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EXPLORING THE ASSOCIATION OF STUDENT-TEACHER RELATIONSHIPS AND MATHEMATICS TEACHING STYLES WITH STAR RENAISSANCE MATHEMATICS SCORES IN A GROUP OF MIDDLE SCHOOL STUDENTS AT A MIDWESTERN SCHOOL.

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Abstract

This study aimed to explore the relationship between middle school students' perceived student-teacher relationships, students' perceived mathematics teachers' teaching styles, and middle school students' Fall benchmark Star Renaissance mathematics assessment scores at a Midwest public school. The positivist paradigm served as a lens to formulate this cross-sectional correlational study. A Qualtrics questionnaire was developed and contained the *Student Version of The Teacher-Student Relationship Inventory (S-TSRI),* an adapted version of *The Teaching Styles Inventory,* and a selection of demographic variables (e.g., grade level, gender, family structure). The Star Renaissance mathematics assessment Fall 2022 benchmark was introduced to the database after collection of data from participants was completed. A census recruitment methodology was utilized and 94 students in 6th, 7th, and 8th grades participated. Descriptive statistics and Spearman Correlation were used to address the study's research questions and test the null hypothesis. The findings indicated no correlations between students' perceived student-teacher relationships, students' perceived mathematics teachers' teaching styles, and students' Star mathematics scores. There were statistically significant strong positive correlations between the students' self-appraised feelings about mathematics and their confidence about their mathematics skills and students' Star mathematics scores. Additional correlations were observed through disaggregation of data by grade level and gender. Teachers must remain cognizant regarding the power of the mathematics narrative in the classroom; these narratives should be optimistic, encouraging, and carrying positive messages regarding students' performance to contribute to (or counter) the students' internal narratives about mathematics.

Key words: middle school students, Star Renaissance Mathematics, teaching styles, student-teacher relationships, narrative about mathematics, students' mathematics self-appraisal.

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Dedication

This dissertation is dedicated to the heart of my study- my current and former students. As Justin Tarte said, “teachers who put relationships first don’t just have students for one year. They have students who view them as “their” teacher for life.” I hope to continue to be your teacher for life.

I also dedicate this work to all the teachers at McKenzie County School District, whom I am lucky enough to work with every day and share my students and experiences with.

Lastly, I dedicate this to my family. Without you, I would have never completed my doctoral degree or dissertation. Dad, and Sue Ann, thank you for the moral support and home-cooked meals when I came home to visit. Mom and Darren, for the moral support, constant reassurance, and proofreading. Meghan, Nick, Tanner, and Emma, for always making me laugh and giving me a break from the stress of graduate school all these years. Ryan, thank you for keeping my dream a reality and never letting me give up. You helped push me across the finish line.

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To Cohort 4, it is an incredible accomplishment to complete a dissertation and doctoral degree. Thank you for the last three years of learning, collaboration, and research. I wish you happiness in all future opportunities.

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CHAPTER I: Introduction

Does a positive student-teacher relationship in middle school set students up for a more positive outlook in the long run? In the history of education, student-teacher relationships have held a lower priority than the content learned. The teacher was in control and was the authoritative figure in the classroom, while the students were compliant with instructions and adjusted to the lecture-based style of teaching, whether or not it matched their learning style. Over time, student-teacher relationships have changed. This shift was towards student-centered, problem-based, and group learning. These teaching styles have had an impact on how students were appraised as agents in their own learning. Additionally, this change in the teaching philosophy has had an impact on the way in which teachers relate to their students.

Student-teacher relationships are quite significant as they positively impact students' academic achievement (Roorda et al., 2017). This academic achievement occurs when the relationship is appraised as important and motivating (Masko, 2018). It also gives students a sense of belonging which encourages the development of personal and social goals (Faust et al., 2014). Whether an association between student-teacher relationships and student academic success indeed exists, a feeling of connection to the school is a critical component for students at any grade level. Specifically, during the pre-adolescent to the adolescent stage, these relationships and connections may change students' development, including social and cognitive development, decision-making and maturity level adjustments (Arslan, 2018).

Middle school is a difficult time for adolescents because they are going through many life changes (Wallace, 2016). Having an adult figure at school that they can talk to is a large component to creating relationships and encouraging success. This is due to the importance of adult figures in students' lives in general (e.g., parents, grandparents, teachers), but at school this

also rings true and is quite critical for their social, emotional, and academic well-being. “Positive Student-Teacher relationships draw students into the process of learning and promote their desire to learn” (Rimm-Kaufman, p. 1, 2010). Relationships with adult figures are not the only important relationship in school. Vygotsky’s social constructivism learning theory (formulated in 1968) teaches professionals serving children that those social interactions are a large factor in development and learning.

Contemporary students experience a mix of teaching styles that range from more passive learning (e.g., lecture instruction) to more active learning (e.g., project-based learning). It has been found that working on activities helps create personal connections with the material (Theobald et al., 2020). These personal connections increase students’ motivation to learn. Mathematics is a content area greatly impacted by the instructional teaching style, and it has been reported that lecture-based teaching styles do not allow students to reach their full potential (Freeman et al., 2014; Theobald et al., 2020). Because student success in mathematics is significantly dependent on engagement, this study focused on the phenomena that linked student-teacher relationships, teaching styles of mathematics teachers, and mathematics academic achievement.

Brief Literature Review

Every Child Succeeds Act (ESSA) continued to keep schools accountable for students’ academic achievement by creating engagement surveys, school accountability, and goal setting in all school districts across the country. This mandate identified student-teacher relationships as one of the most critical factors in establishing an environment conducive to learning (Pigford, 2001). Student-teacher relationships are defined as “the caring and authentic relationships between students and teachers” (Knoell, 2012, p. 45). *Caring, easy to talk to, comfortable to be*

around, enthusiasm for the content, empathy and reliability are some of the teachers' characteristics that students find important (Miller & Mills, 2019). It has also been described by the literature that some students may not reach their full potential academically, developmentally, or socially if they are disengaged at school and unable to relate to adults in the learning setting (Pigford, 2001).

In a 2020 study completed by Scales et al., the authors focused on the development of student-teacher relationships. They asked middle school students questions revolving around the development of relationships, academic motivation, belonging, and school climate. The authors were able to further break down those four categories into smaller subcategories (e.g., express care, challenge growth, share power, belonging, school climate, and socio-economic status). The authors explored the correlation between the subcategories and students' academic achievement (GPA). It was determined that GPA increased based on the increased value of the relationship when teachers provided more than just personal and academic interest.

It is expected that students do not feel engaged in all classrooms, nor do they feel a connection with all teachers and staff in a school environment. This makes the relationships and classrooms where students do feel engaged highly important. "School belonging is a significant predictor of various important school-based and quality-of-life outcomes in youths, including academic achievement, internalizing and externalizing behaviors" (Arslan, 2018, p. 23). This sense of belonging is, to a great extent supported by the existence of a significant student-teacher relationship (Roorda et al., 2017).

Student Development During Middle School Years

Research into brain development is crucial in understanding adolescents who often do not have sufficient brain maturity to organize, plan, prioritize and evaluate the consequences of certain actions (McDonald, 2010; Sylvester, 2003). Adolescents are typically only able to keep

their attention on a specific task for ten to twelve minutes and can only stay in their seats for approximately ten minutes (Ward, 2020). During the brain's transition to adolescence, students often begin to participate in heightened risk-taking behaviors including substance abuse, delinquency, violence, and sexual experimentation (Konrad et al., 2013). Behaviors like these can generate substantial problems in school and negatively impact the relationships students have with their peers and teachers, which unequivocally can negatively impact students' academic performance.

From ages ten to fourteen, adolescents experience many biological, cognitive, and social-emotional changes in their life. These changes are often very challenging (Roeser et al., 2000). At the same time, more mature relationships are developing with parents, peers, and other adult figures. Students start getting ready to transition into the final school stage (i.e., high school) along with other struggling adolescents. For example, Eccles et al. (1996), as cited in Roeser et al. (2000), stated that:

> The challenge of cultivating positive youth development is the dual challenge of understanding, designing, and implanting schoolwide reform efforts that benefit all adolescents during critical developmental periods and targeted intervention and prevention programs. (p. 451).

Relationships established during adolescence are critical for overall well-being, especially peer relationships, student-teacher relationships, and family relationships.

Family Relationships. The middle school years coincide with key changes in adolescent development, including biological and cognitive growth, social development, and the renegotiations of family relationships, especially the parent-adolescent relationship (Adams & Berzonsky, 2003; Grolnick et al., 2007; Keating, 2004; Lerner & Steinberg, 2004; Smetana et al.,

2004; Steinberg & Silk, 2002). When it comes to the role of parents in the academic life of adolescents, the literature has focused on home-based and school-based parental involvement. Home-based refers to parents being involved in the achievement and academics, such as helping with homework and supplementing information. School-based involvement includes the parents' making appearances at the school and having discussions with teachers when given the opportunity. This involvement has little relation to achievement (Strickland, 2016). Both aspects of parent involvement are important for students at all levels.

Researchers have found a connection between family involvement and academic achievement. Parent involvement will decrease chronic absenteeism, school-dropouts and increase student grades, attention, and overall engagement in school (Hill & Tyson, 2009). While student-teacher relationships may be able to impact academic achievement, students need parent involvement to help them be present and allow for these relationships to occur. This allows the student to be able to engage in school culture. Children learn how to relate to adults by virtue of their early years at home. If these relationships are healthy, the chances are that relationships will also be healthy at school unless the teacher does not contribute to the establishment of a relationship (Hill & Tyson, 2009).

School Relationships. Students spend approximately forty hours per week at school, eight hours per day for five days a week. Some students spend more time around school staff than they do with their own families and friends. These numbers display the importance of student-teacher relationships, especially since middle school is a time of significant change. Some middle school students display emotional distress due to their guardians' educational and occupational status, family income, race, culture, and gender (Roeser et al., 2000). Roeser et al. (2000) reported that:

> "adolescents' who felt more emotional distress at the beginning of seventh grade showed lower grades 1 year later and lower self-perceptions of academic competence 2 years later. Such results further document the negative effect that feelings of emotional distress can have on adolescents' academic motivation and achievement over time" (p. 453).

It was also found that adolescents who felt academically competent valued school and received good grades in seventh grade were less likely to feel emotional distress in eighth grade (Roeser et al., 2000). Arslan (2018) discusses how a sense of school belonging and fostering relationships is critical for both school and the psychosocial adjustments of becoming adolescents. Middle school is a difficult time for many adolescents as they are going through emotional, cognitive, and physical changes; this developmental stage contains many elements that impact adolescents' academic success and achievement. With so many different transitions occurring in the minds of adolescents that may cause emotional distress, home as well as school may remain safe zones for students.

Middle School Mathematics Curriculum and Instruction

This study focused on middle school students' academic performance in mathematics. The mathematics curriculum at the middle school level is created from the Common Core State Standards. Common Core State Standards were created when professionals from forty-eight states got together to create new mathematics guidelines to keep American students ahead of some of our greatest rivals including Singapore and South Korea (Garland, 2013). These professionals believed these standards would force for better curricula, better tests, and push school districts and teachers to aim for excellence, not just basic proficiency, for their students (Garland, 2013). There are five domains in the middle school mathematics curriculum: ratio and

proportional relationships, the number system, expressions and equations, geometry, and statistics and probability.

North Dakota has implemented the Common Core State Standards for Mathematics. While many districts and states utilize different forms of assessments, the state of North Dakota utilizes Star Renaissance tests for four benchmark tests per year and the North Dakota State Assessment (NDSA). Middle school students in North Dakota are testing below the proficient line in mathematics. Specifically, their performance is as follows: 62% of 6th graders test below the proficient line, 63% of 7th graders test below the proficient line, and 63% of 8th graders test below the proficient line. Unfortunately, results in language arts and mathematics on the North Dakota State Assessment are slowly decreasing with a lower number of students testing proficient.

In a mathematics curriculum analysis, Ekwueme et al. (2015) found that the average retention rate of learning by lecture is 5%, while that of practice utilizing hands-on learning is about 75%. The majority of students benefit from hands-on instructional approaches and whole class learning due to adolescents' attention spans. In a meta-analysis done by Freeman et al. (2014), results showed that students in traditional lectures were one and a half times more likely to fail than in courses taught with active learning teaching styles. It was considered that on average, student performance on exams, concept inventories, or other assessments increased by about half a standard deviation when some active learning was included in course design (Freeman et al., 2014).

This study contributed to the body of knowledge that addresses student-teacher relationships, the teaching styles, and the students' mathematics academic performance. This study will assist middle schools to address the teaching styles being utilized in the teaching of

mathematics, foster positive student-teacher relationships, and gain access to a body of evidence that links these variables to students' academic performance.

Statement of the Problem

Since 2017, when Every Student Succeeds Act (ESSA) was enacted, the state of North Dakota has distributed the Student Engagement Survey among students in grades 6-8. This survey collects data on three domains: behavior, cognition, and emotions. The behavioral domain refers to a student's efforts in the classroom (Connell & Wellborn, 1991). The cognitive domain investigates a student's investment in learning (Fredricks et al., 2004). The emotional domain measures emotions or feelings about the classroom and school in general (Finn & Rock, 1997; Voelkl, 1997). On the North Dakota Student Engagement Survey, students may obtain one of three types of engagement based on their responses: committed, compliant and disengaged.

The North Dakota Student Engagement Survey findings demonstrate that there is a personal disconnect between students and school engagement as reported by students (Cognia, 2020). Without a more careful analysis of these data, the personal disconnect experienced by adolescent students could lead to a decline in academic achievement and grades. In comparison, the achievement data in mathematics on the North Dakota State Assessment have been slowly declining (Cognia, 2020). This includes a 1% decrease in proficiency levels from the 2018-2019 school year to the 2019-2020 school year and an 8% decrease in mathematics from the 2019-2020 school year to the 2020-2021 school year. The proficiency levels display a decline in proficient understanding, while an overall decrease displays an overall misunderstanding for all students. Mashburn and Pianta (2006), as cited in Hajovsky et al. (2019), stated that positive and supportive student-teacher relationships can facilitate academic growth and motivation while helping them in social and educational environments. The personal disconnect that exists

between North Dakota students and teachers could be the result of a variety of factors that are impacting achievement.

A positivist paradigm was used in this confirmatory correlational quantitative study (Briggs et al., 2012). This paradigm will help the researcher "understand human behavior through observation and reason" (Briggs et al., 2012, p. 23). The goal of this study was to determine whether students' perceptions of teachers' teaching styles and student-teacher relationships are associated with the Star Renaissance Mathematics test scores.

