junior high students at School District R to begin their exposure to the importance of learning in math to their optimal level. In doing so, students would see the benefit of taking advantage of all possible coursework in math and continuing in their math progression through their senior year of high school. As a result, all students would be afforded the possibility of pursuing math-related majors and careers in the future.

Potential Resources

Resources needed for this project include a person to develop the student guidance lessons and formulate a sequential plan of implementation in the junior high schools in School District R. I have the background from my experience as a school guidance counselor for the better part of my career and can serve as the individual who develops and coordinates the implementation of this plan. As a part of this role, I will schedule the sessions with the math and career and technical education teachers to teach the student guidance lessons. The teachers will be able to participate in the lessons cooperatively with me, as I would be responsible for training teachers to implement the lessons in their classrooms. The lessons would be taught in four sequential lessons over each of the two junior high levels, Grades 7 and 8. The topics for the student guidance lessons will include: (a) learning attribute discovery (b) group work focused on students' learning preferences and methodologies for optimal instruction, interests, and skills (c) cross-curricular school connections and (d) math and career connections. The resources that I used to create the student guidance lessons included multiple websites, articles, books, and school guidance curriculum. The focus was on the purpose, process, creation, implementation, and assessment of the self-awareness aspect of psycho-educational development in students through a guidance lesson approach. Other resources needed for these student guidance lessons include Kolb's Learning Style Inventory, iPads, handouts, Power Point presentations, project supplies, and student journals. The student guidance lessons will serve as the primary resource, prefaced by the teacher professional development to support in the implementation of this project with students.

Existing Supports

School District R offers a strong group of quality teachers coupled with a supportive district office that provides the necessary resources to make this plan feasible. I have become the acting district curriculum director involved in all instructional decision-making and student services. Thus, I can provide the necessary supplemental content for implementation of the student guidance lessons. I am the person in charge of coordinating in-service training for teachers to meet the district's needs, therefore this project can become one of the elements explained in the professional development time each year. Professional development days can be focused on student guidance so that teachers have the opportunity and time to make this shift worthwhile for students. Teachers can learn how to work collaboratively on this effort during early release Friday professional learning community (PLC) time. During PLCs, they could discuss ways to continue students' awareness of their optimal learning. Our district office recognizes the importance of meeting as teams to further the aims of the district, which are to improve instruction in our classrooms and provide an education for all learners' needs, which is focused on students being able to reach their learning potential and enter the world career ready.

Tangible resources exist in both hardware and actual person-centered human commodities. School District R is an Apple iPad one-to-one district, therefore all students have their own iPad. All of the schools are linked by video teleconferencing (VTC). At the two larger sites, $25,000 worth of welding and shop equipment was recently added to our shop facilities to support cross-curricular possibilities to enhance the real-world-to-classroom connection. We have two teachers in our Career-Technical Education (CTE) programs who are certified welders. Additionally, within our communities there are many local skilled laborers including welders, carpenters, and those involved in all aspects of the fishing industry, from boats to processing plants.

Many local community members are very willing to share their professional, career, and technical skills with students either in a mentoring or apprenticeship situation. These career professionals vary from computer programmers and accountants to the various skilled labor workforces.

Potential Barriers

Time is the most significant obstacle to overcome in the implementation of student guidance lessons as a tool to help students in their learning and instruction in the classrooms. With the growing need to raise the bar to meet increasingly rigorous state standards, there is little time to infuse any additional sets of expectations. Teachers will need to be amenable to allowing for some flexibility to their balance of straightforward instructional time aligned directly to the curriculum and allowing the time needed to infuse the guidance lessons for self-awareness. Teachers will have to allow for this time so that students see the value in the lessons toward their understanding of the relationship between classroom learning and real-world learning.

Resistance by either students or teachers may also pose a barrier to surmount. Students may need some time to see the benefit of this exploration. In order to gain the most from the student guidance lessons, students need to understand the value in them. Teachers may also need some convincing of the value of this endeavor. Stealing time they would normally use for content delivery may appear to be an infringement on their coveted instructional time. They will need to be given time to invest themselves and buy in to the student guidance approach. This will take thoughtful and strategic planning so that teachers have a desire to see this through for the benefit of their students.

Proposal for Implementation and Timetable

Exposing the teachers to the student guidance lessons model for this project will begin during the 2015-2016 teacher in-service week prior to the start of school. Teachers can begin viewing the student guidance lessons and meet together to collaborate and discuss their thoughts and ideas to offer support for this project implementation. A schedule of when the lessons will take place will be established cooperatively with the teachers from each site and myself. By the beginning of the second quarter (mid-October) of the 2015-2016 school year, the plans for the first student guidance lesson should be in place. Each school will be collaborating with me to create a specific timeline that is most suitable for their teachers and school schedule; however, the ideal timeline will be recommended to all teachers.

The ideal timeline mandates that Student Guidance Lesson 1 occur during the first part of Quarter 2 (early November), the second lesson follow up should take place in January, the third lesson in February, and the last lesson in March. Student reflection and feedback completion will be set prior to the last day of school (May 19th). This timeline would allow for the second half of the school year to be the consistent student awareness and growth time. A review of all student guidance lessons and reflection should occur upon the completion of each year in Grade 7 and Grade 8. Continued collaboration time will need to be afforded to teachers within and among the sites to discuss the implementation strengths and areas for improvement in the future. By the beginning of the 2016-2017 school year, the teachers will be more comfortable with the student guidance lesson instruction and will be able to open communication with students so that the lessons afford the optimal benefit.

Roles and Responsibilities of Student and Others

According to Kolb (1984), individuals create themselves through the choices they make in actual occasions that comprise their life's experiences. Therefore, to support students as they learn, they need to be provided experiences that will help them to direct their future learning potential. Opportunities for optimal learning experiences provide the key to developing learners who seek to continue to grow and develop their gifts and talents. First and foremost, I feel my role and responsibility in this project study is to provide the student guidance lessons and to motivate teachers to use them as an opportunity to build a strong connectedness of student self-awareness and learning in the content areas. By leading the charge as the district level advocate, I will be the proponent of this shift by offering students psycho-educational services. The role and responsibility of the school district is to support the project's efforts and to offer its teachers time for collaboration to discuss how to improve and increase meaningful learning episodes for their students. The teacher's role is to support student learning in an environment that allows for exposure to a variety of aspects of the world inside and outside of the classroom, thus broadening their perspective of their own possiblities. The student's role is to become self-aware and to gain an understanding of themselves as a learner in order to be able to capitalize on their abilities, skills, and interests in the future.

Project Evaluation

Though I have not implemented this project at this time, a formative and summative evaluation plan are described below and will be used to measure the efficacy of the student guidance lessons based on feedback from the participating students in their reflection and evaluation completion. Teachers will also share their feedback towards improvement of the guidance approach. Ultimately, by monitoring resultant increased numbers in advanced math enrollment in high school, the project's aim will be evaluated.

Formative Evaluation

This project will be used to ensure that the goals of student awareness and understanding of their learning are being explored. To ensure this aim, a formative evaluation will be used to gauge this project's efficacy as it progresses from lesson to lesson. This type of evaluation was chosen because the student guidance lessons will be an on-going plan to be used with students in Grades 7 and 8 each year. The lessons are designed to enhance student awareness and understanding of their learning in math and how this learning can promote their growth later on in their educational journey. Student reflections at the end of each session will be used as a formative tool to improve lessons over time.

Summative Evaluation

Student evaluation surveys along with teacher feedback forms will be used to study the outcomes of this project upon its completion. Students will be asked to complete a survey indicating their level of exploration and self-discovery experienced over the duration of the series of lessons for the year. The survey will also include a question in regard to what the students' math enrollment intentions are at the end of each school year (both Grade 7 and Grade 8 students). Teachers will be asked to offer feedback regarding their views on the impact and effectiveness of the guidance lesson approach to building student awareness of the importance of learning math. They will also be asked to submit suggestions for improvements to this approach.

As a follow-up procedure, I will also gather data from math course enrollments over time. Since the ultimate goal of this project is to address the problem of a lack of participation in advanced math courses in high school, I will gather follow-up data on students as they progress through high school. This will help to determine whether or not the outcome of increased advanced math enrollment in high school is achieved.

Using Evaluation Data

The overall evaluation goals for this project include presenting the findings to the team of teachers as well as the administration and the school board of School District R. The major stakeholders are the students, as they will be the ones given the opportunity to more fully develop as learners. The teachers and administrators are stakeholders as well because of their roles as the agents of change in instruction, school curriculum, and content. The school board is also a body of stakeholders in their roles as those able to make policy recommendations and changes to further the aims of the district.

Implications Including Social Change

Local Environment

For the past several years, students from School District R have shown a lack of participation in advanced mathematics courses in high school. According to the historical data dating back to 2010, 30% or fewer graduating seniors chose to take a math course in their senior year. Understanding the importance and the far-reaching effects of a lack of preparation in the content of mathematics has been nearly nonexistent among the student population. This project aims to resolve this deficiency of awareness in students with a set of guidance lessons that will help to connect math learning with their future by providing enriching learning experiences that bridge math and careers. Students who are afforded these experiences will build a stronger sense of their academic self-concept in math that will ultimately assist them in making informed decisions about their futures. The hope is that there will be a shift in advanced math enrollment increasing student participation to an acceptable level. By using the student guidance lessons, students are given the opportunity to promote engagement in learning, therefore increasing student motivation to take more advanced coursework. The schools and local community will reap the benefit from this foundational project as students begin to take advantage of the educational opportunities available to them as they capitalize on this preparation in their future career choices. Becoming more marketable for the local community's workforce and beyond will be the end result.