Theoretical Framework

This quantitative study on student-teacher relationship, teaching styles, and the association with mathematical academic achievement was grounded on the theoretical frameworks of John Bowlby's Attachment Theory (formulated in 1958) and Lev Vygotsky's Social Constructivism Learning Theory (1962). The attachment theory stated that there is a lasting mental connectiveness between human beings after interactions. Attachment is defined as "an emotional bond with another person" (Bowlby, 1969).

Attachment theory (Bowlby, 1969) describes that children who maintain proximity to an adult figure were more likely to receive comfort and protection and more likely to survive to adulthood. Bowlby (1969) found that students with close relationships with their teachers may view their teacher as a "secure base" which allows students to open up in a classroom environment. Students with a "secure base" feel safe making mistakes and feel more comfortable accepting the academic challenges found in classroom learning scenarios (Bowlby, 1969).

Constructivist learning theory describes that student's "construct knowledge rather than just passively take-in {sic} information" (Kelly & Van Zile-Tamsen, 2021). The theoretical basis of constructivist learning theory resides in active learning as a necessary experience for students

to construct new ideas as they engage in various activities that require interaction with peers and adults. Examples of constructivist learning theory in the classroom are reciprocal teaching and learning, inquiry-based learning, problem-based learning and cooperative (small group) learning (Kelly & Van Zile-Tamsen, 2021).

Social Constructivism also uses scaffolding as a critical strategy to help with the support of peers and adults to help them learn (Vygotsky, 1962). When students can discuss the learning, they have a deeper understanding of the concepts. Additionally, when they can touch and manipulate the concept being learned, learning is internalized (Vygotsky, 1962).

Purpose of the Study

The purpose of this study was to explore the association among student-teacher relationships, students' perceived teacher instructional style, and mathematics performance on a group of 6^{th}, 7^{th}, and 8^{th} grade students. This study was approached from a positivist paradigm and utilized survey research as its methodology and two questionnaires as the main data collection methods.

This study aimed to contribute to the body of literature needed to address the problem of student-teacher disconnect by analyzing the teaching styles used by most of the students' teachers and the characteristics needed for positive student-teacher relationships and mathematics performance. Additionally, this study was innovative as data on students' performance of their relationship with teachers and teachers' teaching styles was collected. Ideally, this research will be able to assist middle schools in analyzing the current student-teacher relationships by providing insight into student perceptions and providing research support on potential insight into effective mathematics teaching strategies for these middle school students.

This study focused on filling the gaps in the literature in the areas of student-teacher relationships regarding teaching styles. While there have been studies conducted on the perceptions of student-teacher relationships, there is a gap addressing the teaching styles as an intermediate factor between the relationship and the academic performance. There were also gaps when looking into studies where all three variables: student-teacher relationships, teaching styles, and mathematical academic achievement were involved. This study filled these gaps by addressing all three variables and finding the association that student-teacher relationships and teaching styles have on middle schoolers' mathematical academic achievement.

Research Questions and Hypotheses

Research Question

What is the association among the level of students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style, and students' Star mathematics scores?

Null Hypothesis

There is no association among the level of students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style, and students' Star mathematics scores.

Alternative Hypothesis

There is an association among the level of students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style, and students' Star mathematics scores.

Definitions of Variables

The following are the variables of the study:

Predictor Variables:

- Student-Teacher Relationships
    - Constitutive definition: Defined as a close and supportive relationship with teachers, and is conflict-free, will serve as a "safe haven" and buffer from stress (Ang et al., 2020).
    - Operational definition: For the purposes of this study, student-teacher relationships is measured using the second page of the survey. Defined by question numbers nine through twenty-three, located in Appendix A. This instrument contains Ang, R. P., Ong, S. L., & Li, X. (2020) Student Version of the Student-Teacher Relationship Inventory (S-TSRI): Development, Validation, and Invariance.
- Teaching Styles
    - Constitutive definition: Defined as the continuous and consistent behaviors of teachers in their interaction with students during the teaching-learning process (Grasha, 2002).
    - Operational definition: For the purposes of this study, teaching styles is measured using the third page of the survey. Defined by question numbers twenty-four through sixty-three, located in Appendix A. This instrument was adapted from Grasha (1996) The Teaching Styles Inventory

Outcome Variable:

- Mathematical Achievement
    - Constitutive definition: Mathematical Achievement is the competency shown by the student in the subject of mathematics. Its measure is the score on an achievement test in mathematics (Bhairab Datt Pandey, 2017).

- Operational definition: Stated by Renaissance Star Mathematics, "Renaissance Star Mathematics scores represent how students performed on the test compared with the performance of a nationally representative sample of students, called the norms group. These scores present a snapshot of achievement at a specific point in time" (Renaissance Star, 2016, p. 4).

Intervening Variables:

- Grade
  - Constitutive definition: a level of study in an elementary, middle, or secondary school that is completed by a student for one year (Merriam-Webster, n.d.).
  - Operational definition: Question number two on the first page of the survey shown in Appendix A.
- Gender
  - Constitutive definition: Merriam-Webster defines gender as "the behavioral, cultural, or psychological traits typically associated with one sex" (Merriam-Webster, p. 2b, n.d.).
  - Operational definition: Question number one on the first page of the survey shown in Appendix A.
- Race
  - Constitutive definition: any one of the groups that humans are often divided into based on physical traits regarded as common among people of shared ancestry (Merriam-Webster. n.d.).

    - Operational definition: Question number four on the first page of the survey shown in Appendix A.

- Ethnicity
    - Constitutive definition: quality or affiliation (Merriam-Webster. (n.d.).
    - Operational definition: Question number four on the first page of the survey shown in Appendix A.
- Family
    - Constitutive definition: a group of individuals living under one roof (Merriam-Webster, p. 2b, n.d.).
    - Operational definition: Question number five on the first page of the survey shown in Appendix A.

Significance of the Study

The significance of positive student-teacher relationships cannot be second to assessment, curriculum or instruction when looking at factors to student learning and achievement. The literature reinforces the concept that positive student-teacher relationships are critical to student engagement and achievement. Roeser et al. (2000) considered that "adolescents who felt more emotional distress at the beginning of seventh grade showed lower grades one year later and lower self-perceptions of academic competence two years later" (p. 453). Such results further document the negative effect that feelings of emotional distress can have on adolescents' academic motivation and achievement over time. Therefore, it is necessary for teachers to try and make relationships with students with the goal of helping students achieve.

Professionals can examine the findings of this study in the following manner: First, middle school teachers and staff could dive into the student's perception data on student-teacher

relationships and create an action plan on how to better foster relationships. Second, the data on students' perception of teachers' teaching styles may allow examination into current practices and potentially create a more student-focused and hands-on learning environment. Lastly, administration or instructional coaches may find value in comparing these findings with the results of the engagement survey required by ESSA and measuring the amount of change over time after practices may be put into place.

The benefits of this study would be middle school educators can clearly see what students perceived as positive characteristics of student-teacher relationships and determine how they can more adequately foster these relationships with students. Furthermore, administration can analyze these findings and create new methods of building positive student-teacher relationships to allow for more engagement and ultimately achievement. In addition to the positive student-teacher relationships, the administration and teachers will be able to analyze data collected about teaching styles and their effectiveness.

Research Ethics

Permission and IRB Approval

In order to conduct this study, the researcher received approval from the Institutional Review Board (IRB) from Minnesota State University Moorhead (MSUM) to ensure the ethical conduct of research involving human subjects was maintained. The MSUM IRB approval form can be found in Appendix B.

Informed Consent

The protection of human subjects that participated in the research was assured. Parents of minors that participated in this study were made aware that this study was conducted as part of the researcher's Doctoral Program and that it benefited teaching practices being performed at

their children's school. Parents of minors that participated were fully informed of the purpose and procedures of the study for which consent was asked. Confidentiality was protected through the use of pseudonyms (e.g., Participants 1). The choice to participate or withdraw at any time was outlined both verbally and in writing. As these participants were minors, the Consent Form was signed by the participant's parents or guardians. The minors were read the Method of Assent. The Consent Form for the study is located in Appendix C. The Statement of Assent that was read to the participants before the questionnaire is located in Appendix D.

Limitations

This study measured academic achievement from Star Renaissance mathematics scores, perceptions of student-teacher relationships and teachers' teaching styles via a Qualtrics questionnaire. To explore students' perceptions, they were asked to rate their relationship with their teacher and teaching styles from almost never true to almost always true. An additional limitation is that the data was self-reported and there was always a threat to the internal validity of the study because some students may not have been willing to be fully honest with their responses. The representation of reality can be questioned, due to the development age of the participants, where student-teacher relationships may be a sensitive issue. This study used convenience sampling of middle school students from a western North Dakota school district. It is also unknown if the students followed the guidelines provided by the researcher to base their perceptions on only their current mathematics teacher.

Delimitations

The first delimitation included in this study was that it will only include middle school students, as well as it only included middle school students from one North Dakota school district. The second delimitation related to the use of the Star renaissance mathematics scores; no

other academic performance scores were used. The third delimitation focused exclusively on student-teacher relationships, and student-student relationships were not part of this study. Likewise, there was no data collected with parents, administrators, janitors, lunch staff, or any other school faculty. The last delimitation of this study related to the fact that only five teaching styles (Expert, Authority, Personal Model, Facilitator, and Delegator) were analyzed from the teaching styles survey and mathematics was the only content area subject to data collection.

Conclusion

Chapter 1 provided the reader with a brief introduction and background into student-teacher relationships, middle school students' development, Star Renaissance mathematics assessments, and teachers' teaching styles. This chapter explained the need, purpose, and significance of this study. The remaining content of the dissertation is followed by Chapter 2, the Literature Review, which provides an overview of the context of the study, current scholarly literature on student-teacher relationships, teachers' teaching styles, middle school mathematics achievement. As well as fully describing John Bowlby's attachment theory and Lev Vygotsky's social constructivism learning theory.

CHAPTER II: Literature Review

Using a correlational design, this study sought to understand the interplay of student-teacher relationships, teaching styles, and mathematical academic achievement on middle school students. The study analyzed mathematical data collected during the fall benchmark testing phase, specifically using data collected with the Star Renaissance mathematics assessments. The questionnaire also addressed intervening variables such as gender, grade, race/ethnicity, and family dynamics.

This literature review provided teachers and administrators with an understanding of a few different variables involved in students' academic achievement. It examined the middle school mathematics curriculum used in Common Core Mathematics and provided information about Star Renaissance Assessment tool as well as different teaching styles used in the mathematics classroom. Lastly, because this study sought to focus on middle school students, their perceptions of student-teacher relationships and teaching styles, information about middle school student development and educational psychology was also reviewed.

Methods of Searching

Several methods of searching the literature were used during this process. The MSUM Livingston Lord Library generated substantial literature related to the study. A combination of keywords produced an abundance of primary and secondary resources. The search began with broad descriptors, such as 'student-teacher relationships' and 'middle school.' When over 500 articles appear, certain parameters were set to narrow down the scholarly search to peer-review journals and the advanced search option limiting it to articles published from 2000 to present. These strategies reduced the numbers to approximately 350. In addition to these 350 articles, the author also utilized the search databases with the descriptors 'student-teacher relationships,'

‘middle school’ and ‘mathematics academic achievement’ with the same parameters along with narrowing the years published in 2016 to present. This gave approximately 60 articles to review. In addition, completing a search with the descriptors ‘academic achievement’ and ‘teaching styles’ yielded approximately 70 articles with the same set of parameters. The databases utilized to gather data included Academic Search Premier, ERIC (EBSCO), Research Gate, and Google Scholar. On occasion, an article would be found as unavailable, thus the researcher requested the document through the MSUM library. In all instances, the librarians were able to retrieve the primary articles that fit under the parameters set when completing the initial search.

Designing a method of organization was critical at the beginning of the review. The researcher instituted a technique of coding articles with notes designating them into a relevant heading within the literature review. As an example, if an article held information on student-teacher relationships, that document would be marked with a sticky note denoting it as student-teacher relationship along with another sticky note with relevant data that may be included. This method may seem obsolete as we live in a technological world; however, this strategy was what worked best for the research and the multiple headings and variables involved in the study.

A widespread literature review contributed to the research process and led to the beginning of the study. The collection of literature grew throughout the research process. After four semesters of reading peer-reviewed journal articles, data reports, test instructions, and books, it was confirmed that there was a need to further explore the possible association between student-teacher relationships, and teaching styles to better understand the mathematics performance among middle school students. There was a need to uncover whether there was an association between student-teacher relationships, academic achievement, and teaching styles.

Body of Review

To gain a better understanding of how these variables are inter-related, a review of the literature looking specifically at middle school students' mathematical academic achievement was conducted. This literature review is divided into the following sections: types of relationships between teachers and students, middle school mathematics achievement and instruction, and middle school students' developmental characteristics. The theoretical framework for this study is also described near the end of the chapter.

Low academic achievement is not a problem that can be solved with one solution. It will require students, parents, teachers, administrators, and many others' best efforts including time, energy, and guidance. Middle school low academic achievement has many factors affecting it, such as motivational levels, cognitive and physical development, parent involvement, student-teacher relationships, student-student relationships, home life, differing teaching styles, class schedule problems, study skills, socio-emotional struggles, and the list goes on. The learning environment is a critical component to students' success (Ryan & Deci, 2000), especially a learning environment that encourages success in students by establishing positive relationships (Ryan & Deci, 2000; Eccles et al., 1997).

In a world that is constantly changing and modifying, education and teaching styles are no exception. Over time, many educators have transitioned from an authoritarian style of teaching to a more cooperative interactive style (Garrett, 2008). Schulze and Bosman (2018) discussed that having a positive learning environment and varying your teaching methods to accommodate for a variety of learning styles can be a large advantage for many students. This literature review defines five different types of teaching styles and further discusses the educational practices that are involved in these styles.

It was also discussed how mathematics is a key subject for countries with emerging economies as it helps learners prepare for careers in engineering, natural science, and accounting. Mathematics is a highly tested content area as it is critical for high school success, college, and future careers. Mathematics skills are not only important for students completing high school mathematics classes or preparing for college level courses, but also in terms of careers and American citizenship. From daily activities such as being able to add, subtract, multiply, and divide regarding quantities of an item or recipes, being able to use money, telling time, to requirements of citizenship such as knowing your income and tax information; mathematics is a critical skill. Mathematics education at the middle school level focuses on skills under one of the following concepts: ratios and proportional relationships, number systems, expressions and equations, geometry, statistics and probability, and functions. All of these skills and concepts help to further prepare students for daily life, citizenship, high school mathematics classes, and future college courses.

Relationships in the Middle School Years

Socialization and relationships are not only important for middle school students' academic success but are also important in all aspects of their life. Middle school students are going through many changes during this developmental time, which is why having others to talk to and express feelings to is important. It is key for relationships with middle school students to have specific components including positive communication, supportiveness, and maintaining standards (Hillaker et al., 2008). These components help to guide students through these difficult and uncertain times while allowing them to feel comfortable and open to new conversations and tasks that arise. In addition to middle school students creating relationships with those three components, it is important for the students to learn about how to form those relationships on their own, keep the relationships, and adapt when the relationships may change. Many middle

schools have started to offer social emotional lessons to help students work through this unfamiliar time in their life. Knight et al. (2019) states that the transitional time from childhood to adolescence is the critical time for students to learn about social etiquette as they go through psychological and physiological development. Therefore, the relationships they make during this time can be key for their development.

Family. Student learning is not only influenced by school-related circumstances but also parental expectations and aspirations for their child (Hattie, 2009). The home can be anything from a positive nurturing environment for students to a toxic place with harm and neglect to academic achievement (Hattie, 2009). In America, family structures vary significantly; approximately 62 percent of families have two-parents, while 26 percent have single-parents, and the remaining 12 percent consist of other family structures such as cohabiting and remarried parents (Hattie, 2009). It has been found that students with single-parent families have lower mathematics achievement than students with two-parent families (Pong et al., 2003). Pong et al. explain that this was due to the resources that may not be available to children from single-parent families compared to children from two-parent families.

In addition to single-parent families being busy at work during non-school hours compared to two-parent families (Pong et al., 2003). It has also been found that one of the largest contributions from family and home life is parents knowing how to speak the language of school to be able to help their children with homework and discuss different aspects of their school days (Hattie, 2009). Iverson and Walberg (2015) discovered that the socio-psychological environment of the home and the intellectual discussions that happen at home are more important than the socioeconomic status or family structure. While many researchers have studied family relationships and home contributions, it has been reported the largest variable factor is parental

expectations and aspirations (Clinton et al., 2007; Hattie, 2009). Studies have shown that socioeconomic status and type of parent homes are as dominating of a factor when discussing student academic achievement when compared to family and parent-student relationships. The relationships children have with their parents and families in their home environment show a positive correlation to academic achievement and healthy relationships (Hattie, 2009). Hattie (2009) explains this is due to families being able to help each other with homework, discuss aspects of their day whether positive or negative, and offer positive feedback regarding their future academic ambitions.

Teachers. While student-teacher relationships are a huge component of a student's day, family relationships are also key (Weghlage, 1990). Social bonding, whether with family, teachers, peers, or any adult figure is an important feeling of attachment that students should experience in order to increase academic achievement (Weghlage, 1990). The feeling of attachment can create meaningful and healthy relationships with adults and peers in a school setting, which can be tied to positive educational gains (Hattie, 2009; Weghlage, 1990). It is well-known that emotional support from and closeness to authority figures are indicators for students' academic success in upper elementary and middle school age students (Oz & Dolapcioglu, 2019). Students, especially at the middle school age, are going through many physical and emotional changes and having these emotional support systems secures students' feelings of success and acceptance at school. Consequently, having these support systems is a way for the students to feel success and accepted at school. At school, student-teacher relationships can drastically affect students' grade point average (Scales et al., 2020).

When parents and children are asked what makes the difference in academic achievement, one of the answers most likely reported is *teachers* (Hattie, 2009). Student-teacher

relationships are defined as “caring and authentic relationships between teachers and the students” (Knoell, 2012, p. 4). At a time when many students are meeting multiple new teachers and classmates to begin middle school, having personal conversations, and creating relationships with their teachers may not be the most important aspect of entering middle school. Rather conversations and relationships with other students are more important. It was reported that supportive relationships with teachers foster engagement in learning (Hughes et al., 2008; Ladd et al., 1999). Spilt et al. (2012) states that these student-teacher relationships do not need to begin as close and supportive relationships but can form and grow overtime and through conversations and engagement. Pianta (1992) states, “poor relationships with teachers evoke feelings or insecurity and distress, which limits children’s ability to devote energy to academic and social learning activities” (p. 27). These authors explain to us that relationships are not static and can blossom into positive, close, and supportive relationships, but that there are negative consequences if these relationships are not able to grow and emerge.

Relationships are nurtured within larger social environments. For example, student-teacher relationships are constrained by the social organization of schools (Pianta & Walsh, 1996). The social organizations of schools can include class schedules, lunch structures, and classroom settings. These constraints impact student-teacher relationships as they may not be able to interact on a personal level due to large class sizes or little time for casual conversations as classes are rotating through multiple teachers (Pianta & Walsh, 1996). Pianta (1999) proposes that broader contextual factors characteristic of schools, such as the formality of classroom instruction, limit the types of interactions that take place. He discusses the trust that is fostered between teachers and students, while playing and talking outside of the typical classroom environment is key to student adjustment to school. To a degree, Pianta's propositions are in line

with a different method of developing "caring" relationships with students, such as formality in the classroom and the fostering of relationships outside of lessons. Noddings (1984) proposes that caring requires recognizing that students have emotional and social needs as well as academic.

Some of the intervening variables that were addressed in the research of student-teacher relationships were gender, race, and age. Much of the research that has been studied on teachers' demographics in regard to student-teacher relationships fell under the perceptions of students' domain. It was discovered that women teachers were able to experience closer, more personal, and non-confrontational relationships with students than men (Zee & Koomen, 2017). The authors, Zee and Koomen (2017) also found that older teachers and teachers with more experience were able to form closer, more supportive, and personal student-teacher relationships with their middle school students. Lastly, teachers and students with similar demographics such as race, socioeconomic status, and gender were able to form relationships more competently (Roorda et al., 2011).

Positive relationships were found more often between middle school students and teachers when the teacher was described as having a warm demeanor, being caring, challenging, having an interest in students' personal life, and not being stressed (Yoon, 2002; Scales et al., 2020). Based off patterns of student-teacher interactions, students create relationships with teachers who provide closeness and emotional security (Baker, 2006; Hamre & Pianta, 2001; Maldonado-Carreno & Votruba-Drzal, 2001; Roorda et al., 2011); as well as, when those students have positive relationships there has been an increase in students' sense of well-being, classroom engagement, and academic performance (Baker, 2006; Hamre & Pianta, 2001; Maldonado-Carreno & Votruba-Drzal, 2001; Roorda et al., 2011).

Middle School Mathematics Achievement

When transitioning from elementary school to middle school, students must deal with many changes such as scheduling, multiple teachers, time allotted for class, homework, and the rigor of Common Core State Standards. Throughout middle school, students are taught many skills in the areas of ratios and proportional relationships, the number system, expressions and equations, geometry, functions, and statistics and probability. In each of the three years of middle school students learn at least four to five of those areas with approximately one to three common core state standards under each area. This results in mathematics teachers teaching approximately ten to fifteen new common core state standards each year, along with reviewing past mathematics skills the students may need to be successful. It would also cause students to need to learn how to have an hourly schedule with different teachers for each hour. This middle school transition also includes less time per content area and more homework assigned per class on a regular basis.

Mathematics achievement is a component of learning that all schools are focusing on due to the general decline in mathematics academic achievement, lower ACT and SAT mathematics scores, and mathematical careers. Government and school officials became concerned with low achieving schools in 1997 and established No Child Left Behind (NCLB) in 2001 (Ding & Davidson, 2005). Later in 2015, this initiative changed to Every Student Succeeds Act (ESSA), both initiatives focus on yearly academic progress keeping school districts accountable, and yearly growth progress. During the time of the NCLB, two groups of students were found to be "disadvantaged:" the English language learners who were deemed as non-proficient in English and special education students (Ding & Davidson, 2005). It was reported in a study completed from 1998-2001 with over 1,000 schools involving middle school students who showed growth in one testing year tended to show losses the next testing year (Ding & Davidson, 2005). This

was thought to be from a range of reasons such as summer deficits, middle school changes, lack of English proficiency, lack of retention of information, and need for a higher order of thinking at the next grade level (Ding & Davidson, 2005).

Mathematics achievement is an important aspect of middle school academics because mathematics is one of the core content areas that is highly tested. Academic achievement in middle school has different definitions and standards for each individual state and district. As stated by Reddy (2005), achievement in mathematics is a key indicator of the performance of the school system. It has been described that interventions such as feedback, small-group instruction, allotted time for reviewing past skills, intervention curriculum (e.g., Trans-mathematics), peer-assisted learning, and teacher-lead instruction are effective when teaching students. There are also new mathematics innovations that have the greater academic effects on lower achieving students compared to higher achieving students (Hattie, 2009). Baker et al. (2002) discussed the power of interventions when learning mathematics is a huge component of higher achievement. Interventions that produced the greatest effects were feedback for students, peer-assisted learning, teacher-led instruction, direct instruction, and concrete feedback to parents,

One of the huge curricular breakthroughs for mathematics was that real-world problems that involved high level of manipulative material were found to be more effective (Athappilly et al., 1983; Hattie, 2009). This is a reason that many twenty-first-century mathematics curricula incorporate word problems and real-world activities and problems. This is also when project or problem-based learning may come into play for many schools and mathematics curricula. One of the difficult parts for many middle school students in mathematics is that it is structured with high order skills (i.e., problems with critical, logical, reflective, and metacognitive thinking with analyzing, evaluating, and creating mathematical problem) paired with multiple previously

learned skills (i.e., area of 3D shapes or prism, algebra, word problems, and multi-step addition, subtraction, and multiplication problem) (Hajovsky, 2020). This becomes difficult for students that may have not achieved mastery in these previously learned skills and do not have the prior knowledge to use them in higher order thinking (Hajovsky, 2020). Mathematics is a content area that heavily requires prior knowledge to be successful in current skills. These cognitive mathematics requirements intersect with the emotional stage of adolescents. This cognitive and emotional development learning through real-life projects and problems allows middle school students to further understand and master common core state standards.

Mathematical achievement is defined as the competency shown by the student in the subject of mathematics (Bhairah et al., 2017). Its measure is the score on an achievement test in mathematics (Bhairab et al., 2017). Mathematical academic achievement may vary in the different domains of mathematics such as geometry, algebra, probability, and statistics. While there are different components in mathematics that can be assessed, students are able to get composite scores on standardized testing to give an overall view of their mathematical achievement. Students are expected to show mathematics growth in multiple domains each year, including showing mastery or testing proficient on the State Assessment (Ding & Davidson, 2005). Each state and school district offers multiple forms of assessments such as teacher-generated summative and formative curricular assessments, benchmark or adaptive (e.g., Star Renaissance Mathematics, curriculum benchmark, MAP), and State Testing (e.g., NDSA, MCA, SDA). All these assessments provide school districts, teachers, parents, and students an understanding of the growth that is being made or the areas needed for improvement.

Star Renaissance Assessment

In 1845, when James Knox Polk became President of the United States, it was decided that there was a need to secure students' understanding of all subjects to support a growing

country (NEA, 2020); therefore, American students were given their first written mandated test. This was an external standardized test called the National Assessment of Educational Progress (NAEP) (Renaissance, 2019). Before this time, all school districts had been using oral forms of assessments administered by teachers (NEA, 2020). From 1875 to the beginning of World War I, all schools began to use externally mandated written assessments (NEA, 2020).

Renaissance Learning is an educational software company that was founded in 1986 to help test K-12 students over mathematics and reading standards. It was founded by Judith Paul and Terrance Paul in Wisconsin and the headquarters remained in Great Lake, Minnesota since its existence. Renaissance Learning offers educational software in Accelerated Reader, reading, early literacy, mathematics, writing, and daily progress monitoring (i.e., Star Assessments). Moreover, Renaissance Learning also offers supplemental resources for teachers and classrooms such as handbooks, workbooks, motivational items, and professional development opportunities (CrunchBase). In 1996, Renaissance Learning administered its first computerized adaptive test, which it adapts to the tester's ability level and applies questions in their testing levels (Renaissance, 2019). The software company began with Star Reading in 1996, and Star Mathematics assessment soon followed in 1998 (Renaissance, 2019). In 2002, in accordance with No Child Left Behind, all 50 states were mandated to participate in standardized testing.

Renaissance Star Assessments have four pillars to help teachers and schools assess K-12 students accurately and effectively. These pillars are purposeful, proven, powerful and predictive; all of which help Renaissance create assessments that are beneficial for school districts (Renaissance, 2020): all assessments should be purposeful, proven, powerful and predictive. Assessments are purposeful, when they provide data that educators need and value to address the instructional decisions they must make on a daily basis. Assessments must also be

proven; teachers and administrators want to be able to trust assessments to have reliability, validity, and supported by research-based evidence. The term powerful is used in regard to assessment when the assessment delivers maximum information from test data to allow for major impacts on education in a minimal amount of time. Lastly, the term predictive is used in regard to data from data from the Renaissance Star Assessment that functions as a predictor of students' future scores on high-stake tests. Using these four pillars, the Star Assessment provides teachers and schools with reliable and valid data instantly, so they are able to target their instruction, monitor student progress, and provide appropriate materials and interventions for these at-risk students (Bulut & Cormier, 2018; Renaissance, 2020). Studies have been completed on Renaissance Learning Star Mathematics validity and reliability in 2014 with American Educational Research Association, in 2001 by VanDerHeyden, and a Monte Carlo Simulation test in 2018 (Bulut & Cormier, 2018). The National Center on Response to Intervention, a branch of The American Institute for Research completed a study in 2004 where they discovered the coefficients of validity and reliability remained in the 0.79 to 0.834 range (Bulut & Cormier, 2018). Similar coefficients of validity and reliability were found (0.77 to 0.80) in a 2008 study completed by The Regional Educational Laboratory at Pennsylvania State University (Bulut & Cormier, 2018).

Star Renaissance Assessments uses two different components to make the test more efficient and accurate. Renaissance Star uses computer adaptive tests (CAT), which continually adjusts the difficulty of the test based on student performance on previous questions (Renaissance, 2020). This allows for the test to be shorter and free from questions that are too hard or too easy. The second component is item response theory (IRT), which puts student performance and item difficulty on the same scale and estimates the probability of a student

answering it correctly (Bulut & Cormier, 2018; Renaissance, 2020). When educational administrators decide to implement Renaissance Star as assessment systems, teachers are provided with multiple measurements.