Beyond the Local Environment

In the larger context, teachers could extend this guidance approach to meeting the needs of their students by continuing to build this learner awareness in their students. As a result, students across the nation may see the benefit of continued, advanced coursework in math and its link to numerous careers in the world of work. Students can be afforded novel experiences that engage them in ways that create connections between core curriculum content and their personal preferences, abilities, skills, and interests building on their learning potential.

Conclusion

This project created an opportunity for students to grow and develop as learners. The results from this project can have an impact on the local setting by creating a foundation to enhance potential in math learners. This project's aim could be relative to students throughout the nation as well. The next steps for following through with creating change and providing students with the necessary understanding of themselves as learners are included in the student guidance lessons. The following section provides reflections on the process of researching and creating this project. The project's strengths and limitations are discussed as well as suggestions for future research are outlined also.

Section 4: Reflections and Conclusions

Introduction

Focusing on the art of teaching and learning as a complimentary action is my goal as an educational leader. I conducted a mixed methods project study to explore the potential relationship between gender, students' learning styles, and their choices of whether or not to participate in higher-level math in high school. I chose to explore learning styles and self-efficacy in mathematics based on Kolb's LSI and Bandura's social cognitive construct of self-efficacy (Kolb, 1984; Bandura, 1986). I began with a quantitative approach by examining the learning styles of students as measured by Kolb's LSI. In doing so, I was able to see how many students fell into which learning style types and compare that data among grade levels, genders, and whether or not the students chose to take higher-level mathematics courses in high school. I was also able to use historical math enrollment data to see which of the students were on-track, meaning they took the prerequisite courses in a timely manner. In exploring student math enrollment, I was able to see who had the potential to take higher-level math in their senior year, should they choose to do so. Among those students, I could then determine those who were on-track, and which ones chose to take advanced math. Subsequently, I conducted qualitative interviews with a subsample of participants. By coding their responses for themes, I was able to determine what may have shaped students' math learning outcomes and reasons for taking or not taking advanced math classes. I found that students' learning styles did not have a significant impact on math course choice decisions. Instead, the students' experiences in math from an early age were most important in terms of building their math self-concept and academic self-efficacy, which influenced their decisions for math continuance in high school. Armed with this information, I was able to devise student guidance lessons for my project.

I wanted to assist students in becoming more aware of their learning preferences at an early point in their schooling. I provided student guidance lessons as a method to bridge the connection between the classroom learning of students and their future goals in regards to their postsecondary options. Specifically, the lessons begin with the discovery of individual learning preferences and continue by establishing a foundation of understanding of how math learning can be optimized and how math is significant to student career readiness. In this section, I address the strengths, limitations, and recommendations of this project as well as how the project may be extended further to continue to build student awareness of how learning advances their future goals. I also analyze and reflect on my multiple roles as scholar, practitioner, and project designer. I conclude with a detailed description of the importance of this project study.

Project Strengths

I believe that a key strength of this study was its design, which was that of a mixed methods approach. By using quantitative data, I was able to assess students' learning styles and compare their previous math course participation. In using a sequential mixed-methods design, I followed the quantitative data collection and analysis with qualitative interviews of students. Through the use of qualitative interviews, I was provided with rich, descriptive data of the students' math experiences, which I used to map out the project direction. Using open-ended questions, I was able to delve deeper into participants' responses. Students described their experiences freely and in an open manner based on the open-ended question structure. The participant interviews led to follow-up prompting questions that provided me with information that allowed me to delve deeper into the qualitative interviews. A strength of the study was that it generated a picture of the student experience that could only be gained through a qualitative approach. As the students shared their experiences, it became clear to me what my project should be and I could only have gained this clarity through interviews with actual students.

Therefore, the project developed into four sequential student guidance lessons created to be implemented in Grades 7 and 8, during which time students make pivotal decisions about their high school courses (Massiha, 2011). Incorporating the lessons at such an early grade level was an additional strength of the project. It is often too late to structure an on-track math sequence once the students have reached high school (Elam et al., 2012). Math instruction is sequentially based with one course providing a critical foundation for the next one. If the sequential progression of math courses does not begin early enough, then students may not have sufficient time within the high school years to reach an advanced level in math. Therefore, early student awareness in the junior high years is critical. For this reason, I view my focus on Grades 7 and 8 to be an intrinsic strength of this project.

Additionally, this project had several strengths for student development. One is the building of students' awareness of their optimal learning, and another is that of creating a connection between the learning of math to careers beyond high school. I created the student guidance lessons as a tool to assist students in building their sense of the academic self with regard to math learning. The guidance lessons also contribute to students' development by building a foundation of understanding of the learning of math and its relevance to numerous college majors and most career fields. Students who gain this knowledge would subsequently be more prepared for the decisions they will have to make in planning their secondary courses. The students will also learn that those choices also effect decisions beyond high school with regard to being prepared for college or the workforce.

The student guidance lessons will provide a mechanism of self-reflection and self-discovery that creates a strong sense of academic self for students. Having a clear grasp of how one learns and how one can capitalize on learning preferences in order to optimize learning is a critical piece in developing as a dynamic learner (Kolb & Yeganeh, 2011). Not all learners are alike, nor do they learn in the same way. Each student has his or her own unique set of preferences that makes learning more salient. Finding the methods that resonate with each of them is of monumental benefit to a learner as he or she progresses towards attaining the desired learning outcomes (Kolb & Kolb, 2005). I designed the student guidance lessons to build on student awareness of the key factors that make learning feel more attainable and guide learning choices in a way that is informed and preparatory for the future. Because students at the study site have had little guidance counseling in school, I designed the student guidance lessons to be an early intervention to help students understand that they need to be active learners, rather than passive learners, and that they can be their own best advocates when it comes to making educational choices. I found that another strength of this project was that it illustrated the significance of math in many avenues of postsecondary options. Strong applicability of this project to the broader context of the world is present. The fact that the project made learning relevant to the real world built a connection to potential future aspirations outside of the classroom.

The sequential nature of the student guidance lessons was a strength of this project. The lessons built upon one another, giving the students continued support in gaining a better understanding of themselves, their learning, and the role of math in their lives. I believe that four sessions each year for both junior high school years will provide a strong foundation for students in making informed educational decisions. The lessons are implemented at an opportune time and are spread over a span of time that is crucial in students' educational development (Burton, 2010). The lessons provide a framework of discovery and use for future learning opportunities. I will use the student guidance lessons to inform students in a manner that will help to develop their awareness of themselves and of their education. Once the students have this awareness, they will be able to use that self-knowledge to guide their decision-making and to develop themselves fully as learners.

Recommendations for Remediation of Limitations

Although I believe that this project has many strengths, I acknowledge that it has several limitations, as well. The demographic make-up of the target student population was one such limitation. However, with some effort this limitation can be resolved over time through expansion of the guidance approach to include a greater number of students at varying grade levels. Another limitation was the location of the study. Because I drew from a very defined study population, I am unable to generalize my study findings to the broader population of learners. However, I believe that I can address these limitations through practice within the local setting and participant feedback that I will use to inform my plans for future guidance efforts.

The target population for implementation was junior high students, therefore, the approach of self-reflective guidance could be viewed as insignificant or trivial to this population. Intrinsic complexities of maturity and development of middle school aged students may decrease the influence of the guidance lesson goals. Students in Grades 7 and 8 may view this student guidance lesson approach as a waste of time. If that were the case, they would not take the self-reflection aspect seriously, thus affecting the impact the guidance lessons would have on future educational choices. Because students in School District R have not had school guidance counseling in the past, they may also view their time spent in these sessions as unimportant. The model of guidance counseling will be foreign to them, and they may view the sessions as isolated and irrelevant endeavors, thus not investing themselves in the true discovery and usefulness of the knowledge they are gaining. One way to remedy this limitation would be to continue with sequential lessons beyond junior high and expand the student guidance lessons into high school. Another way that this limitation could be decreased is that as time progresses, students will become aware of the guidance counseling approach, and it will not be viewed as such a novel experience. Accordingly, students may have more favorable attitudes towards the purpose of the guidance lessons in positively impacting their learning in the long-term.

An alternate approach of addressing the problem of lack of participation in higher-level math would be to approach the solution from an instructional practices standpoint by intervening with teachers' instructional approaches and methodologies in the early grades. If students develop their efficacy feelings towards math at early stages in their educational development, intervention in the elementary grades could also be a starting point to build learning awareness and understanding of math skill significance. Bolstering math confidence at an early age could be a parallel and primary invention as well. The qualitative data indicated that a strong impact in math course decision-making was formulated from earlier math learning experiences and early feelings of positive self-efficacy. Therefore, an alternative to guidance lessons for students in middle school could be training of elementary teachers to be able to provide responsive teaching in the elementary grades with a focus on fostering early math confidence and laying the foundations of math skill importance early on.

Another limitation was the fact that this project was based on findings from a study that was comprised of a very small group of participants in a very unique location. The constructs that I determined to be factors in math course taking decisions may not be generalizable to a larger population of students. The fact that this study took place in a remote region of Alaska may also factor into the inability to generalize this project to students outside of Alaska, where students may already have had exposure to guidance sessions with similar tenets in mind. With limited interview participants (four males and four females), this was not truly an adequate representative sample of students nor of genders. From these limited data, I was not capable of assessing any generalizable statements of relationship. I could implement further research to continue this data collection with a more diverse and greater number of interviewees, which would build a stronger set of findings to inform the project in the future.

Scholarship

As I researched and conducted my project study, I learned that initial assumptions may not always materialize as relationships once the findings from the analysis come into light. As a researcher, I developed the ability to be flexible and amenable to the direction presented within the findings, which is what true scholarship is founded upon. Following the data is an essential element to quality research.