The three most often used growth measurements are 1) scaled scores, 2) student growth percentile, and 3) annual growth charts. Scaled scores help teachers to compare student performance over time using numerical scores that will increase or decrease based off growth and gives a comparison to where this correlates to grade level (Bulut & Cormier, 2018; Renaissance, 2020). Student growth percentile compares a student's growth to the national norm by grade, while annual growth charts display a student's growth over one year as well as over multiple years of growth (Bulut & Cormier, 2018; Renaissance, 2020). Star Renaissance Assessments are trusted and used by many districts in the country to help provide data driven student interventions and student growth data (Bulut & Cormier, 2018; Renaissance, 2019; Renaissance, 2020).

Teaching Styles

Teaching is not an easy career choice; this is even more so in regard high stakes content areas such as mathematics and reading. Becoming a mathematics teacher requires more high-level college mathematic courses, additional education classes in teaching specific age ranges, and American teacher certification exams in mathematics appropriate for the state. A mathematics teacher must receive teacher preparation from an accredited school or program, as well as complete an American teacher certification exam in the age and content area desired. Teachers can continue their education through Master's programs in mathematics, curriculum and instruction, elementary, and middle school education.

Learning is a process that is not unknown to teachers, students, parents, and administrators; however, learning is not a visible act: teaching is (Hattie, 2009). Learning is a

cognitive process that is measured indirectly because of its internal process. This is why teachers, administrators, and curriculum designers create assessments for students to demonstrate their understanding (Hattie, 2009). John Hattie (2009) states that the content of the curriculum is less important than the strategies used to teach. Curriculum refers to "lessons and academic content taught in a school or in a specific course or program" (The Glossary of Education Reform, 2015). Curriculum helps educators and administrators arrange the lessons and units they plan to teach during an appropriate time. Curriculum also helps educators and administrators know what needs to be taught, but it does not in fact tell educators *how* they need to teach or *what style* it will be taught under. Teaching styles can be defined as "a teacher's preferred way of solving problems, carrying out tasks, and making decisions in the process of teaching" (Gafoor et al., 2012, p. 143).

Learning styles are defined as "the way in which individuals begin to concentrate on, process, internalize, and retain new and difficult information" (Dunn, 1990, p. 225). Dever (2011) stated that teaching styles should not only be based on teachers' preference but also student learning styles, content area, and size of the student class. Student learning styles, content areas, and class size are crucial components to teaching and learning, as through differentiated instruction strategies academic achievement can be accomplished (Levy, 2008). It is beneficial for teachers to use a wide variety of activities to reach students who have diverse learning styles (Levy, 2008; Bender, 2012). Teaching styles may vary depending on the content area being taught, such as teaching mathematical knowledge and skills, which requires more repetition and patience when students may make errors (Tschannen-Moran & Woolfolk Hoy, 2001). Additionally, class size impacts teaching styles used in the classroom. This is inevitable as some teaching styles require peer collaboration, teacher led direct instruction or materials that may be limited (Hattie, 2009).

Many teaching styles have positive attributes when discussing student learning (Kiefer & Pennington, 2017). When comparing active learning and traditional authoritative learning, it was found that active learning has many benefits such as they are student-centered, maximize participation, are highly motivational, and give real life connections to the subject matter by encouraging students to move beyond textbook examples (Bonwell & Eison, 1991; Ladousse, 1987; McKeachie, 1999; Schaftel & Schaftel, 1976; Van Ments, 1994). Conversely, traditional authoritative learning is more information and fact-based lecture style learning such as memorization, lectures, quiz, and tests with feedback (Dever, 2011).

The third part of this research survey (Appendix A) delved into teachers' teaching styles. While there are many teaching styles, survey questions are adapted from The Teaching Styles Inventory developed by Grasha (1994). For this study, the author chose to identify and question students on five different types of teaching styles: 1) expert teaching, 2) authority teaching, 3) personal model teaching, 4) facilitator teaching, and 5) delegator teaching. Grasha (1996) describes expert teachers as the transporting of knowledge through content, materials, and timing. The author outlines authority teachers as being not flexible, having set classroom routines and rules, and having an authority status with their students. While personal model teachers are defined as a teacher who encourages students to observe and work together. A facilitator teacher allows students to take responsibility for their learning and create cooperative learning. Lastly, the author describes a delegator teacher as a student-based teaching environments and allows students to be independent learners.

As this literature review focused on the content area of mathematics, it is critical to note that students' ability to memorize basic facts in their early years is a factor in later mathematical success (Tschannen-Moran & Woolfolk Hoy, 2001). Overall, throughout the literature it has

been established that teaching methods with a component of hands-on learning have been found to be the most effective for adolescents. This includes learning methods such as problem-based learning, project-based learning, hands-on learning with manipulatives, and other active learning techniques. Through active learning, adolescents are able to regain their focus through movement and change in activity (Hattie, 2009).

Cornell University completed a study and discovered that active learning creates a personal connection and sense of belonging to adolescents learning as well as motivation to learn (Bonwell & Eison, 1991; Hattie, 2009; Ladousse, 1987; McKeachie, 1999; Schaftel & Schaftel, 1976; Van Ments, 1994). Active learning also allows students to collaborate with peers which is an important aspect in adolescents' development as it fosters confidence in their learning through conversation. Research conducted by Grasha (2002) indicated that a constructivist teaching style affected students' perceptions toward teaching and learning in specific content areas such as physics and mathematics. Chang (2008) explored the perceptions of students who were taught within a constructivist approach and a traditional approach. When students were taught using a constructivist approach rather than a traditional one, they valued the ability to actively participate in group discussions and evaluate concepts they learned more. Chang's study suggested that the constructivist teaching style promotes greater flexibility in teaching and brings about students' use of deep learning strategies (thinking and discussing) and knowledge formation.

Middle School Students

Middle school students are classified as grades sixth through eighth grade, most likely between the ages of eleven to early fourteen years old. During these ages, adolescents experience many different changes, including biological, cognitive, and socio-emotional ones (Roeser et al., 2000). These adolescents are also handling maturing relationships with parents, peers, and transitioning into a new school (Roeser et al., 2000). Many of these students will tackle the

middle school years by switching friend groups, finding clubs and activities to be involved in, and keeping a positive attitude toward the future. It has been reported that during this time of adolescence, when children are going through biological and cognitive development and evolving social aspects, it will be a key factor in whether they continue to stay engaged and perform well in school (Eccles & Midgley, 1989; Erikson, 1950; Masten & Coatsworth, 1998).

Middle school is a key moment for adolescents in their academic achievement timeline. Faust et al., (2014) state that middle school is a time of greatest vulnerability with challenges and changes in values, norms, self-esteem, and a strong need for positive relationships and approval from adults and peers. To complicate the situation, adolescents are also going through the many challenges of puberty. Furthermore, the transition from elementary school to middle school puts stress on social contexts of adolescents (Crosnoe, 2000). Social contexts are a key factor when discussing middle school students and the transitions they may endure.

Cognitive growth is a predominant piece of adolescent development. During adolescents, the prefrontal cortex is beginning to rapidly mature, which increases the levels of thinking and understanding (Cocchimiglio, 2022). Adolescents are also able to process differently during this brain development. They may experience their deductive reasoning increase, better decision-making skills, their capacity for working memory increase, their ability to retrieve memories becomes faster, and their ability to learn independently expand (Cocchimiglio, 2022). Through these cognitive shifts, adolescents are better equipped for the challenges that middle school education presents them.

Along with cognitive development, middle school students are also going through gross and fine motor skill development. Gross motor skills include large-scale body movements such as walking and running, while fine motor skills require hand-eye coordination. During

adolescence, children are able to improve their coordination, balance, agility, synchronize their movements, and develop smoother and more controlled movements (Morelli, n.d.). Fine motor skills also develop and show improvement during this time: using their hands for more manual activities, completing complex craft projects, using simple tools, and increasing their computer skills (Morelli, n.d.). When relating motor skill development to educational improvements, fine motor skills show more value considering they need it for computer skills, typing, writing, and cell phone usage.

Language development is an element of adolescence that is most visibly seen or heard in adolescents' lives. During this language development, adolescents have increased language skills including sophisticated forms of language and new vocabulary (Morelli, n.d.). Moreover, adolescents begin to have a greater understanding of communication and multi-layered meaning of words and phrases. When talking about this nuanced under of meaning, this includes understanding and using complex jokes, metaphors, similes, puns, and sarcasm in everyday conversation. Lastly, adolescents will reach peak mastery of their lips, tongues, and breathing to be able to construct and speak lengthy thoughts (Morelli, n.d.).

Finally, one of the most frequently discussed changes in adolescents is their social and emotional wellbeing. Throughout these changes, adolescents are ultimately trying to find their identity (Tozer, 2016). Adolescents may be trying to solve where they fit in the world, their cultural background, family expectations, new or old peer groups, and clubs or sports. Adolescents are overwhelmed not only by social aspects of adolescent development but also the emotional changes they experience. Adolescents are still trying to process how to control and express their new-found emotions (Tozer, 2016; Morelli, n.d.). During this time adolescents are more sensitive, unpredictable with their emotions, self-conscious about their physical appearance

and changes that may have happened, and feeling as if they are bullet-proof (Tozer, 2016). All of these new social and emotional changes may be cause for parents and teachers to reach out to struggling children and allow them to discuss their social and emotional turmoil.

Child Development. Child development is not a linear process; there are many factors that influence growth and development. During the middle school years, students are transitioning from concrete operational stage to formal operational stage (Collin et al., 1984). Formal operational stage is the fourth and final stage of Piaget's developmental theory. Children reach this stage during adolescence and continue developing through adulthood (Collin et al., 1984). Throughout the formal operational stage children are able to think abstractly, manipulate thoughts and ideas in their head, and process mental operations that may not focus on the here and now (Piaget, 1958). During these stages adolescents learn how to properly participate in society in terms of socialization, language, and socio-emotional skills (Collin et al., 1984).

While development is not "one size fits all", humans go through Piaget's four stages at different points in their life (McLeod, 2020). These four stages include: sensorimotor, preoperational, concrete operational, and formal operational. Beginning from birth to approximately two years-old, children develop through the sensorimotor stage. This stage includes learning about the world through the senses and actions, and the continued development of the cognitive skills such as thinking, learning, remembering, and paying attention (McLeod, 2020). During the sensorimotor stage children learn through experiences, and through trial and error; the biggest goal of this stage is for children to grasp the idea that objects exist even if children are not able to see them (Marcin, 2018). From approximately age two to age seven, children develop into preoperational stage. This is when children begin to see the world through language and imagery, towards the end of this stage humans begin to start seeing the logic and

not just symbolism (McLeod, 2020). In addition, at the preoperational stage children begin to have memory and imagination, adults may see many children at this stage having imaginary friends and playing in make believe worlds or situations. This is also when children are most often described as egocentric or selfish, this is due to the fact that they have difficulty understanding and thinking outside of their own viewpoints (Marcin, 2018).

At the beginning of middle school, many students are in the concrete operational stage which occurs from approximately age seven to age eleven. At the concrete operational stage, children are beginning to come out of the egocentric stage as they can start to understand and think about others and their viewpoints (McLeod, 2020; Marcin, 2018). Additionally, children are able to work through problems without having to encounter it in real life. This makes story problems easier to solve for these students as they can imagine how to work through it instead of needing to encounter it (Marcin, 2018). During this stage, middle school teachers may begin to ask more open-ended questions as students are better able to process and understand potential solutions. Teachers may also use three-dimensional models, experiments, and riddles to allow students to use their analytical thinking and understanding of abstract concepts (Marcin, 2018).

During middle school, students reach a more advanced cognitive stage of development called formal operational stage (McLeod, 2020). During this stage, children become adolescents, and many of their physical characteristics may change. They also can handle abstract ideas, explain and understand arguments, and handle hypothetical problems and questions (McLeod, 2020). Throughout the transition into the formal operational stage, adolescents are better able to understand multiple variables of information, and they are better able to build off prior knowledge without completely changing what they already understood (Marcin, 2018). These key developmental characteristics make it easier for adolescents to understand some of the

abstract concepts they are taught in middle school. They are also able to build on the prior knowledge they have learned at the elementary school level. These developments also make it possible for adolescents to have conversations where they must think about hypothetical situations and problems and provide a reasonable argument in response. These types of conversations would not be possible to have outside the formal operational stage as they do not yet possess these hypothetical and argumentative skills (McLeod, 2020; Marcin, 2018).

Mental Health. Middle school is a time of many different challenges impacting the life of adolescents. These challenges may result in academic decline, impact social adjustments, and translate into mental health issues (Green et al., 2021). Approximately one-half of American adolescents will experience a mental health disorder at some point in their life, while half of all mental disorders will begin during adolescence (Kessler et al., 2005; Merikangas et al., 2010). These studies have shown that adolescence is a vulnerable stage in a student's life, and the overall changes and difficulties that occur could create a life-long impact.

Adolescence can pose challenges for students, and their middle school years can offer an ideal opportunity to enhance social and emotional understanding. This opportunity is due to the physical and cognitive development that occurs during middle school, which allows for adults to promote positive outcomes for their children (Green et al., 2021). Some of these positive outcomes may include peer, parent, and adult relationships, positive academic achievement, increased community and school involvement, and emotional and mental health understanding. Positive relationships and social-emotional programs may help the development of social-emotional skills, academic functioning, mental health, and overall health and well-being of students (Dowling et al., 2019; Jones et al., 2017).

Social and emotional understanding is key for the development and maintenance of positive relationships, the ability to cope with challenges, and overall health (Green et al., 2021). Evidence shows that social and emotional understanding declines in middle school; it is not uncommon for students to experience declines in self-efficacy, social awareness, self-regulation, and self-management (West et al., 2016; Green et al., 2021).

Theoretical Framework

This study was grounded in two theoretical paradigms: Lev Vygotsky (1962) Social Constructivism Learning Theory and John Bowlby (1958) Attachment Theory. The quantitative research study integrated these theories into the theoretical framework for this study. The study utilized two theories that allowed the researcher to better understand the complex nature of student-teacher relationships, academic achievement, and teaching styles.

Social Constructivism Learning Theory

One of the theoretical perspectives adopted in this study was Lev Vygotsky's social constructivism theory. Lev Vygotsky's social constructivist theory described as the idea that cognitive functions are products of social interactions (Vygotsky, 1962). He not only states that cognitive functions are produced by social interactions but highlighted the construction of knowledge is built through collaboration (Vygotsky, 1962). Vygotsky's theory also teaches that knowledge is not an individual experience but rather a shared experience with multiple parties through interaction, discussion, collaboration, and processes of learning (Vygotsky, 1962).

Referring to Figure 1 below; there are many different classroom practices that can help student understanding and learning. For instance, Figure 1 discusses reflection of student work, dialogue, web-based communities, peer to peer collaboration, discussing with the student what they want to construct, learning groups, and thought and language. These are not the only examples of social constructivism as classroom practices, this study delved into five different

types of teaching styles that have varying levels of social interaction between teacher, student, and peers.

Figure 1

Vygotsky's (1962) Social Constructivism. Students can learn more with the knowledge of others. (Educational Implications of Vygotsky's Theory of Social Constructivism by Dr. Vasundhara Padmanabhan YouTube presentation).

By design, Vygotsky's theory holds value for multiple variables of this study. Beginning with student-teacher relationships, his theory holds important elements of student-teacher interactions that are imitated, practiced, and internalized by the students (Green & Gredler, 2002). Throughout social constructivism, it is also believed that social and cultural influences impact students and the way that they learn (Kalina & Powell, 2009). By default, humans interact with their peers as well as adults, allowing them to gain knowledge and experience from the people around them. Specific to this study, participants were questioned about their relationships with their teachers and their real-life experiences through these social interactions.

The other component of Vygotsky's social constructivism theory that framed this study was the variable of teaching styles. This theory believes that ideas are created through interactions with others (Kalina & Powell, 2009). Vygotsky (1962) theory also discusses scaffolding to assist students in learning more effectively. Kalina and Powell (2009) discuss that "teachers should promote dialogue of the material so that students can critically think about what they are learning" (p. 5). This theory gives evidence that effective teaching styles include elements of social interaction, scaffolding, and discussion of learning material (Vygotsky, 1962).

Learning conditions and social interactions are primary contributors to student learning. This theory helps to emphasize the importance of what the learner brings to any learning situation as an active meaning-maker and problem-solver (Turuk, 2008). Thus, emphasizing, active learning teaching styles and peer interactions while learning is taking place. Student collaboration is a key component of social constructivism in addition to the teacher and adult collaboration. "Learners first succeed in a new task with the help of another person and then internalize this task so that they can perform it on their own" (Adam, 2017, p. 24). Therefore, when teaching styles are being studied and practiced, social constructivism is a theory that needs to be analyzed as collaboration, discussing their learning, and social interactions are all large contributors of student success.

Attachment Theory

In all relationships, there are two different factors at hand: the two perspectives of the people in the relationship, and the priority given to the relationship. This remains true in regard to student-teacher relationships, especially with adolescents (Riley, 2010):

> "There is no such thing as a single human being, pure and simple, unmixed with other human beings. Each personality is a world in himself, a company of many. That self… is a composite structure … formed out of countless never-ending influences and exchanges between ourselves and others. These other persons are in fact therefore part of ourselves… we are members of one another" (Bowlby, 1979, p. 137).

As stated above, when adolescents transition into middle school, and begin changes in development, they are able to have countless influences and exchanges with others. This allows others to have an impact on adolescents' personalities and development through these conversations, influences, and exchanges.

Bowlby's attachment theory (1979) discusses how social–emotional development can help identify markers predictive of later academic performance and social competence. With attachment theory comes three different types of attachment that are 1) secure, 2) anxious-ambivalent, and 3) anxious-avoidant (Kennedy & Kennedy, 2004). Poor attachment skills may result in disorganization, maximum distress in simple situations, and exaggerated emotional reactions. Bowlby (1962) discovered that the relevance of early positive attachment to a caregiver is not only critical for securing those relationships, but it is also important in emotional, social, and cognitive development. It is important for adolescents to have the understanding and ability to achieve optimum cognitive development. Additionally, Bowlby (1962) discusses that creating attachment and relationships outside the traditional parent-child relationships is crucial for future success. This is when the school setting plays a major role, as this is where children spend approximately one-third of their day and can foster attachment with school staff and teachers.

Attachment figures are important figures in adolescents' lives as they are going through many different physical and emotional changes. "For a person to know that an attachment figure is available and responsive gives him a strong and pervasive feeling of security, and so encourages him to value and continue the relationship" (Bowlby, 1979, p. 27). Therefore, a student-teacher relationship allows the student to feel secure and continue to want to add value into that relationship and into their academics (Bowlby, 1979). This feeling of security and attachment allows for continued success during and after the school day (Pianta & Steinberg, 1992).

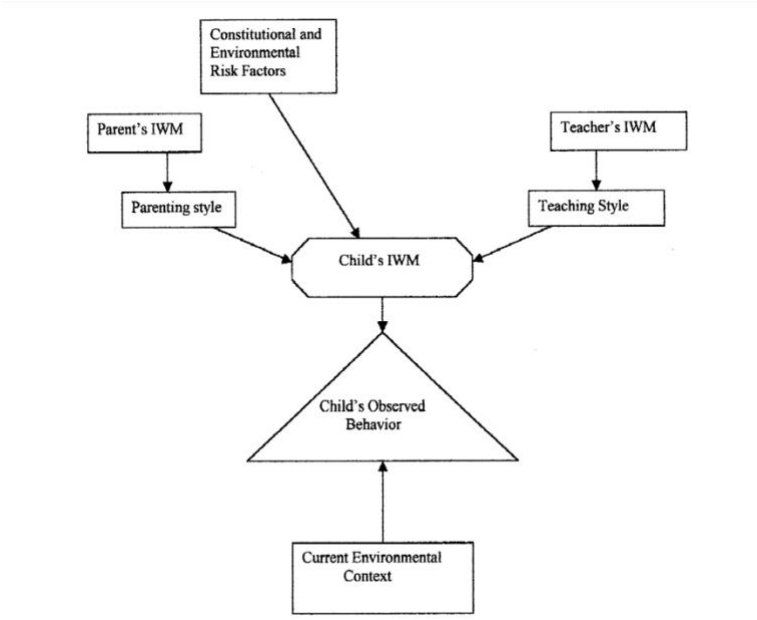
Displayed in Figure 2, Bowlby (1979) attachment theory not only finds connections between parents' internal working model (IWM) and their parenting style but also the connections between teacher's IWM and teaching style. There are also constitutional and environmental risk factors all of which impact the student's IWM, which translates into their observed behavior:

> "The quality of the teacher–student relationship may be the single most important factor for positive adaptation to school. Especially for at-risk students, teachers may be their only positive, supportive adult model and thus they have a unique opportunity to help students foster positive representations of themselves, others, and relationships" (Kennedy & Kennedy, 2004, p. 253).

Attachment theory helps to explain parental and family interactions, as well as student-teacher relationships as positive, and supportive relationship. All of these factors involved in the attachment and growth of students create different levels of their internal working model and their behaviors observed by others.

Figure 2

Bowlby (1988) Attachment Theory with Parent's and Teacher's Internal Working Model (IWM) and Styles



Research Questions and Hypotheses

Research Question

What is the association among the level of students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style, and students' Star mathematics scores?

Null Hypothesis

There is no association among the level of students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style, and students' Star mathematics scores.

Alternative Hypothesis

There is an association among the level of students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style, and students' Star mathematics scores.

Conclusion

This research topic was influenced by personal experience with middle school students and an increased understanding of the extent to which student-teacher relationships and teaching styles vary. The Midwestern school district tracked students' academic achievement on mathematics assessments such as Star Renaissance and the North Dakota State Assessment (NDSA). The reports displayed the students' mathematics learning level each school year during the fall, midwinter, winter, and spring, as well as the NDSA in the spring on all grade level standards. Teachers and students spend a great deal of time together and it is expected that teachers form and maintain relationships with students. Teaching styles also differ between individual teachers and content areas, it is not tracked, but rather observed by administrators the teaching styles of teachers during formal observations.

Chapter III: Methodology

This study utilized correlational research to examine the association among student-teacher relationships, teachers' teaching style, and students' academic achievement on the Star Renaissance Mathematics Assessment in a group of middle school students. The results from this study provided teachers and administrators with a better understanding of the possible influence student-teacher relationships and teaching styles can have on students' academic achievement in mathematics. The results from this study served as foundational information to design professional development opportunities for teachers. The knowledge generated by this study provided some guidelines for school district administrators and teachers who are entrusted with enhancing student mathematics academic achievement. This chapter provides a layout of the plan of action for the study.

Hypotheses and Research Questions

Research Question

What is the association among the level of students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style, and students' Star mathematics scores?

Null Hypothesis

There is no association among the level of students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style, and students' Star mathematics scores.

Alternative Hypothesis

There is an association among the level of students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style, and students' Star mathematics scores.

Research Design

This study utilized a correlational research design within the positivist paradigm. Correlational research designs, which are a type of descriptive research, are meant to investigate the possibility of relationships between two or more variables (Fraenkel et al., 2015). The positivist paradigm was chosen due to the study examining human behavior to better understand the true nature of student-teacher relationships and teaching styles. This study exemplified the positivism paradigm by including questionnaire research as the type of methodology (Crotty, 1998). As described by Crotty (1998) the ontology of the positivism paradigm indicated there is a single reality and truth that can be objectively measured. The researcher decided that the study fit into the positivist ontology as each student has one truth and reality feasible to be measured objectively by the instrumentation of this study, which will be a questionnaire. Because the epistemology of positivism explains that "reality can be measured and hence the focus is on reliable and valid tools to obtain that" (Crotty, 1998, p. 256), the questionnaire contained Likert style questions that will allow the students to have choices to self-assess their experience. The questionnaire and Star Renaissance Mathematics Assessment have both been indicated by their authors to be reliable and valid tools.

Threats to Internal Validity

Listed below are possible threats to the internal validity of a correlational study. Ideas to offset the potential impact of these threats have also been provided.

Subject Characteristics. One of the threats to internal validity was subject characteristics. Fraenkel et al. (2015) described this as "whenever two or more characteristics of individuals are correlated there exists the possibility that yet other characteristics can explain any relationships found" (p. 335). During the study, students received a questionnaire asking questions about demographic data, mathematics skills, student-teacher relationships, and their mathematics teachers' teaching style. The researcher was not able to control for all the potential variables that may have created differences across participants in this study, but the most common variables were accounted for as demographic questions in the instrumentation (e.g., gender, ethnicity).

Location. A second threat to internal validity is location. Fraenkel et al. (2015) defined a location threat as "whenever all instruments are administered to each subject at a specified location, but the location is different for different subjects" (p. 335). In regard to this study, all participants took both their questionnaire and their Star Renaissance Mathematics Assessment in the same building: the middle school where this study took place. Dependent on who their mathematics teacher was, they may have been on the second floor, or the first floor and they may or may not have had windows; but the school relied on one air conditioning unit and that was set at relatively the same temperature in every classroom. Therefore, very little should be different in terms of comfort, visibility, and temperature.

Instrument Decay. Another internal validity threat was instrument decay, and it has to do with the study instrumentation. Fraenkel et al. (2015) described instrument decay as participants experiencing boredom, feeling tired, or being inattentive due to the length of the instrument. When working with students of any age it is always a possibility that their performance may not have reflected their academic learning level. Their cognitive learning and

feelings may have had an unfortunate impact on their academic testing. The teacher and researcher were not able to control the students' effort and scores on the Star Renaissance Mathematics Assessment or any of the other instruments used for data collection in this study. In addition to the Star Renaissance Mathematics Assessment, participants must also take a questionnaire (Titled: Qualtrics questionnaire), which consisted of sixty-three questions. Two sections of the questionnaire consisted of 5-point Likert scale questions, which should not create major challenges for middle schoolers. Lastly, data collection would take place in two different days, therefore reducing the time required on each session potentially offsetting this threat.

Data Collector Bias. The fourth threat to internal validity was data collector bias. Data collector bias was determined to be "an unconscious bias on the part of the data gatherers whenever both instruments are given or scored by the same person" (Fraenkel et al., 2015, p. 337). While students were self-administering the Qualtrics questionnaire, the researcher was present with participants to provide clarification when needed. However, the researcher was not administering the Star Renaissance Mathematics Assessment. This internal threat to validity was further minimized by informing the participants that the survey was anonymous.

Testing. The last threat for internal validity was defined as the experience of responding to the first instrument may influence subject response (Fraenkel et al., 2015). For this threat, the researcher was there to explain and stress that the second component of the questionnaire is about their relationship with their teacher and not their interest for the subject of mathematics, as well as the third component being about their teachers' teaching style and not about their success at mathematics.

Threats to External Validity

The researcher chose to recruit the entire population of middle schoolers attending the school where this study took place.

Setting

The study included students who are a part of a Midwest state school district. This county is a large western county in a Midwest state with a population of approximately 14,700. This city has a population of approximately 7,900 and the tenth largest city in the state. This area is known for the oil field industry, trucking, and hot oil companies. Although the majority of the population is White (69.5%), there is also a strong minority of Hispanic families (20%). There are also many transient families. The main cause for the increase and decrease of transient families is due to the oil industry that surrounds this school district. Many transient families make this school district their primary residence from spring till early fall, and then they leave during the cold and the months that are slow during the oil field. The price of oil is a big obstacle for many of these families, especially when trying to make decisions for the school year.

This school district consists of five schools: two elementary schools, one middle school, one high school, and one alternative school. At this school district the average student-to-teacher ratio is fifteen to one, but at the middle school, the ratio is fourteen to one. There are thirty-six full-time teachers at the middle school. There are three full-time special education teachers; three full-time physical education teachers; six elective teachers that teach agriculture, art, technology, family and consumer science, choir, and band; and two teams of core teachers for each grade level (6 total) that teach science, mathematics, language arts, and social studies. When looking at the demographics of these thirty-six full-time teachers, eight of them are men and twenty-eight are women and all thirty-six are White.

The yearly mathematics performance of this school district on the North Dakota State Assessment (NDSA) is consistently below proficient at sixty-three percent. Therefore, the middle school incorporates two mathematics intervention programs per grade level. Furthermore,

each grade level participates in three class periods per week of additional mathematics intervention time to practice basic mathematics facts including but not limited to addition, subtraction, multiplication, and division of whole numbers, fractions, decimals, and integers.

Participants

The participants in this associational study were 6th, 7th, and 8th grade students attending this Midwestern middle school. In this district, there are approximately 2,000 students, and of those students, 413 are enrolled at the middle school. During the 2019-2022 school year, all students received free lunches in response to COVID-19.

When looking at the demographics of the middle school, there are 148 6^{th} grade students, 145 7^{th} grade students, and 120 8^{th} grade students. Out of those 413 students, forty-three percent are girls, and fifty-seven percent are boys. When looking at the student diversity of the middle school, 70% identified as White, and 30% identified as Minority, including 19.1% Hispanic or Latino, 3.4% American Indian or Alaska Native, 2.4% two or more races, 2.2% Black or African American, 1.7% Asian or Asian/Pacific Islander, and 1.2% Native Hawaiian or Other Pacific Islander. Although all students received free lunches due to COVID-19, it was stated that thirty-three percent of students at the middle school are considered economically disadvantaged.