My initial theoretical framework was based on Kolb's Learning Styles and how those learning styles may impact academic choices in math. I made an initial hypothesis that learning style would be a factor in students' choices to take higher-level math in high school. However, as my study progressed, I found that students had little awareness of their learning style and that there was not a common learning style among students who chose to take higher-level math. Therefore, my initial hypotheses were not supported by the findings. Thus, in accordance with research scholarship, I began to shift my focus in the direction of the findings and review the literature that supported the findings on what does drive students to take or not to take higher-level math.

From the qualitative interviews, I found that there was not necessarily one isolated event or concrete reason that drove the students who chose to take higher math to do so. However, their experiences in math did show commonalities. The one commonality among those students who did not choose to take higher-level math was their lack of awareness of how they might need math in their future work or college life. The two students who did take higher-level math were aware of this significance. Learning in ways that resonated with them, for instance hands-on active learning tasks, were a common, favorable endeavor among the participants. Another common theme was the feeling of strong math capacity or self-efficacy; most participants had a strong sense of math confidence. From this finding, I began to realize that there were social cognitive aspects that could factor into the development of math-seeking behaviors. Within the literature, one can find evidence of strong math self-confidence as an aspect of learning that develops at a very young age in school. Thus, my project began to develop as a guidance approach to assist students in growing and developing as learners to foster achievement through building self-awareness and self-confidence in doing math and seeking math continuation.

Therefore, the aspect of scholarship became the driving force for the shifts in my study perspective. The project progressed as I learned from the data, and I began building upon that learning by seeking a balanced literature review that saturated the content. Epitomizing the aspects of scholarship means that as a researcher, I was able to shift my focus and use my research and current literature to develop a project that was aligned with the true reflection of the study, and not just where I wanted the study to end up. In adhering to the expectations of true scholarship, my study had more relevance and significance because it was generated from a place of understanding of how the findings transpired and what was illustrated in the current literature. My project became a reflection of not only my ideas, but also a reflection of the research that it will contribute to the field.

Project Development and Evaluation

As I progressed in my project development, I learned that flexibility and being amenable to changes were of paramount importance. A project developer needs to be open to feedback and willing to let go of ideas that are deemed to be unfavorable to the project's aims. As obstacles and challenges arise in the development of the project, the developer must be able to amend the plan and make decisions to change parameters that are not feasible or that do not align with the direction of the findings. Following the findings is what makes the project appropriate and valuable, so the project developer must always keep the findings in mind when moving the project forward. Being open to shifts and changes is key to making the project work. If certain aspects of the projects do not seem to follow these overall goals, then the developer needs to seek out alternate ideas that reflect the true goals of the project. Organization and attention to detail are also elements that factor into the success of a project. Maintaining a timeline and following the sequence of the project needs to take place as well. Finally, the project developer needs to be able to have an unbiased view to reflect upon the project, seeing both the strengths and limitations with an impartial perspective.

To assess the efficacy of this project, I plan to use a formative evaluation. At the completion of the student guidance lessons, there will be an outcome evaluation survey completed by the students. This information will be used to gauge the effectiveness of the student guidance lessons in making students aware of the ways in which they learn most favorably, and also what they learned in regard to the significance of math in their lives beyond the classroom. This information will be used to expand the student guidance lessons and make improvements to support the intent of heightening student awareness. The long-term outcomes of this project will be based on how many students continue in their math progression and ultimately reach advanced math levels.

Leadership and Change

During this project, I learned that a strong leader is able to look critically at a problem, listen to the data reflective of the problem, and use the information before her to make an informed decision regarding a possible resolution to the problem. This process leads to changes that will impact the school environment in a positive way. Creating a sense of purpose in students' actions toward learning is the way in which a leader can grow future potential in her students. Through exposure to this sense of inspiration, a leader can grow that same investment and passion within her students. This project has fueled my love of learning and renewed my spirit in imparting this love of learning in students. As a leader who is passionate about student learning, I have surfaced as a leader in my district who is eager to share this passion and motivate others to seek opportunities to spark student investment in their learning.

Change cannot occur without a purpose. Without a purpose, there is no motivation to make a change. By creating a new mechanism of discovery for students, I was able to lead an initiative of student growth to produce an outcome of academic improvement. Students who have a greater sense of their learning become the advocates of their own achievement. Investment in their education is the key to motivation for educational continuation. Being a leader who inspires others to grow and improve is an aspect of this project that was an unanticipated outcome that I gained as a leader. I have a deeper understanding of how student discovery leads to student growth and ultimately fosters student achievement. During the project I became the agent of change that I set out to become by instilling the passion for growth that is the potential of all learners.

Analysis of Self as Scholar

Throughout the course of my research and the development of my project study, I have learned that I am a driven individual who sets high expectations and strives to reach my goals. As a goal-oriented scholar practitioner, I am ever seeking opportunities to grow as a leader and educator by contributing to my school environment and the field of education. Through enhancing my knowledge base and bridging academia with practical school-wide applications that improve the education the students under my direction, I am the agent of change I set out to become. As a scholar, I view myself as a leader who is an advocate of learning and of growth in both students and teachers in my district. I am a scholar-practitioner who understands that knowledge is power. I consider myself a lifelong learner and I want to instill that love of learning and passion for improvement in my students and staff. Through the research process, I learned that leaders are guided by knowledge and driven by an understanding of the learning process. When coupled with a genuine investment in the education of the whole student, leaders can inspire, motivate, and initiate a lasting impact on students. The Walden University doctoral study journey that I have undertaken and completed has shaped me into a true scholar-practitioner.

Analysis of Self as Practitioner

As a practitioner in the field of education, I have filled many roles within the school environment including teacher, school counselor, building administrator, and district level administrator. Throughout my career, I have never lost sight of my true passion in schools— educating students. As I reflect upon the research process within this project study, I am satisfied that I have saturated the literature and that I have delved deeply into my topic to afford a broad and inclusive perspective on teaching and learning. This process has afforded me the opportunity to take a real problem within my local setting and explore my knowledge of the angles and avenues of discovery open to me in the literature to generate a real solution. As a research-practitioner, I can be put this solution into practice immediately, addressing a local need, and supplying the resources ncessary to remedy that need. My project has allowed me to be a leader with a plan grounded in data and supported by research. Through my investigative inquiry, I now have answers to inform the solution. Through this process, I have become a practitioner who can assert the knowledge necessary to put a plan into action and support school improvement. As a practitioner, I plan to continue to use this process to enhance improvement efforts in the future in my district and in the field of education as a whole.

Analysis of Self as Project Developer

As a project developer, I have learned that my knowledge and expertise can be used to develop future programs that will promote positive changes in my schools and foster student growth. I have grown my skill set to encompass research aptitudes including: raising my capabilities to conduct research, learning how to organize and analyze data, developing analytical findings that will generate a project, and implementing that project to address a problem. I have learned that flexibility and open-minded discourse are the foundational attributes of a sound project development process. Additionally, I have learned how to use findings to guide project goals and inform appropriate decision-making. I have learned to accept constructive criticism and remain open to alternate viewpoints. Throughout the project study, I have remained steadfast in my determination and focus to develop a project that is truly student growth driven and aligned with an established local need. My confidence and intrinsic value as a researcher and educator have flourished within this project.

The Project's Potential Impact on Social Change

The project's potential impact on social change has implications at the local level as well as in schools that want to raise the level of participation in math courses in their secondary population. In doing so, schools can take on the initiative to afford their students equitable access to the pursuit of high earning careers that are available to those individuals who major in the STEM fields. The need to provide all students the opportunities necessary to reach their potential in math, and therefore strengthen the pool of the future STEM work force is of critical importance (National Academy of Sciences, 2010). I researched the precursors to math continuation behaviors as a possible solution to the lack of participation in higher-level mathematics in high school. The findings from my study indicated that students' feelings towards learning in math are formulated at a very early stage in their educational careers; however, efforts to solidify and strengthen those feelings have not been capitalized on. The result has been declining numbers of students who pursue math beyond what is required and even fewer who continue on in their schooling to major in math-intensive fields or seek math-related careers. By providing opportunities that foster math development in students, these declining numbers may be improved through the efforts of schools that provide interventions at an earlier stage in the schooling of young learners.

The student guidance lessons that I provided through this project will benefit students by initializing awareness of math learning preferences, building math self-efficacy, and bridging the connection of math learning in school to careers that exist in the real world. Students will benefit from the heightened awareness of their educational competencies in math and from an early exposure to math interconnectivity to the outside world. This project study initiated social change by providing a necessary resource for students to learn to capitalize on their learning in math. The impact of optimizing on this new self-awareness, will result in later learning potential in math as it relates to continuation in math content and within the world of work.

Implications, Applications, and Directions for Future Research

The results of this study contain educational implications that support expanding future guidance opportunities for students to become aware of how they learn and to become an advocate in their own educational decision-making. In this project study, I explored learning preferences and math course taking choices across secondary grade levels and between genders. Although the results indicated that neither learning style nor gender had a significant impact on student decisions to take or not to take higher-level math in high school, there was a clear thematic commonality that surfaced within the qualitative interview findings. The commonality that existed was that students' feelings about math are formulated through their experiences in math, and that these experiences begin at a very early stage in their educational careers. Also, a similar issue among students was that they demonstrated little self-awareness of being a reflective learner, of knowing how they learn best, and of knowing how their learning factors into the choices they make later on. Ultimately, how those choices may limit or constrain career options in the future is not something that students understand.

Therefore, the implication of this study is a need for student guidance to assist students in their understanding of learning in math and how this may impact their choices later in life. The purpose of this project was to incorporate a guidance approach to build student awareness of learning and math. Students who participate in these guidance lessons will develop a way to gain ownership and investment in their learning and be able to act as their own educational advocates. As an educational advocate, they will be better informed to make the decisions on course taking that will align their goals with their aspirations, thus affording them the opportunity to reach for their potential and not be limited later on.

Another educational implication of this study addresses the need for students to fill the present gap in the STEM fields. Currently, the United States is lacking in the pool of individuals who are needed in our growing, global economy to enter into the fields of math and sciences. The existence of a notable shortage of individuals who are seeking math-intensive and science-intensive majors is creating a void in the math and science career fields. Employable, knowledgeable individuals are greatly needed to fill these positions in our society. It is incumbent upon our schools to educate students to become viable contributing members of society, equipped with the 21st century skills necessary to accept the challenges of the highly coveted positions in math, science, and technology. Therefore, today's students would be capable of becoming the new innovators of our nation. This project begins the grassroots efforts of offering the foundational grounding for students that will allow them to begin to see their learning potential in math and to spark the motivation to seek and attain the highly marketable skills afforded by learning math to a high level.

Applications focused on raising student achievement through guided instruction in learning competencies emerged throughout this study. As the data were looked at in an analytical manner, the findings illustrated a need for students to gain an understanding of how they learn and how to apply that learning to their future careers. In raising students' awareness and understanding of learning in math, students were given a chance to make better, more informed decisions about their education that they may not have discovered elsewhere. Applications of this research were demonstrated by showing how connections to student achievement can be linked to student self-efficacy and academic confidence. Those constructs need to be explicitly taught for students to optimize their capabilities.

Future research into student self-awareness and self-efficacy in learning and the impact on student potential achievement could extend this guidance approach to encompass more of the students' educational experiences. Additional research is necessary to explore the potential of how infusing guidance and student discovery could potentially enhance the self-efficacy construct in learners. The psychological effects of academic confidence were shown to be far reaching in the literature, and if educators can bolster this confidence at an early age, the impact on potential student achievement and success in school could be extensive. Further research examining other factors that impact student learning experiences in both positive and negative ways may also contribute to the solution to building the optimal student experience in mathematics learning.

Conclusion

Through conducting this study, I was afforded the opportunity to become a reflective practitioner as I gained insight into student's experiences in learning math. The findings showed that the experiences students have impact their future decision-making, and therefore future learning potential in math. The review of the literature and the ensuing project addressed the local problem of a lack of participation in higher-level math in high school. Through the completion of this doctoral study, I addressed the need for raising student's awareness of their own capacity for learning math and the far-reaching impact their decision to take or not take math has on their future career and college choices. In providing guidance lessons for students, this project offered a mechanism by which students could develop their understanding of how they learn and how the learning of math can assist them in reaching their career and work paths in the future. School District R will continue to address future areas of concern with regard to offering the best preparatory educational program for all students. The current research study promotes social change by creating an environment for students to grow and develop as learners in the early stages of their education. As educators, our ultimate goal is to help students reach their own learning potential, and through this research that aim has been advanced.

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Appendix A: Project

Professional Development for Teachers to Direct College and Career Ready (CCR) Student Guidance Lessons

Session 1:

- **Introduction of College and Career Ready (CCR) Student Guidance Lesson Implementation**
  - Rationale
  - Purpose
  - Goal

- **AK Standards Discussion**

- **Outline & Overview of the Student Guidance Lessons in Grade 7 and Grade 8**

Session 2:

Work Session for Implementation of Student Guidance Lessons in Grade 7 and Grade 8

Session 3:

Evaluation and Feedback for Improvement

- Summative Evaluation
- Plan for Improvements
- Expansion of Student Guidance Lessons

Professional Development for Teachers to Direct College and Career Ready (CCR) Student Guidance Lessons

Session 1 agenda
In-service week august 2015

Session 1 topic:
Introduction of College and Career Ready (CCR) Student Guidance Lesson Implementation

Rationale:

Describe the problem being addressed:

There is a lack of continued participation in mathematics beyond the minimum requirements for high school graduation in the district. According to historical data from the past several years, only approximately one-third of high school seniors are opting to take advanced mathematics courses in their fourth year of secondary school leaving them vulnerable to limitations in their post-secondary college major options. With a growing need for prospective employable individuals in the math and science fields, students who are not leaving high school with optimal preparedness to take college level mathematics courses is a concern.

Purpose

Describe the reason guidance lessons are the necessary approach:

Among students there is a lack of awareness of the importance of math and its significance to future aspirations that choosing not to take higher level math courses could have on their post-secondary plans. Students do not have a high awareness their optimal learning methods or of how to capitalize on their learning preferences or of their best learning experiences and how those have shaped their course decision-making process. Without consistent guidance, students are aimless in their course choices.

Goal

Describe the goal of the guidance lesson approach:

This approach is designed to offer a set of sequential Student Guidance Lessons for students at the middle school level involving guidance counseling coupled with on-going lessons to coach students on strategies to better optimize their learning through differentiated methods in tune to varied learning styles within the mathematics classroom that also links this learning to possible future educational goals. As an additional caveat, students learn to increase their level of enjoyment in math and also build their level of motivation for course continuation.

How this fits into our AK standards

Activity 1: jigsaw read

(count off by 5's and read the paragraph corresponding to your number)

Focused read

(read for the topic of college and career readiness connection)

small group share-out

(share your reading and the points related to CCR)

Excerpt from: Alaska English/Language Arts and

Mathematics Content Standards

High academic standards are an important first step in ensuring that all Alaska's students have the tools they need for success. These standards reflect the collaborative work of Alaskan educators and national experts from the nonprofit National Center for the Improvement of Educational Assessment. Further, they are informed by public comments. Alaskan teachers have played a key role in this effort, ensuring that the standards reflect the realities of the classroom. Since work began in spring 2010, the standards have undergone a thoughtful and rigorous drafting and refining process.

A nationwide movement among the states and employers has called for America's schools to prepare students to be ready for postsecondary education and careers. Standards in English/language arts and mathematics build a foundation for college and career readiness. Students proficient in the standards read widely and deeply in a range of subjects, communicate clearly in written and spoken English, have the capacity to build knowledge on a subject, and understand and use mathematics.

Industry leaders were part of Alaska's standards review. Repeatedly these leaders placed the greatest weight on critical thinking and adaptability as essential skills in the workplace. Industry leaders believe that strengthening our K-12 system will help ensure that Alaskans are prepared for high-demand, good-wage jobs. Instructional expectations that include employability standards will help students prepare for a career.

Additionally, institutions of higher education were engaged in refining Alaska's standards. These educators focused on whether the standards would culminate in student preparedness. Students proficient in Alaska's standards will be prepared for credit-bearing courses in their first year of postsecondary education. It is critical that students can enter institutions of higher education ready to apply their knowledge, extend their learning, and gain technical and job-related skills.

These standards do not tell teachers how to teach, nor do they attempt to override the unique qualities of each student and classroom. They simply establish a strong foundation of knowledge and skills all students need for success after graduation. It is up to schools and teachers to decide how to put the standards into practice and incorporate other state and local standards, including cultural standards. In sum, students must be provided opportunities to gain skills and learn to apply them to real-world life and work situations.

Early intervention as the teacher's Role in creating College and career ready graduates

Activity 2: first reading of the student guidance lessons

Teachers break out into grade levels teams and they will overview the Student Guidance Lessons in Grade 7 and Grade 8 and discuss initial thoughts, concerns, and ideas. They will record these thoughts, concerns, and ideas to be shared with the whole group at Session 2. Their exit ticket for lunch is turning this information in written form.

Math CCR Lesson #1: 7th grade

LESSON TARGETS:

- Completion of Kolb's Learning Style Inventory
- Introduce the exploration of learning and courses choices

MEASURES OF SUCCESS---Students will be able to:

- Give a summary of their LSI learning style type and their own ways of interpreting this related to their ways learning
- Relate their ways of learning to coursework taken and plans for the future

Math CCR Lesson #2: 7th grade

LESSON TARGETS:

- Connection of math learning and work/careers
- Utilizing online resources for STEM career exploration

MEASURES OF SUCCESS---Students will be able to:

- Discuss the ways in which math connects to the world of world beyond the classroom
- Formulate a plan of how to utilize the courses in school to optimize options beyond high school

Math CCR Lesson #3: 7th grade

LESSON TARGETS:

- Connection of math learning, motivation, and enjoyment
- Utilizing online resources for math advancement through computer-based methods

MEASURES OF SUCCESS---Students will be able to:

- Bolster their math confidence through learning math in novel ways to increase motivation and enjoyment
- Create a plan to continue these efforts including applying for summer programs and/or making a plan for future class completion

Math CCR Lesson #4: 7th grade

LESSON TARGETS:

- Self-reflection
- Putting the Math Path plan in place

MEASURES OF SUCCESS---Students will be able to:

- Reflect upon what they learned from the Student Guidance Lessons with regard to their math learning and math potential for the future
- Take ownership over their plan by setting math path short-term and long-term goals

---

Math CCR Lesson #1: 8th grade

LESSON TARGETS:

- Review of My Math Plan and goals sheet from previous year
- Sharing of experiences among peers in regard to math experiences

MEASURES OF SUCCESS---Students will be able to:

- Develop an understanding of how math learning self-discovery can be extended each year into the developmental educational process
- Make connections between experiences and potential plans for the future

Math CCR Lesson #2: 8th grade

LESSON TARGETS:

- Introduction of high school math course choices and STEM connections
- Utilizing online resources for continued STEM career exploration

MEASURES OF SUCCESS---Students will be able to:

- Discuss the ways in which math course choices connect to the STEM fields and the world of world beyond the classroom
- Formulate a simple plan describing a potential STEM career pathway

Math CCR Lesson #3: 8th grade

LESSON TARGETS:

- High school planning and credit requirements for graduation
- Link between high school credits and entry requirements for postsecondary options

MEASURES OF SUCCESS---Students will be able to:

- Describe the requirements for high school graduation and show an understanding of the link of high school credits to postsecondary options
- Create a 4-year plan for future class completion aligned with current career interests

Math CCR Lesson #4: 8th grade

LESSON TARGETS:

- Self-reflection
- Create 9th grade schedule

MEASURES OF SUCCESS---Students will be able to:

- Reflect upon what they learned from the Student Guidance Lessons with regard to their course progression and post-secondary plans
- Take ownership over their plan by completing their 9th grade schedule

Professional Development for Teachers to Direct College and Career Ready (CCR) Student Guidance Lessons

Session 2 agenda
PLC Friday (EARLY) September 2015

Session 2:
Work Session for Implementation of Student Guidance Lessons in Grade 7 and Grade 8

Activity 1: SHARING OF THOUGHTS, CONCERNS IDEAS FROM SESSION1
I will have the thoughts, concerns, and ideas from Session 1 written up in the form of a chart of Thoughts, Concerns, Ideas. The whole group can then add any additional ones to the chart. Thoughts will be validated, concerns will be brought to group resolution, and ideas will be documents for lesson expansion plans.