Sampling Procedures

The study used a cross-sectional survey utilizing a census method. A cross-sectional survey was described as information collected from a predetermined population at a specific point in time or within a short period of time (Fraenkel et al., 2015). The predetermined population for this study was middle school students enrolled in mathematics classes at a public school in a midwestern state. According to Fraenkel et al. (2015) a cross-sectional census takes place “when an entire population is surveyed (p. 358). The researcher conducted a census survey

by reaching out to all the middle school students in 6th, 7th, and 8th grade. While teachers were not included in the study, it was during their classes that data was collected. There are two mathematics teachers per grade level, making a total of 6 mathematics teachers and their respective groups of students. There is a master list of students enrolled in 6th, 7th, and 8th grade that will be used to keep records of who received information forms, consent forms, and turned in signed consent forms.

Instrumentation

Through this study, there were two different instruments used: 1) Qualtrics questionnaire, and 2) Star Renaissance Mathematics Assessment. The Qualtrics questionnaire included three different sections: 1) Demographic data, 2) Student Version of the Student-Teacher Relationship Inventory (Ang et al., 2020), and 3) The Teaching Styles Inventory (Grasha, 1996) (See Appendix A). The questionnaire (See Appendix A) for this research project consisted of sixty-three questions. It sought to find information about the students' demographics, interest in mathematics, students' perceptions of their student-teacher relationships and their teachers' teaching styles. The Star Renaissance Mathematics Assessment collected data on mathematics performance.

Student Version of the Student-Teacher Relationship Inventory (S-TSRI), (Ang et al. 2020).

The student-teacher relationship questions were used from R.P. Ang et al. (2020) inventory survey titled, Student Version of the Student-Teacher Relationship Inventory (S-TSRI) from the article titled Student Version of the Student-Teacher Relationship Inventory (S-TSRI): Development, Validation, and Invariance. The researcher was able to receive permission to use this survey including information about scoring and validity and reliability data (R.P. Ang, personal communication, February 13, 2022). The questionnaire has fourteen questions that focus on student-teacher relationships, located in the second section of the questionnaire. It

consisted of 3 categories: instrumental help (items 2, 6, 9, 10, 12), satisfaction (items 1, 3, 5, 13, 14), and conflict (items 4, 7, 8, 11). The category score for these questions was calculated by summing up all the items related to that particular category. A higher score in each category indicated a higher level of satisfaction, instrumental help, and conflict with that teacher, which distinguished a component of their relationship. This section of the questionnaire was on a 5-point Likert scale including the following answer choices: 1) almost never true, 2) seldom true, 3) sometimes true, 4) often true, and 5) almost always true. The domains of the S-TSRI questionnaire were found to have the following values in a Cronbach alpha test: Satisfaction at .90, Instrumental help at .86, and Conflict at .85.

The Teaching Styles Inventory (Grasha, 1994).

The teaching style questions were adapted from *The Teaching Style Inventory* developed by Anthony Grasha in 1996. The researcher found this inventory questionnaire when researching teaching styles, it was found in Anthony Grasha's 1996 publication *A Matter of Style.* The questionnaire has forty questions that focus on teachers' teaching styles, located in the third and final section of The Qualtrics questionnaire.

When scoring the teaching styles section of the inventory, five teaching styles could be identified: expert, authority, personal model, facilitator, and delegator. An expert teacher is defined as a teacher who gives importance to transmitting knowledge, and determines the content, materials, and timing. An authority teacher is found to be not flexible, and have classroom routines are critical, students are not provided with the opportunity to be creative. Personal model teaching encourages students to observe the teacher, teach by example, and work together. The facilitator allows student to take responsibility and create cooperative learning experiences. Lastly, the delegator creates a student-based teaching environment, and contributes to student perception of themselves as independent learners. Within those five teaching styles,

there are eight items: expert (items 1, 6, 11, 16, 21, 26, 31, 36), authority (items 2, 7, 12, 17, 22, 27, 32, 37), personal model (items 3, 8, 13, 18, 23, 28, 33, 38), facilitator (items 4, 9, 14, 19, 24, 29, 34, 39), and delegator (items 5, 10, 15, 20, 25, 30, 35, 40).

The teaching style scores for these questions were calculated by summing up all the items related to that particular category. A higher score in each category indicates a higher perception of expert teaching, authority teaching, personal model teaching, facilitator teaching, and delegator teaching. This section of the questionnaire used a 5-point Likert scale including the following answer choices: 1) strongly disagree, 2) disagree, 3) undecided, 4) agree, and 5) strongly agree. The overall teaching styles inventory survey reported a Cronbach alpha value at 0.9098. Each of the teaching styles was given a Cronbach Alpha value: expert (0.75), authority (0.76), personal model (0.83), facilitator (0.87), and delegator (0.77). However, due to the adaptation, the recalculation of the reliability values was completed.

The third section of The Qualtrics questionnaire was adapted from the original *The Teaching Style Inventory*. The modifications were due a change in intended participants, the intended participants of the survey were teachers while the participants of this study were middle school students. The modifications that were made included the addition of the statement “in this class” at the beginning of every item. Additionally, the reading level needed to be modified due to the lower reading and comprehension level of middle school students in comparison to teachers. The language was modified by searching for synonyms of the difficult words and selecting a word more appropriate for middle school students for example, item 1 had the following wording *facts, concepts, and principles are the most important things that students should acquire* and was adapted to *in this class, my teacher feels facts, views, and mathematics rules are the most important things to learn.* The final version was reviewed by a group of seven

middle school teachers to confirm the reading level was appropriate for the participants of this study. Minor recommendations for word choice were given, and the researcher adapted based off recommendations.

Questionnaire: Demographics

The demographic questions included questions that were found in the literature to have an impact on students' ability to relate to teachers, learn, and perform in mathematics. The researcher asked six demographic questions at the beginning of the questionnaire. These questions included 1) to which gender do you identify, 2) indicate your grade level, 3) how old are you, 4) how would you describe your race/ethnicity, 5) how would you describe your family, 6) do you receive any academic services. Although all these questions were created based off the literature, the researcher hoped to decrease the possible effect of intervening variables frequently described as impacting the experience of middle school students.

The questionnaire merged all three sections into one a single sixty-three question Qualtrics questionnaire. The Star Renaissance Mathematics Assessment was administered at a separate time in coordination with the Fall benchmark testing window.

Star Renaissance Mathematics Assessment

This study used the Star Renaissance Mathematics Assessment as a second instrument, utilizing the fall benchmark test scores. The benchmark tests consisted of approximately thirty-four questions. Star Renaissance Mathematics Assessment uses item response theory (IRT) for computer-based adaptive item selection, test scoring, and finds the probability of a student answering correctly by putting both student performance and item difficulty on the same scale (Renaissance, 2020). Schools may administer the Star Renaissance Mathematics Assessment to students during the "benchmark" screening, which occurs in the fall, winter, midwinter, and spring. These scores are useful when comparing performances over testing dates and grades. The

Star Mathematics scaled scores can range from 0-1400. There are specific benchmarks and cut scores students should reach based on moderate growth rate. This allows Renaissance to create a trend line and predict their proficiency on the state assessment. It also allows for teachers and school personnel to implement an intervention plan as needed. The Star Renaissance researchers indicate that Star Renaissance Mathematics is an accurate, valid, and reliable assessment. In a 2002 to 2004 study completed at the Regional Educational Laboratory at Pennsylvania State University, found the Star mathematics assessment has internal consistency correlation coefficient scores of .77 to .80. Similarly, in 2008 to 2012, The National Center of Response to Intervention and Regional Educational Laboratory at Pennsylvania State University found the reliability coefficient scores to be between .70 to .80. A study completed in 2004 by the American Institute for Research found the accuracy, validity and reliability data coefficients ranging from .79 to .834.

Data Collection

Data for this study was collected in two phases which occurred simultaneously. Data from approximately four hundred participants was collected using Qualtrics. While phase I was happening, participants were also taking their Fall Star Renaissance Mathematics Assessment. The students received the questionnaire via a direct link displayed to them through their mathematics teacher's Google Classroom. The researcher was meeting with students during a period of six days, one day in each mathematics teacher's classroom and an additional day to allow absent students to be a part of the study. The Star Renaissance Mathematics Assessment was administered by the students' mathematics teacher in their regularly scheduled Fall benchmark timeline. It is critical for the school district to have all students take this benchmark test so within a week of the original testing date, they have all absent students make up the test.

The Director of Curriculum and Learning gave the researcher full access to the Star Renaissance Mathematics Assessment data.

Data Analysis

The data was analyzed using Statistical Package for Social Sciences (SPSS). The Qualtrics questionnaire data were analyzed using SPSS where the ratio data was summarized using measures of central tendency (i.e., mean, median, and mode), and measures of dispersion (i.e., standard deviation). Categorical data was analyzed using SPSS and summarized using frequencies and percentages. Finally, testing the study's null hypothesis was done by using Pearson Product Moment Correlation. When using Pearson's Correlation test, there are four parametric assumptions that must be explored to fit the data. These assumptions are: 1) the variables should be measured at an interval or ratio level, meaning they are continuous; 2) there is a linear relationship between the variables being studied; 3) there are no significant outliers; and 4) the variables should be normally distributed.

Table 1

Research Question Alignment

Research Question (RQ)	Variables	Design	Instrument	Validity & Reliability	Technique	Source
What is the association among the level of students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style, and students' Star Mathematics score	Demographics (Intervening)	Correlational	Qualtrics questionnaire	N/A	Questionnaire	Students
	Student-teacher relationships			R: Satisfaction .90, Instrumental Help .86 Conflict .85 V:		
	Teaching styles			R: Expert .75 Authority .76 Personal Model .83 Facilitator .87 Delegator .77 V:		
	Mathematics Achievement		Star Renaissance Mathematics Assessment	R: .7 to .8 V: .79 - .834	Star Renaissance Mathematics Assessment	

Procedure

The informed consent form was sent home with all middle school students at the beginning of the academic school year. The students were required to bring back the signed informed consent form to participate in the study. The deadline to return the form was September 16, 2022. The students received two reminders to return their informed consent form signed by their parent or guardian, the first two weeks from the due date (September 2), and a second reminder one week from the due date (September 9). The researcher administered the questionnaire throughout all grade levels and mathematics classes. Therefore, the researcher read the method of assent (Appendix D) to all students before the study began. The first question after the method of assent, the students each inputted their four-digit lunch number as their code. This corresponded with the code that appeared on the spreadsheet used to transfer the mathematics scores so that the researcher could transfer them to SPSS. The researcher utilized six days of classes, one for each teacher, at the end of September 2022 to complete data collection, in addition to one final day to gather any students that were absent during the initial day. The researcher collected and transferred Star Renaissance Mathematics scaled scores into a spreadsheet once the testing window had closed for the Fall test. The researcher utilized the students' four-digit lunch code on the spreadsheet for their Qualtrics data to be inputted into SPSS, as well as their Star Renaissance Mathematics scaled score. Data analysis was completed by the researcher using SPSS once all the data was collected in approximately October.

Ethical Considerations

It is crucial that the survey remained anonymous. All respondents asked to participate were students whose parents signed an informed consent form. An informed consent and information form about the survey was sent to potential participants to bring home to their

parents for questions and information. The students were read a method of assent before the questionnaire was distributed.

> "Your parents have given permission for you to participate in a research project I am doing, but you can still decide whether you would like to participate or not. If you do not wish to participate, there will be no consequences with your grade, our relationship, or in regard to your school day. This is completely voluntary. The only impact this study will have is to help me better understand how student-teacher relationships and teachers' teaching styles can help you learn. Here's exactly what will happen. You will come to mathematics class I will have you take a survey. You will also take your STAR Mathematics benchmark test as normal. I want to find out some better ways to help students learn and do better. Are there any questions?"

Once the method of assent was read, students must have responded to the confirmation question, that they were comfortable with participating in this study.

Conclusion

This study sought to determine if there was an association between student-teacher relationships, teachers' teaching styles, and students' academic achievement on the Star Renaissance Mathematics Assessment. Research questions revolved around student perception of their relationships with their mathematics teacher, and their perception of their mathematics teachers' teaching style. Chapter 4 will contain the findings and results from the research study and the research question.

CHAPTER IV: Research Results

Mathematics is a highly tested content area and a critical indicator of students' later academic success (Reddy, 2005). Overall, in the state of North Dakota there has been a consistent decline in mathematical achievement in middle school students (Cognia, 2020). In the Spring of 2019, 34% of 6-8 students tested at the *proficient* level in mathematics in comparison to the Spring of 2021, when proficient students dropped to 29%, which showed an overall 5% decrease (ND Department of Public Instruction, 2021). Contrary to this trend, in the Spring of 2019, 24% of 6-8 students tested at the *novice* level and two years after, in the Spring of 2021, this percentage increased by 4 points to 28% (ND Department of Public Instruction, 2021). These results are indicating a down-trend in *proficient* level, but an up-trend in *novice* level. For this transition to have occurred, it would mean that students were unable to learn the required material for that given grade level and not able to perform required mathematical standards. Throughout many classrooms, schools, and districts, school officials and teachers are trying to find the most effective way to help students reach academic performance expectations across the year and thus impact their learning. In the middle school years, multiple types of student-teacher relationships are formed (e.g., instrumental help, satisfaction, and conflict). Likewise, when considering mathematics teaching styles, teachers will gravitate around some of the most commonly identified styles (e.g., expert, authority, personal model, facilitator, and delegator). According to the literature (e.g., Bender, 2012; Hattie, 2009; Levy, 2008; Oz & Dolapcioglu, 2019; Weghlage, 1990), specific types of student-teacher relationships and mathematics teaching styles impact students' academic achievement. Because of the down-trend observed in the most current mathematics performance data for middle school students at the school where the researcher works, the present study focused on exploring the potential association between

student-teacher relationships, mathematics teaching styles, and middle school students' Star mathematics scores.

The results are presented in this chapter and are organized to address the research question used to guide the inquiry of this study. The study also gathered data on demographic variables such as gender, grade, race and ethnicity, family structure, and extra academics. These demographic variables were identified as important components throughout the literature, in addition to the researcher's professional interest, given that she is a middle school mathematics teacher. For this study, students' perception of their student-teacher relationship, and students' perception of their mathematics teachers' teaching style were the predictor variables. The students' Star mathematics performance was the outcome variable.

Research Question

The following section provides an analysis of the data and the results. Below, are the research question, the null and alternative hypotheses.

Research Question

What is the association among the level of students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style and students' Star mathematics scores?

Null Hypothesis

There is no association among the level of students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style and students' Star mathematics scores.