Activity 2: Work Session in Grade level teams
Teachers will split up into grade level teams and immerse themselves in the Student Guidance Lesson plans; discuss their role, necessary supports and resources, and possible challenges; teams will work together to formulate an implementation action plan.
Exit ticket for teachers will be a completion of the following document:

Student Guidance Lesson Implementation Work Session Notes

Name:____

Grade Level:_________________

Subject I teach:___________________________________

My role as the teacher is:

To fulfill this role I will need the following supports and resources:

To meet any challenges that may arise I will do the following:

My implementation plan for lesson delivery is the following:

Additional comments:

Professional Development for Teachers to Direct College and Career Ready (CCR) Student Guidance Lessons

Session 3 agenda
PLC Friday (mid) September 2015

Session 3:
Evaluation and Feedback for Improvement

Summative evaluation

Activity 1: small group pro's and con's discussion
Teachers will meet in small groups to discuss the positive and negative aspects of the implementation of the Student Guidance Lessons. They will develop a list of each to be shared with the whole group. The recorders from each group will post the pro's and con's on chart paper for the whole group.

Activity 2: summative evaluation form
Teachers will individually complete a Summative Evaluation Form.

Plan for improvements

Activity 1: brainstorm session
Based on the posted con's listed on the chart paper, teachers will brainstorm ideas for improving the Student Guidance Lesson implementation for the future. They will share their ideas with various teachers around the room recording new responses until their list is full and they are no longer finding any new ideas. Then, I will facilitate a whole group sharing by calling on teachers to share an idea that was shared with them. This will allow teachers to feel comfortable sharing areas of improvement honestly without feeling as though they will offend anyone with their responses.

Expansion ideas

Activity 1: growing the program
In grade level teams, teachers will come up with ways in which the Student Guidance Lessons may be expanded. They will formulate a mechanism for fleshing out new ideas at a future PLC.

Activity 2: final share-out
I will lead a round robin sharing of thoughts in regard to the overall experience of collaborating as teachers, implementing an early intervention program for building college and career readiness skills for students, and the process of using the data to drive future learning aims for students.

Student guidance lesson summative evaluation

Please circle the answer that best reflects your feelings in regard to each statement.

1. Implementing the Student Guidance Lessons for College and Career Readiness was a positive experience for me as a teacher.

Strongly Agree Agree Neutral Disagree Strongly Disagree

2. Students gained a stronger awareness of themselves as learners.

Strongly Agree Agree Neutral Disagree Strongly Disagree

3. Students gained a better awareness of how learning in school relates to future careers.

Strongly Agree Agree Neutral Disagree Strongly Disagree

4. Students seemed to enjoy the Student Guidance Lesson approach.

Strongly Agree Agree Neutral Disagree Strongly Disagree

5. As a teacher, I enjoyed the Student Guidance Lesson approach.

Strongly Agree Agree Neutral Disagree Strongly Disagree

6. I believe it is part of my role as a teacher to instill a college and career readiness perspective in my students.

Strongly Agree Agree Neutral Disagree Strongly Disagree

7. I would like to participate in developing future Student Guidance Lessons to build student readiness for the future.

Strongly Agree Agree Neutral Disagree Strongly Disagree

8. The Student Guidance Lessons were well-matched to our purposes of building college and career readiness for our students.

Strongly Agree Agree Neutral Disagree Strongly Disagree

9. The Student Guidance Lessons are a beneficial addition to the learning of our middle school students.

Strongly Agree Agree Neutral Disagree Strongly Disagree

10. I have additional comments to offer that were not touched upon in this survey.

____

____

____

____

____

____

If you would like to have further discussions regarding the Student Guidance Lesson approach and future expansion of this program, please fill out the bottom of this form.

Name:____

Grade Level:____

Subject I Teacher:_____________________________________

College and Career Ready (CCR)
Student Guidance Lessons

Math CCR Lesson #1: 7th grade

LESSON TARGETS:

- Completion of Kolb's Learning Style Inventory
- Introduce the exploration of learning and courses choices

MEASURES OF SUCCESS---Students will be able to:

- Give a summary of their LSI learning style type and their own ways of interpreting this related to their ways learning
- Relate their ways of learning to coursework taken and plans for the future

MATERIALS NEEDED:

- KLSI 3.1
- Student Reflection worksheet

FACILITATOR NOTES

This Student Guidance Lesson is based on allowing students time to complete the LSI and drawing from their math experiences in discussions of future math plans. Facilitators will need to assess how much background discussion will need to take place explaining the LSI and how much time the students will need to be ready to discuss their results. If students do not have much background in taking a self-report inventory, this is an excellent opportunity to begin the discussions.

CORE ACTIVITY

Introduction: Explain that students will be taking a learning style inventory designed to help them discover their learning preferences and match those preferences to learning methods that are most conducive to new learning for them. The KLSI 3.1 was created by David Kolb (2005). Share that students will be answering a set of 12 question items and they will be indicating on a 1-4 scale which statements reflect their learning preferences most and least. They will be instructed on how to score their LSI resulting in their learning style type determination.

SECONDARY ACTIVITY

1. Students are given time to think about their learning style and briefly record key information on the Student Reflection Worksheet so that they can share information and discuss their results with a small group.
2. Allow time for small groups to discuss their results and what was surprising or interesting about the information.
3. Have the small groups report out and as a whole class summarize what they discovered about learning and future plans.

Student Reflection Worksheet: Inventory Summary

The worksheet is designed to help you record your interpretations of the LSI. Be as complete as possible so you can review the information at later times along your educational journey. Be prepared to share your answers with a small group.

Activities that best describe what I like to do

Personal qualities that describe me

Results of the inventory – learning style type that seems to be a fit me: ____

Is that how you saw yourself? What is surprising? What is interesting about this?

Math CCR Lesson #2: 7th grade

LESSON TARGETS:

- Connection of math learning and work/careers
- Utilizing online resources for STEM career exploration

MEASURES OF SUCCESS---Students will be able to:

- Discuss the ways in which math connects to the world of work beyond the classroom
- Formulate a plan of how to utilize the courses in school to optimize options beyond high school

MATERIALS NEEDED:

- iPads
- Web resources
- Student Reflection worksheet (2)

FACILITATOR NOTES

This Student Guidance Lesson is based on extending student thinking regarding how their learning of math in the classroom impacts their options in high school and beyond. Facilitators will need to guide the discussion of math connections through the use of web resources to illustrate the math-to-world connection.

CORE ACTIVITY

Introduction: Share with students that today's guidance lesson is going to focus on a "math career path". Remind students that an occupation is a series of jobs and a career is the lifetime of making good use of your skills learned, knowledge acquired, and experiences that have taken place over throughout your schooling. Connecting classroom learning with the world of work is not necessarily automatic for students;

they will need to be led through this process.

SECONDARY ACTIVITY

1. Students will be asked to generate a list of activities in which they have used math outside of the classroom. From those listed skills, students will begin to explore websites to inform them regarding the skills necessary to enter into the STEM related fields.

2. Students will begin to explore STEM based websites while engaging in activities that will grow their learning and understanding of these fields.

3. Female students will be directed to specific sites that focus on women in the STEM fields

Closing:

Discuss with the students what they learned? Ask them what was most interesting or most surprising. Relate this discussion to the next workshop where students will be charting their individual math path.

WEB RESOURCES

www.theconnectory.org/why-stem
www.mastrsindatascience.org

- The Ultimate STEM Guide for Kids
- Fab Fems

Additional STEM Websites from www.mastersinscience.org

Code.org: This site allows students to learn about building iPhone games and includes how to write a computer program from the ground up.
Engineering, Go for It! (eGFI): This site focuses on building awareness of engineering.
EPA Students: This website is run by the Environmental Protection Agency and it provides news, homework resources, and ideas for school projects.
Exploratorium: The site has a variety of interactive activities.
Extreme Science: This site houses many facts about nature, science, and resources for school.
How Stuff Works: This is a site that holds copious articles about science and how things work.
Museum of Science + Industry Chicago Online Science: This site allows students to play

games, watch science related videos, create virtual experiments or use forensic science to analyze everyday items.

NASA Education for Students: This site offers career information and aerospace engineering.

NOVA: The website is in cooperation with PBS's well-known science show and provides videos and articles related to STEM.

Science Buddies: This site has a plethora of ideas for science fair projects and details related to STEM careers.

STEM-Works: This site has many activities related to STEM along with articles and career information.

TechRocket: This website contains online learning youth.

Tynker: This website affords kids the opportunity to develop computer programming skills through online courses geared towards young people.