Alternative Hypothesis

There is an association among the level of students' perceived student-teacher relationship, students- perceived teachers' mathematics teaching style and students' Star mathematics scores.

Instrument

The Qualtrics questionnaire that was used had three components: 1) the demographic component (6 questions), 2) The Student Version of the Student-Teacher Relationship Inventory (Ang et al., 2020), and 3) The Teaching Styles Inventory (Grasha, 1994). For the student-teacher relationship, the second component of the questionnaire, there were three relationship types that were generated. While for mathematics teachers' teaching style, the third component of the questionnaire, there were five styles that were generated. Each of the three student-teacher relationship types, and the five teaching styles were given points based off the Likert-style items found in Table 1 below. Table 2 shows the types of student-teacher relationships and teaching styles as well as the corresponding item.

The data analysis process for the questionnaire items was 1) downloading the data from Qualtrics and uploading the data into SPSS, 2) formatting the SPSS database (e.g., defining values), 3) Creating composite scores for: a) each teaching style and b) student-teacher relationship style.

Table 2

Student-Teacher Relationship Types, and Mathematics Teacher Teaching Styles and Corresponding Item Numbers

Variable	Items	Maximum Score	Reliability Level
S-TSRI			
Instrumental Help	Items 2, 6, 9, 10, 12	25	.86
Satisfaction	Items 1, 3, 5, 13, 14	25	.90
Conflict	Items 4, 7, 8, 11	20	.85
Mathematics Teacher Teaching Style			
Expert	Items 1, 6, 11, 16, 21, 26, 31, 36	40	.75
Authority	Items 2, 7, 12, 17, 22, 27, 32, 37	40	.76
Personal Model	Items 3, 8, 13, 18, 23, 28, 33, 38	40	.83
Facilitator	Items 4, 9, 14, 19, 24, 29, 34, 39	40	.87
Delegator	Items 5, 10, 15, 20, 25, 30, 35, 40	40	.77

Additionally, four ratio scales (i.e., 0 - 10) were formulated to gather data on students' 1) feelings about mathematics, 2) confidence in mathematics, 3) appraisal of the relationship with their mathematics teacher, and 4) appraisal of their teacher's mathematics teaching style. The questionnaire can be found in Appendix A.

Lastly, the researcher utilized the results from the Fall benchmark of the Star mathematics test. Below in Table 3, are the scale scores from Star Renaissance that correspond with the specific percentile rank. The students' scale scores were collected from the school's Star Renaissance website and inputted into the SPSS database alongside the data from the Qualtrics questionnaire.

Table 3

Percentile Rank and Fall Scaled Scores for Star Mathematics Scores Based off Grade Levels

Grade Level	Percentile	Scaled Score
6th Grade		
	10th	968
	20th	1001
	25th	1012
	40th	1039
	50th	1055
	75th	1095
	90th	1122
7th Grade		
	10th	986
	20th	1020
	25th	1032
	40th	1062
	50th	1080
	75th	1120
	90th	1149
8th Grade		
	10th	997
	20th	1035
	25th	1049
	40th	1082
	50th	1099
	75th	1143
	90th	1176

*Note: The following scale score is used from the Fall benchmark, it serves as a proficiency benchmark to meet end-of year performance goals. A Percentile Rank of 40 or higher will likely meet end-of-year performance goals as defined by the state standards (Renaissance Learning, 2020).

Pilot Procedure

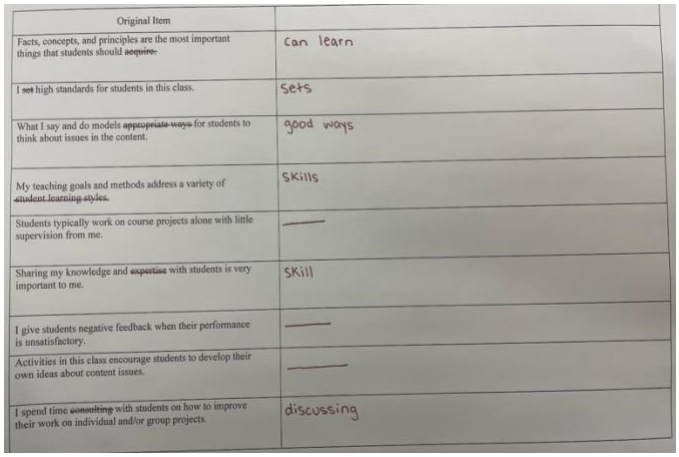
The questionnaire underwent one pilot testing phase, with two groups. The first group of the pilot phase was six teachers from the Midwestern middle school where this study took place. These teachers were given a paper copy of the Qualtrics questionnaire on a Monday and asked to return it with any feedback or corrections in two weeks' time. They were asked to read through

the questions and underline any words they felt middle school students might struggle reading and comprehending. They were then advised to write words that would be better fit for middle school vocabulary levels to replace the underlined words. The teachers were given the instructions after school as a group. The selection criteria included having worked in the district for more than five years and have a background in middle school education. Six teachers met the criteria. The researcher chose two that had mathematics backgrounds, two that had English backgrounds, and the last two had done their master's degrees in middle school education and therefore, were knowledgeable about middle school students and the reading level used.

The recommendations obtained from teachers included: 1) adding the bolded words "think of your mathematics teacher," 2) add what the numerical numbers meant for the sliding scales question (i.e., 0 meaning no relationship, 10 meaning one of the best relationships with a teacher), and 3) all statements in the teaching styles portion should begin with the statement "in the class" to create a uniform set of questions. Lastly, throughout the teaching styles portion there were words removed from the questionnaire and replaced with synonyms better suited for the reading level of middle school students (e.g., expertise and knowledge, initiative and lead, principles and rules). Refer to Appendix E to find the original questions and the recommendations provided by the pilot teachers. An example of Teacher 6's recommendations are provided below in Figure 3.

Figure 3

Teacher 6's Recommendations for Changes for Teaching Style Questionnaire.



Original Item	
Facts, concepts, and principles are the most important things that students should ~~acquire.~~	can learn
I ~~set~~ high standards for students in this class.	sets
What I say and do models ~~appropriate ways~~ for students to think about issues in the content.	good ways
My teaching goals and methods address a variety of ~~student learning styles.~~	skills
Students typically work on course projects alone with little supervision from me.	——
Sharing my knowledge and ~~expertise~~ with students is very important to me.	skill
I give students negative feedback when their performance is unsatisfactory.	——
Activities in this class encourage students to develop their own ideas about content issues.	——
I spend time ~~consulting~~ with students on how to improve their work on individual and/or group projects.	discussing

The second group participating on the pilot testing phase was composed of sixteen 6th grade students. Their advanced mathematics teacher received the link to the questionnaire and provided students with access. The academic achievement level of this class was at a 7th grade level for mathematics, and a 6th grade level for reading.

The researcher videoed in on the smart board and explained that "the students should review the questions and write down any comments on the word choice, structure of the questions, and the understanding of the question." The researcher and classroom teacher began by giving the students ten minutes to review the questions, after five minutes they asked students if there were any questions or concerns. During this questioning, the researcher realized that students had not assessed the questions but responded to them as if they were participants in the study.

The researcher then stopped the students from completing more of the pilot questionnaire and explicitly directed them to read each of the fourteen questions in The Student Version of the Student-Teacher Relationship Inventory, and write any comments on the length, clarity, format of the questions for discussion. After ten minutes of silent work time to read through each

question, the researcher went through each of the fourteen questions and asked if there were any comments to be made on the length, clarity, or format of the question. The only comment that was made by one student, agreed by a second student was, "*make sure the kids read the bullet point instructions, so they know it's ONLY about their mathematics teacher and not all their teachers*." As this was already in the direction, the research chose to bold the words *your mathematics teacher*, therefore the instructions read as follows: "**Think of your Mathematics Teacher"** when you answer the following statements in this section." Once the researcher had read through and asked about all the student-teacher relationships questioned, they transitioned to the mathematics teachers' teaching style questions. The researcher again explicitly instructed the students to read each of the forty questions and write any comments on the length, clarity, and format of the questions, they were given twenty minutes to do so. After the twenty minutes were over, the researcher followed the same format for reviewing the students' feedback. The first comment that was made was "*there are so many of these questions*," which ten other students agreed upon. A second comment was, *"And these questions were so much longer too!"* This statement was also agreed upon by five of those same students and three additional ones. The researcher proceeded to read through each individual question and asked for any comments. There were no comments on any issues related to misunderstanding, length, clarity, or format of questions. The last statement that was made was, "*I understand the question more when you read it out loud,"* twelve out of the fifteen students agreed with him.

Due to the three comments made about the number of questions, length of questions, and questions being easier to understand than when someone else read them out loud, the researcher began to investigate the possibility of having the questionnaire read aloud to the prospective participants. The researcher read the work by Gresch et al. (2016), showing that many students at

the middle school and elementary level are struggling readers. Because of this, when students were handed a questionnaire, they may not understand the questions, and the quality of the data collected was not as good as when the questions were read aloud to them. Given the fact that 49% of the students at the participating school in grades 6-8 are testing below grade level in reading, with 16% approximately reading one grade level behind, and 22% approximately reading two grade levels behind, and 11% performing at an even lower level (Renaissance, 2020), the researcher decided to modify the questionnaire administration: From self-administered to read-aloud by the researcher. This was done in hopes that it would encourage students to complete the whole questionnaire, not just click through and leave unanswered questions, but instead responding with honesty that would reflect their accurate mathematics learning experience at their school.

Participants

This study was conducted at a middle school in a Midwestern school district, which according to the school district website enrolled 453 students in the 2022-2023 school year. The school district consists of two elementary schools, one middle school, one high school, and one alternative high school. Participants were recruited from the middle school population. Consent forms were handed out to the middle school students, who were given three reminders in two-week increments to return the form. This resulted in 99 participants returning their signed consent forms, representing a 22% return rate.

When looking at the data from the 99 participants, there were three participants who did not respond to any of the questions, and they were deleted from the sample. Furthermore, case 4 was removed from the study as they did not accept the statement of assent, this participant did identify as a boy in 6th grade. In addition, case 58 was also removed for not accepting the

statement of assent, this participant was a girl in 7th grade. Once removing these five participants, the data contained 94 participants. Participant demographic details are summarized in Table 4. In Table 4, it is described that the majority of the participants that took this questionnaire were White (64.9%), followed by Hispanic (22%).

Table 4

Demographic Variables

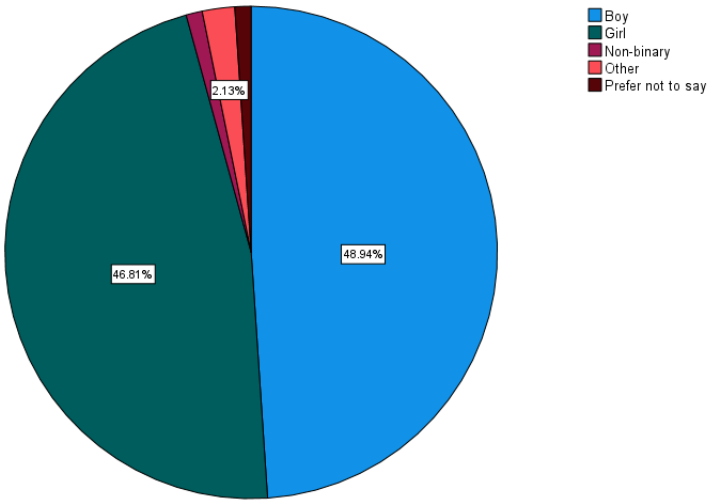
Variable	Frequency	Percentage
Gender Orientation		
Boy	46	48.9%
Girl	44	46.8%
Non-binary	1	1.1%
Other	2	2.1%
Prefer not to say	1	1.1%
Grade		
6th	29	30.9%
7th	33	35.1%
8th	30	31.9%
Missing	2	2.1%
Race/Ethnicity		
American Indian/Alaska Native	1	1.1%
Asian	2	2.1%
Black or African American	2	2.1%
Hispanic or Latino/a	21	22.3%
Native Hawaiian/Pacific Islander	1	1.1%
Other	6	6.4%
White	61	64.9%
Extra Academics		
504 Plan	4	4.3%
ELL	8	8.5%
Special Education	6	6.4%
Other	15	16.0%
Family Structure		
1 parent	4	4.3%
2 parents/Don’t live together	9	9.6%
2 parents/Live together	76	80.9%
Other	5	5.3%

	Mean	Standard Deviation
Age	12.24 (Max= 14, Min= 11)	1.00

As shown in Figure 4, of the 94 participants, 46 identified as a boy, (48.9%), 44 identified as a girl (46.8%), 1 identified as non-binary (1.1%), 2 identified as other (2.1%), and 1 responded as prefer not to say (1.1%). For the gender demographic question, participants were able to respond by typing an explanation in addition to selecting *other*, one of the two participants declined to respond, while the other typed "a boy and a girl."

Figure 4

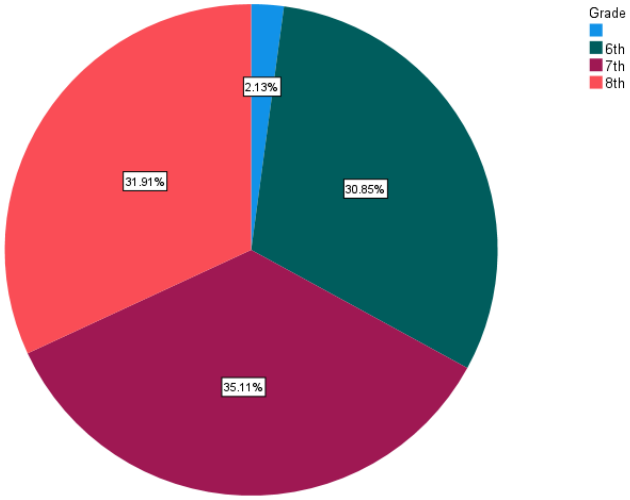
Participants Gender Orientation



Across the 94 participants, 29 were in 6th grade (30.9%), 33 were in 7th grade (35.1%), (31.9%), 30 were in 8th grade (31.9%), and 2 did not answer this question (2.1%). This is shown in Figure 5 below. The minimum age noted was 11 years old, the maximum age noted was 14 years old, and the mean age was 12.24 years.