Student Reflection Worksheet: Math Career Path

The worksheet is designed to help you record your self-discovery. Be as complete as possible so you can review the information at later times along your educational journey. Be prepared to share your answers with a small group.

Activities that involve math outside of the classroom

Math-to-World Career Connections I found

Where can you see yourself? What is surprising? What is interesting about this?

College and Career Ready (CCR)
Student Guidance Lessons

CCR Lesson #3: 7th grade

LESSON TARGETS:

- Connection of math learning, motivation, and enjoyment
- Utilizing online resources for math advancement through computer-based methods

MEASURES OF SUCCESS---Students will be able to:

- Bolster their math confidence through learning math in novel ways to increase motivation and enjoyment
- Create a plan to continue these efforts including applying for summer programs and/or making a plan for future class completion

MATERIALS NEEDED:

- iPads
- Web resources
- Student Reflection worksheet (3)

FACILITATOR NOTES

This Student Guidance Lesson is based on fostering math confidence, motivation, and enjoyment for students. Facilitators will need to guide the exploration of math tools and academic games available online and also assist with the summer program application process.

CORE ACTIVITY

Introduction: Share with students that today's guidance lesson is going to focus on a building math confidence by working to increase math motivation by enhancing math enjoyment with novel math experiences.

SECONDARY ACTIVITY

1. Students will be asked to utilize iPads to explore math games and applications.

2. Students will set up a math path plan for their course taking in school before they graduate.
3. Students will begin applications for summer math enhancement programs.

WEB RESOURCES

www.mastrsindatascience.org

- The Ultimate STEM Guide for Kids

www.STEMak.org/summerprograms
www.ansep.net (Alaska Science and Engineering Program)

Student Reflection Worksheet: Math Motivation and Enjoyment

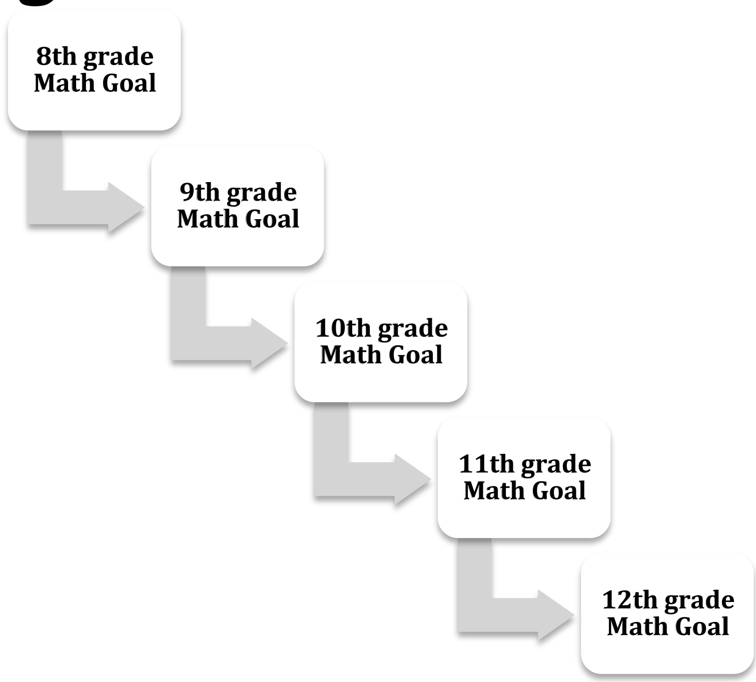
The worksheet is designed to help you record thoughts about today's math self-discovery lesson. Be as complete as possible so you can review the information at later times along your educational journey. Be prepared to share your answers with a small group.

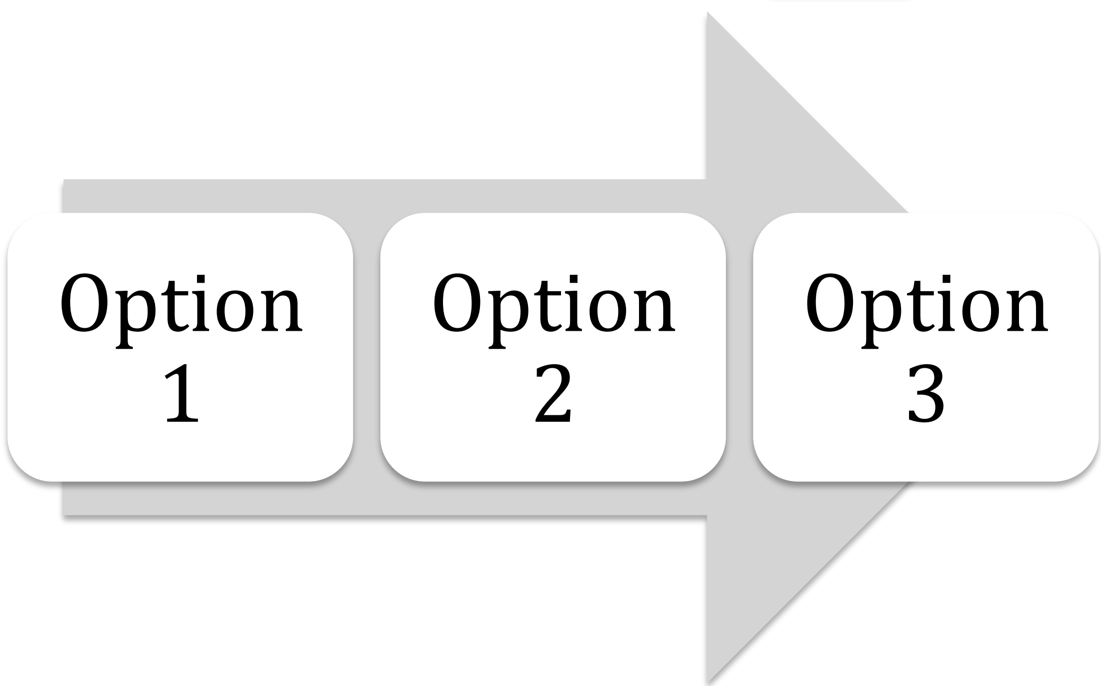
Computer-based Math games/activities that I found and enjoyed

Math-to-World Career Connections I found

What motivates you to learn math and how can you involve more of these activities in your learning? What summer programs are you interested in pursuing?

My Math Path


8th grade Math Goal
9th grade Math Goal
10th grade Math Goal
11th grade Math Goal
12th grade Math Goal


Option 1
Option 2
Option 3

College and Career Ready (CCR)
Student Guidance Lessons

Math CCR Lesson #4: 7th grade

LESSON TARGETS:

- Self-reflection
- Putting the Math Path plan in place

MEASURES OF SUCCESS---Students will be able to:

- Reflect upon what they learned from the Student Guidance Lessons with regard to their math learning and math potential for the future
- Take ownership over their plan by setting math path short-term and long-term goals

MATERIALS NEEDED:

- Short-term and long-term math path goals sheet
- Student Reflection worksheet (4)

FACILITATOR NOTES

This Student Guidance Lesson is the culmination of the self-awareness gained throughout the 4 lessons. Students will recap what they have learned about themselves and share those most salient personal discoveries in determining their Math Path. Facilitators will need to guide the final "take-aways" from the series of lessons.

CORE ACTIVITY

Introduction: Share with students that today's guidance lesson is the final session of the year in which they will be taking some tome to reflect on what they have learned about math and about themselves. They will also be making tangible short-term and long-term goals for themselves.

SECONDARY ACTIVITY

1. Students will complete short-term and long-term math path goals to put into action immediately.

2. Students will set up a Math Path plan folder to follow them into the next school year (8th grade).

My Math Path Plan

Short-term goals:

This week I will:

This month I will:

This year I will:

My Math Path Plan

Long-term goals:

Next year I will:

In high school I will:

After high school I will:

Student Reflection Worksheet: Reflection and Plan to Action

The worksheet is designed to help you record thoughts about math self-discovery throughout the series of Student Guidance Lessons. Be as complete as possible so you can review the information at later times along your educational journey. Be prepared to share your answers with a small group.

Most important things I learned in the Student Guidance Lessons about math

My "take-aways" from my math self-discovery

Next steps… Action steps to put my goals into action are:

Short-term goals:

1.
2.
3.

Long-term goals:

1.
2.
3.

College and Career Ready (CCR)
Student Guidance Lessons

Math CCR Lesson #1: 8th grade

LESSON TARGETS:

- Review of My Math Plan and goals sheet from previous year
- Sharing of experiences among peers in regard to math experiences

MEASURES OF SUCCESS---Students will be able to:

- Develop an understanding of how math learning self-discovery can be extended each year into the developmental educational process
- Make connections between experiences and potential plans for the future

MATERIALS NEEDED:

- My Math Path Plans and goals
- Student Reflection worksheet (1)

FACILITATOR NOTES

This Student Guidance Lesson is based on allowing students time to review their math learning self-discovery from the previous year (in 7th grade) by revisiting the documents generated including Student Reflection worksheets, My Math Path Plans, and the short-term and long-term goals developed to put the plans into action. Previous math experiences will be drawn into discussions of future math plans. Facilitators will need to assess how much background discussion will need to take place reviewing the focus on the guidance lessons for math self-discovery and how much time the students will need to discuss their current thoughts regarding their math progression.

CORE ACTIVITY

Introduction: Explain that students will be taking a more focused role in their math learning self-discovery throughout the 8th grade Student Guidance Lesson series in order to guide their math course choices as they work towards entering high school. Share that students will be exploring more high school course choice connections to math related fields and that by the end of the year, they will have a clearer understanding of their next steps if they are interested in ultimately pursuing a college major or career with a math focus. Today's focus is reviewing plans and sharing relevant math experiences.

SECONDARY ACTIVITY

1. Students are given time to think about their math learning experiences from previous years, the My Math Plan and goals sheets from last year, and briefly record key information on the Student Reflection Worksheet so that they can share information and discuss their self-awareness and understanding at this point in time.

2.Allow time for small groups to discuss their math experiences including previous year's classes, summer camp experiences, or other related jobs completed, relating what they have learned about themselves and/or about math connections.

3. Have the small groups report out and as a whole class summarize what they discovered about learning and future plans.

Student Reflection Worksheet: Review of Math Self-Discovery

The worksheet is designed to help you record your personal reflections regarding previous math experiences and self-discovery. Be as complete as possible so you can review the information at later times along your educational journey. Be prepared to share your answers with a small group.

My current thoughts about My Math Plan are…

My current status toward reaching my short-term and long-term goals is…

I have learned the following about my math learning and experiences…

College and Career Ready (CCR)
Student Guidance Lessons

Math CCR Lesson #2: 8th grade

LESSON TARGETS:

- Introduction of high school math course choices and STEM connections
- Utilizing online resources for continued STEM career exploration

MEASURES OF SUCCESS---Students will be able to:

- Discuss the ways in which math course choices connect to the STEM fields and the world of world beyond the classroom
- Formulate a simple plan describing a potential STEM career pathway

MATERIALS NEEDED:

- Student Career Pathway worksheet
- High school course listings and descriptions
- College/major/program resources (on-line)
- Student Reflection worksheet (2)
- iPads

FACILITATOR NOTES

This Student Guidance Lesson is based on extending student thinking regarding how their learning of math in the classroom impacts their options in high school and beyond. Facilitators will need to guide the discussion of math connections through the use of web resources to illustrate potential STEM pathways.

CORE ACTIVITY

Introduction: Share with students that today's guidance lesson is going to focus on a potential "math career path". They will be exploring math course choices in high school and the progression in order to reach the outcome level desired in order to pursue particular avenues in college or the workforce after high school.

SECONDARY ACTIVITY

1. Students will be given a worksheet to chart out the routes to a potential math related career.
2. Students will begin to explore STEM based coursework and programs in post-secondary institutions through online resources.

Closing:
Discuss with the students what they learned? Ask them what was most interesting or most surprising. Relate this discussion to the next workshop where students will be developing their high school course-taking plan.

WEB RESOURCES

University of Alaska Anchorage
http://www.uaa.alaska.edu/

Occupational Outlook Handbook: Bureau of Labor Statistics
http://www.bls.gov/ooh/

Student Career Pathway Worksheet

The worksheet requires you to look at three different career pathways and to evaluate what you think may be the best fit for you. Follow the steps and be prepared to share what you learned with a small group of your peers. It is especially important to consider the math and science opportunities you have in school and beyond high school.

	Possible steps in my career pathway	Starting Place 1	Starting Place 2	Starting Place 3
1	One of my interests			
2	Possible jobs that fit my interests			
3	Occupational areas I might like to explore			
4	High school courses that would help			
5	Outside of school activities that would help me			
6	Post-secondary programs I may want to consider			
7	First stop-first job			
8	My first year salary potential			

Student Reflection Worksheet: Math Career Path

The worksheet is designed to help you record your self-discovery. Be as complete as possible so you can review the information at later times along your educational journey. Be prepared to share your answers with a small group.

High school courses that I am interested in taking…

STEM field careers that I found interesting and would like to learn more about…

What did you find that was interesting, surprising, exciting?

College and Career Ready (CCR)
Student Guidance Lessons

Math CCR Lesson #3: 8th grade

LESSON TARGETS:

- High school planning and credit requirements for graduation
- Link between high school credits and entry requirements for postsecondary options

MEASURES OF SUCCESS---Students will be able to:

- Describe the requirements for high school graduation and show an understanding of the link of high school credits to postsecondary options
- Create a 4-year plan for future class completion aligned with current career interests

MATERIALS NEEDED:

- PowerPoint
- High school course listings and descriptions
- Student 4-year Course Taking Plan
- Student Reflection worksheet (3)

FACILITATOR NOTES

This Student Guidance Lesson is based on students using their self-discovery to put a plan into action that is reasonable, appropriate, and based on student interests, capabilities, potential future aspirations. Facilitators will need to illustrate these points through the PowerPoint presentation and then guide the 4-year Course Taking Plan process.

CORE ACTIVITY

Introduction: Share with students that today's guidance lesson is going to have the specific focus of developing a concrete 4-year Course Taking Plan aligned with students' future plans.

SECONDARY ACTIVITY

1. Students will be asked to view a PowerPoint and participate actively in discussions.

2. Students will set up a 4-year plan for their course taking in school before they graduate.

MY HIGH SCHOOL PLAN
College and Career Ready

What to take? Where to go? How will I know? SETTING YOUR BAR SKY HIGH!!

Mapping Your Future

- How many of you have heard seniors say things like the following:
- “I only need 2 classes to graduate.”
- “It’s my senior year. I’m just gonna coast.”
- “I already have all of my Math (or English), I am not taking anymore my senior year.”

What's wrong with this picture?

- Think-Pair-Share
  - Ask your partner the following:

1. Why might this not be the best strategy?
2. What are we in high school for anyways?
3. Where do I see myself at the end of high school?

Set your bar high…sky high!

- Instead of thinking what is the minimum, challenge yourself to take advantage of the maximum.
- Instead of taking the easy route, seek out the route that will prepare you for your future
- Instead of avoiding extra content classes, take more to open doors, not close them.

What are credits? Why do they matter?

- In high school, you accrue credits to gain the right number to qualify for graduation.
- Pass a class you get the credit, fail a class you don't…when you don't you jeopardize your timely graduation.
- How many credits do you need to graduate from AEBSD?

AEBSD requires…

- 26 credits to graduate
- 7 periods a day for 4 years gives you 28 credits
- So why do I need to take a full schedule my senior year??????

Set your bar high
That's why!!!!

Taking extra classes does all of the following:

- prepares you for college, life, and the world of work
- affords you the skills necessary to be successful in continuing your learning or education
- helps you optimize on your FREE opportunities to learn

Now, let's do the "Math"…

Pre-Algebra > Algebra > Geometry > Algebra II >

What comes next?

For many students nothing.

What did we learn about majors in college and careers that require math?

Requirements vs. Electives

- Math, Science, English, Social Studies, Health, PE
- Elective examples: culinary arts, welding, foreign language, yearbook, photography, etc.

College and Career Ready

- Basic College Ready rule of thumb: 4 Math, 4 English, 4 Science, 4 Social Studies, 2 Foreign Language
- AEBSD requirements: 3 Math/4 Sci or 4 Math/ 3 Science, 4 English

Talk with your elbow partner about the differences

My 4-Year HS Plan

- Ask yourself:
- What are my short-term goals? Long-term goals?
- College, career, work goals?
- What are my skills and capabilities? Areas of improvement?
- How do I make my goals a reality?

My 4-Year Plan Work Session

- You will need:
- High school course listing/descriptions
- My 4-year Plan worksheet
- A partner

Time to set your bar…

- SKY HIGH

Student Reflection Worksheet: High School Plan

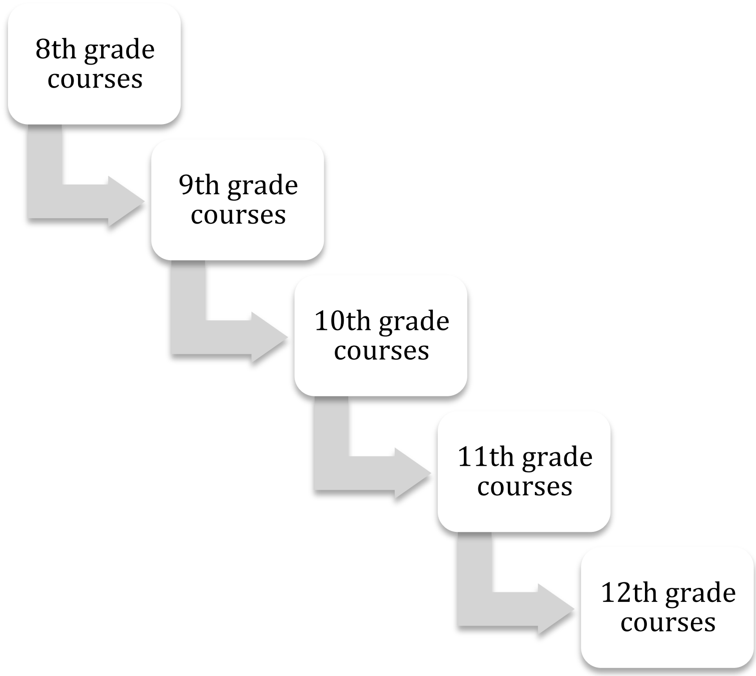
The worksheet is designed to help you record thoughts about today's math self-discovery lesson. Be as complete as possible so you can review the information at later times along your educational journey. Be prepared to share your answers with a small group.

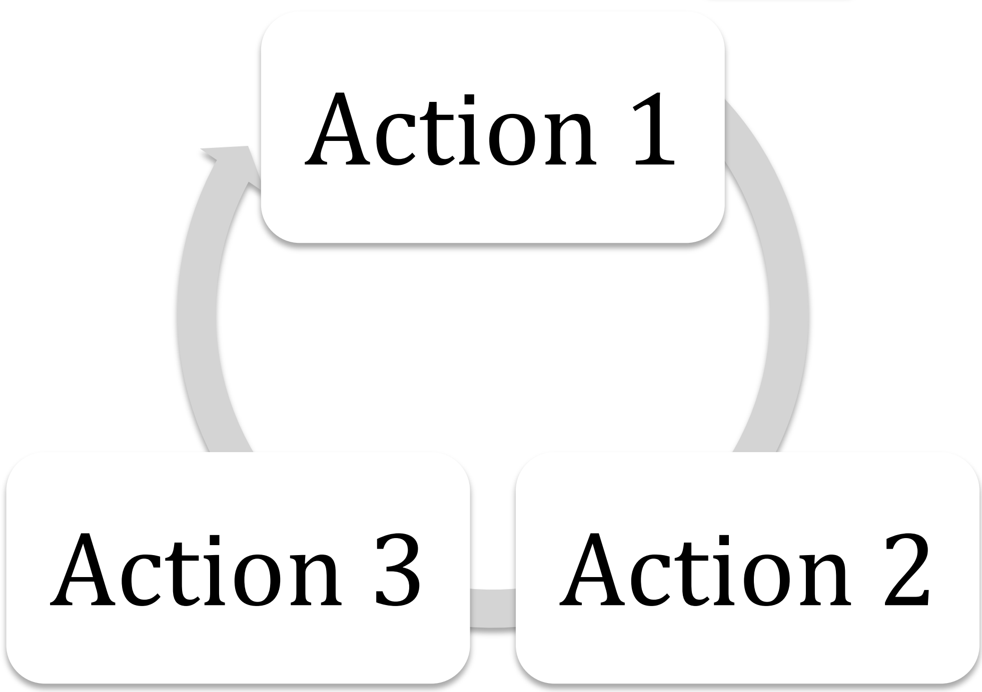
My plan for high school course taking makes me feel…

Things I can do to make my plan work for me…

Things I learned about how high school courses impact future plans…

My 4-Year Plan





Math CCR Lesson #4: 8th grade

LESSON TARGETS:

- Self-reflection
- Create 9th grade schedule

MEASURES OF SUCCESS---Students will be able to:

- Reflect upon what they learned from the Student Guidance Lessons with regard to their course progression and post-secondary plans
- Take ownership over their plan by completing their 9th grade schedule

MATERIALS NEEDED:

- Student Reflection worksheet (4)
- Student folders

FACILITATOR NOTES

This Student Guidance Lesson is the culmination of the self-awareness gained throughout the 4 lessons. Students will recap what they have learned about themselves and share those most salient personal discoveries in determining their future course taking plans. Facilitators will need to guide the final "take-aways" from the series of lessons.

CORE ACTIVITY

Introduction: Share with students that today's guidance lesson is the final session of the year in which they will be taking some time to reflect on what they have learned about math and about themselves and their futures. They will also be making their 9th grade schedule of classes.

SECONDARY ACTIVITY

1. Students will complete their 9th grade schedule
2. Students will set update their Math Path plan folder to follow them into the next school year (9th grade).

Student Reflection Worksheet: Reflection

The worksheet is designed to help you record thoughts about math self-discovery throughout the series of Student Guidance Lessons. Be as complete as possible so you can review the information at later times along your educational journey. Be prepared to share your answers with a small group.

Most important things I learned in the Student Guidance Lessons…

My "take-aways" from my math self-discovery

Three things I will do to continue my self-discovery about my future…

1.
2.
3.

Appendix B: Open-Ended Interview Questions

The purpose of this interview is to gain a deeper understanding of the student experience with regard to learning math. By delving into the student experience, the researcher will gain a richer description of how past learning experiences have impacted math course participation decisions.

1. What type of a student do you think you are? How do you know? GPA, Honors, Advanced Placement, basic courses, remedial, special classes?
2. What mathematics courses have you taken in high school? Tell me about the last math class you took. Prompts: What kinds of things did you learn? Describe a typical lesson in that class.
3. According to the LSI that you took, you were identified as a potential ___ learner. This means that you have an affinity for…

   {explanation of the kind of learner that the LSI says that they are}

   Do you feel that describes the way in which you learn? Why or why not?

   Prompt: Can you think of an example of when you learned mathematics/some other subject in this way?
4. Think back to the type of instruction you had in math class, Please describe what you remember. Prompt: Lead the student to expound on whether or not this instruction helped or hindered them.

Please describe what you remember. THEN lead them to tell you whether or not it helped or hindered them.

5. How confident do you feel in mathematics? To what do you attribute your confidence level in mathematics to? / To what do you attribute your lack of confidence in mathematics to?
6. You are/are not taking higher level mathematics, what do you feel has caused your decision to take more advanced levels of math?

Description of Interview Process:

The interviews will take 30-40 minutes and will be conducted in a neutral space in the school setting that is set up in a way that maintains participant privacy. The interviews will be audiotaped for transcription by the researcher at a later time. To begin the discussion with the participant, the LSI data will be used from the local site and matched to the participant in the interview phase of the study. Participants will be informed of their LSI learning style at this time. The researcher will explain what their LSI learning style means according Kolb's theory. The researcher will also explain that the participant can opt out of their participation in the interview at any point in time during the interview.

Appendix C: Sample Qualitative Interview Transcript

Interview 1

Participant #3(F1) Grade 11; Gender F; No Advanced Math; On-Track;

LSI Type: Accommodating

Researcher (R): "The purpose of this interview is to gain a deeper understanding of the student experience with regard to learning math. By delving into the student experience, I, the researcher will gain a richer description of how past learning experiences have impacted math course participation decisions."

"So the first question is…"What type of a student do you think you are? How do you know?

Participant (F1): "Like a good one or what do you mean?"

R: "More like how do you know you are a good student, what type of grades or honors would describe you?"

F1: "I like…LEARN WELL from teachers."

R: "What does that mean to you?"

F1: "I get **good grades**. I have a **high GPA**. I plan to go to **college**."

R: "What math courses have you taken in high school?"

F1: "Basic 7th grade all the way through Algebra II."

R: "So tell me about the last math class you took."

F1: "My Geometry one? Or Algebra II?"

R: "Yes, those classes. What kinds of things did you learn?"

F1: "I didn't learn too much. I didn't learn very much from that teacher."

R: "Describe what a typical lesson would have been like in that class."

F1: "It would be like he would give us problems to do and we would just do them on our own. He didn't give us much encouragement to do it."

R: "According to the LSI that you took, you were identified as a potential accommodating learner. This means that you have an affinity for learning by doing. Do you feel that describes the way in which you learn? Why or why not?

F1: "It does. I learn by *doing hands-on things*. I remember more that way. Like when I am studying for something it's easier to do it *hands-on*."

R: Can you think of an example of when you learned mathematics or some other subject in this way?

F1: "Umm…when you need to *draw things* out to figure out an equation. That's more *hands-on*. That's more *hands-on* for me, than just reading it."

R: "Think back to the type of instruction you had in math class, please describe what you remember."

F1: "Well, I remember one teacher named, Mrs. ###. She taught us pretty well. She uh, she made, she made it hard for us to learn. I mean by that she nailed it into our heads. I never really liked her until the end. But I realized she taught us REALLY GOOD."

R: "What are some of the things that she did?"

F1: "Uh, she didn't quite go by the book. She went by packets. That made us help learn more. And she did Khan Academy. She did more *hands-on* stuff that helped us learn more. She did stuff so we would actually do it."

R: "How confident do you feel in math?"

F1: "Math is one of my <u>STRONGEST</u> subjects."

R: "What do you attribute your confidence level in mathematics to?"

F1: "It's kind of like a 7. I <u>LIKE MATH</u>."

R: Ok and so do you attribute that to some of your experiences in math? Did what you told me about learning math factor into this confidence? Basically, where did your confidence come from?"

F1: "It more comes from **taking tests**. And figuring out that I am way better in math than I am in reading or anything else."

R: "So you are taking a math class this year or are you not?"

F1: "I couldn't take a math class this year."

R: "Oh, so you didn't take math your senior year then. So was that a scheduling issue, would you have wanted to take math?"

F1: "It was more of missing the first week of school and I would be <u>way far behind</u> now. Plus because Mr. ### gives *lots of homework*."

R: "You are not taking a math course this year, what do you feel has caused your decision not to take Advanced Math?

F1: "Well, I would just <u>be behind</u> so I didn't want too many **hard classes** this year. And well, they are doing Algebra II and Geometry in there and it would have just been me in that class. And I thought well, it probably *would've been too much* just to do me so I <u>dropped</u> it."

R: Ok. Well, that is it. Thank you very much for letting me interview you.

<u>Qualitative Transcription Coding Key</u>

grades & testing (font change)

college plans (bold)

<u>SELF-EFFICACY FEELINGS-POSITIVE (FONT CHANGE AND UNDERLINED)</u>

<u>self-efficacy feelings-negative (underlined)</u>

doing (enclosed in asterisks)

personal effort (italics)

Appendix D: Chi Square Analysis in SPSS

RQ #2: Does a common learning style exist among students who were and who were not on track to take higher math in high school?

Chi Square Test: *On-Track Math and Learning Style Crosstabulation*

	Value	df	Asymp. Sig. (2-sided)
Pearson chi square	1.979[a]	3	.577
Likelihood ratio	2.016	3	.569
N of valid cases	63		

a. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 1.78.

RQ #3: Does a common learning style exist among students who do and do not take higher math in high school?

Chi Square Test: Higher Math and Learning Style Crosstabulation

	Value	df	Asymp. Sig. (2-sided)
Pearson chi square	5.650[a]	6	.464
Likelihood ratio	7.154	6	.307
N of valid cases	27		

a. 10 cells (83.3%) have expected count less than 5. The minimum expected count is .37

RQ #4: Does a common learning style exist between male and female participants?

Chi Square Test: Learning Style and Gender Crosstabulation

	Value	df	Asymp. Sig. (2-sided)
Pearson chi square	2.595[a]	3	.458
Likelihood ratio	2.653	3	.448
N of valid cases	63		

a. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 1.90.