Figure 5

Participants Grade Level

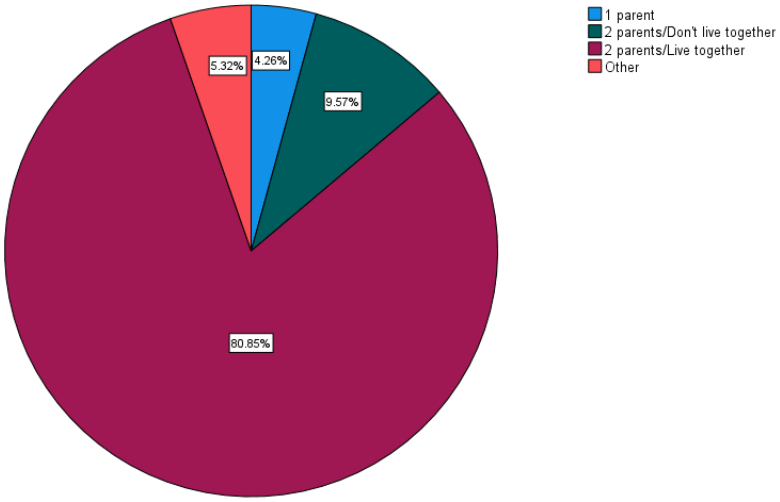


The last demographic question asked students about their family structure. As seen in Figure 6, 4.3% identified as having 1 parent, 9.6% identified as having 2 parents that do not live together, 80.9% identified as having 2 parents that do live together, and 5.3% identified as other. This question allowed a text response when selecting *other*, the five responses given were; *4 parents, 2 live together and 2 don't, stepmom lives with real dad, stepdad lives with real mom, 2 parents, 10 siblings, 1 parent 2 brothers,* and *3 parents one does not live together*.

Demographic data were disaggregated using grade level. In the spread of participants throughout the grade levels, it was found that two participants did not answer what grade they were in, hence they were excluded from the analysis. In all three levels, the largest race and ethnicity group was White, the second largest group was Hispanic or Latino/a and then *Other*. Lastly, in family structure for all three grade levels the largest category was 2 parents that live together, the next category was 2 parents that don’t live together, and the smallest category for all grade levels was 1 parent.

Figure 6

Participants Family Structure



Research Question

The following section provides an analysis of the data that will address the studies research question.

***Research Question*- What is the association among the level of students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style and students' Star mathematics scores?**

To investigate the relationship among students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style and students' Star mathematics scores, the researcher examined data obtained from The Student Version of the Student-Teacher Relationship Inventory, The Teaching Styles Inventory, and students' Fall Star mathematics scores from Star Renaissance.

Table 5

Predictor and Outcome Variables Descriptive Statistics

Variable	Mean	Median	Standard Deviation	Reliability Level of Test
Star Mathematics Score	1052.35	1058.00	61.33	.7 to .8
Student-teacher relationship				
Instrumental Help	12.80	13.00	4.27	.86
Satisfaction	20.56	21.00	3.68	.90
Conflict	6.83	6.00	2.95	.85
Mathematics teacher teaching style				
Expert	28.39	28.00	3.47	.75
Authority	26.61	26.00	3.22	.76
Personal Model	29.01	30.00	4.74	.83
Facilitator	29.01	29.00	4.39	.87
Delegator	26.28	26.00	3.72	.77

Note: Maximum score for Star Mathematics Score is 1400. Maximum scores for Instrumental Help and Satisfaction are 25, Conflict is 20. Maximum scores for Expert, Authority, Personal Model, Facilitator, Delegator are 40.

Star Mathematics Scores

When investigating students' Star mathematics scores, it was noted that the highest mean score came from 7th grade. While the 6th grade mean score was significantly lower than 7th and 8th grade. The overall students' mean score was 1052.35, therefore 7th and 8th grade students mean scores were closer to that of the overall mean score. This is summarized in Table 6 below.

Table 6

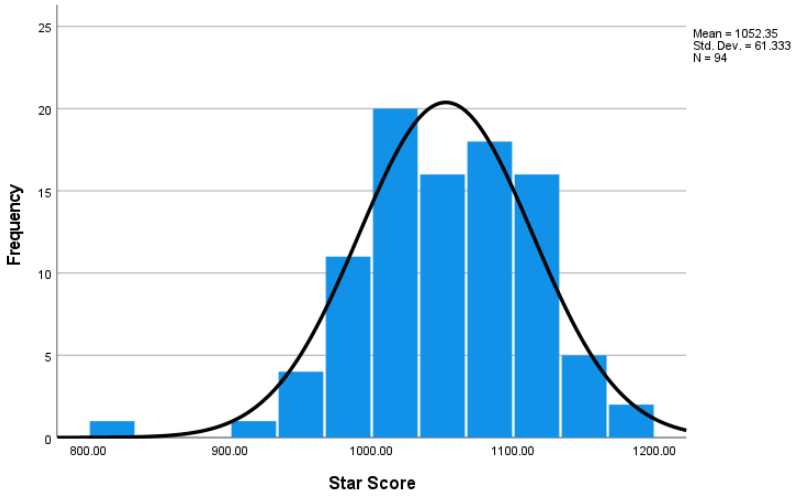
Star Mathematics Scores Score Distributions Disaggregated by Grade Level

Grade Level		Minimum	Maximum	Mean	Percentile Rank	Standard Deviation
Overall	*n*= 94	833.00	1189.00	1052.35	--	61.33
6th Grade	*n*= 29	833.00	1140.00	1023.69	30th	66.02
7th Grade	*n*= 33	967.00	1140.00	1066.12	40th	48.25
8th Grade	*n*= 30	937.00	1189.00	1064.43	30th - 35th	63.85

Figure 7 showed the Star mathematics score distribution for the entire sample. The histogram showed a slight negatively skewed distribution. This skewness showed that most students obtained higher scores than the mean. For the 94 participants who completed the questionnaire, all 94 had completed the Star Renaissance mathematics test. The highest possible score on the Star mathematics test is a 1400 across all grade levels. The minimum score from the sample was 833, the maximum score was 1189. For reference in the histogram below, in the 6th grade, the scale score for the 50th percentile rank is 1055, in 7th grade it is 1080, and in 8th it is 1099.

Figure 7

Students Star Mathematics Score Distribution



Student-Teacher Relationship Types Scores

Through *The Student-Teacher Relationship Inventory* (Ang et al., 2020), there were fourteen questions in which five question were about *instrumental help*, five were about *satisfaction*, and four were about *conflict*, as shown in Table 2 (see page 65). The questions explore the nature about each student-teacher relationship; therefore, this required the generation of three scores, one for each student-teacher relationship type (i.e., *instrumental help*,

satisfaction, and *conflict*). As it can be deduced, a total student-teacher relationship could not be generated as the questions were formulated by specific relationship types. For this reason, each student had a separate score for each student-teacher relationship type.

Table 7 compared the mean scores of the student-teacher relationship types for each grade level as well as for the total sample. Across the grade levels, it was found that all had approximately the same *instrumental help* mean score.

Table 7

Student-Teacher Relationship Types Score Distributions Disaggregated by Grade Level

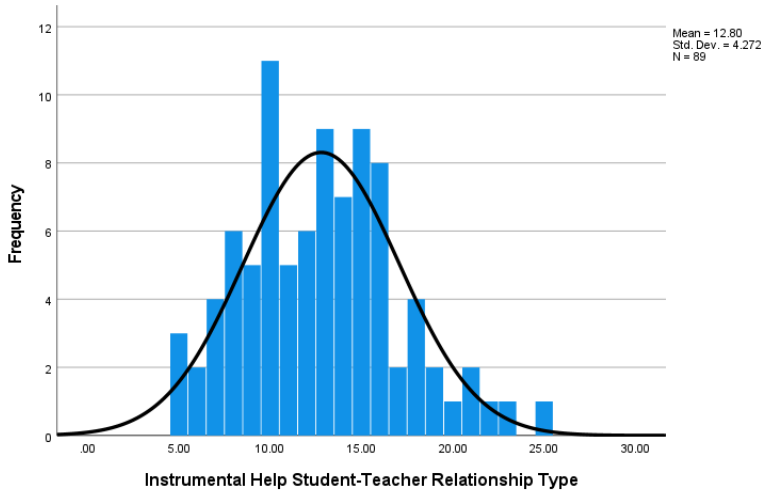
Grade Level		Mean	Standard Deviation
Overall			
Instrumental Help	$n = 89$	12.80	4.27
Satisfaction	$n = 89$	20.56	3.68
Conflict	$n = 94$	6.83	2.95
6th Grade			
Instrumental Help	$n = 29$	13.00	3.62
Satisfaction	$n = 29$	21.38	3.65
Conflict	$n = 29$	6.55	3.12
7th Grade			
Instrumental Help	$n = 32$	13.13	4.77
Satisfaction	$n = 30$	19.27	4.35
Conflict	$n = 33$	7.64	3.14
8th Grade			
Instrumental Help	$n = 26$	12.00	4.48
Satisfaction	$n = 28$	21.07	2.62
Conflict	$n = 30$	6.27	2.51

Shown in Figure 8 is the score distribution for the student-teacher relationship type *instrumental help*. Student-teacher relationship type *instrumental help* ($n = 89$) had a mean score of 12.80 ($Mdn = 13.00$, $SD = 4.27$). The slight positive skewness of this histogram suggested that students would not classify the relationship with their teachers as the *instrumental help* type.

Student-teacher relationship type *instrumental help* is defined as an instructional help, transmitting knowledge, providing advice, and instruction (Ang et al., 2020).

Figure 8

Student-Teacher Relationship Instrumental Help Type Score Distribution



Shown in Figure 9 is the score distribution for the student-teacher relationship type *satisfaction*. Student-teacher relationship type *satisfaction* (n = 89) had a mean score of 20.56 (*Mdn* = 21.00, *SD* = 3.68). The negative skewness of this histogram suggested that students would classify the relationship with their teachers as the *satisfaction* type. Student-teacher relationship type *satisfaction* is defined as positive, characterized by warmth, support, and affection (Ang et al., 2020).

Shown in Figure 10 is the score distribution for the student-teacher relationship type *conflict.* Student-teacher relationship type *conflict* (n = 94) had a mean score of 6.83 (*Mdn* = 6.00, *SD* = 2.95). The positive skewness of this histogram suggested that students would not classify the relationship with their teachers as the *conflict* type. Student-teacher relationship type *conflict* is defined as negative, unpleasant, and conflictual (Ang et al., 2020).

Figure 9

Student-Teacher Relationship Satisfaction Type Score Distribution

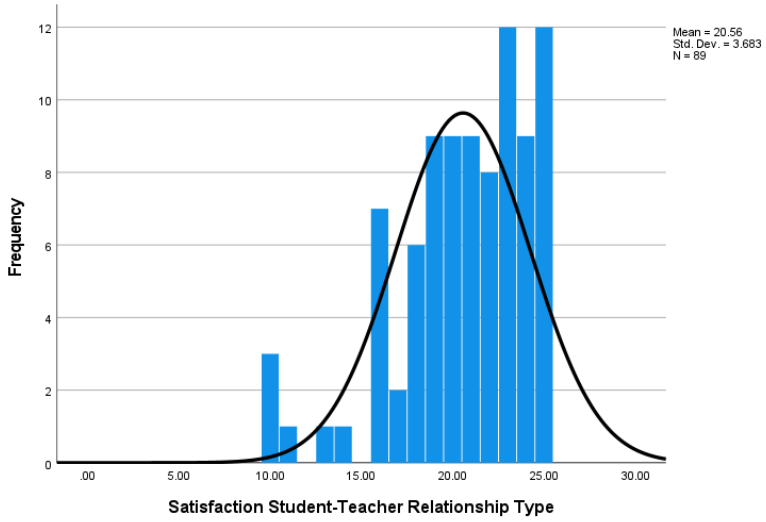
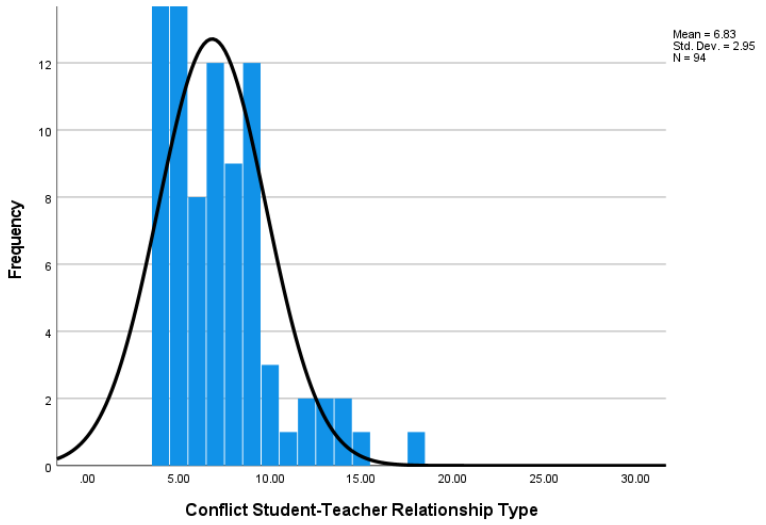


Figure 10

Student-Teacher Relationship Conflict Type Score Distribution



Mathematics Teacher Teaching Style Scores

The Teaching Style Inventory (Grasha, 1994) contained forty questions, each one of the five styles were composed of 8 Likert scale items: *expert, authority, personal model, facilitator*, and *delegator*. This can be shown in Table 2 (see page 65). The questions were created to get

responses and student ratings on each of the teaching styles, therefore it presented the need to generate five different composite scores, one for each of the teaching styles (i.e., *expert, authority, personal model, facilitator,* and *delegator*). As it was indicated earlier in this chapter, a total teaching style could not be generated as the questions were formulated by specific teaching style. Therefore, each student had a separate score for each teaching style.

Table 8 below compared the score distributions of the five teaching styles across grade levels as well as an overall score for the total sample. The values were very comparable across grade levels as well as teaching styles.

Table 8

Mathematics Teachers' Teaching Styles Score Distributions Disaggregated by Grade Level

Grade Level		Mean	Standard Deviation
Overall			
Expert	$n = 90$	28.39	3.47
Authority	$n = 85$	26.61	3.22
Personal Model	$n = 90$	29.01	4.74
Facilitator	$n = 87$	29.01	4.39
Delegator	$n = 89$	26.28	3.72
6th Grade			
Expert	$n = 27$	28.11	3.53
Authority	$n = 27$	25.37	3.53
Personal Model	$n = 29$	30.10	3.95
Facilitator	$n = 27$	28.96	3.40
Delegator	$n = 29$	26.31	3.07
7th Grade			
Expert	$n = 31$	28.03	3.67
Authority	$n = 28$	25.25	3.03
Personal Model	$n = 31$	28.16	5.50
Facilitator	$n = 29$	28.76	5.35
Delegator	$n = 30$	26.40	4.01

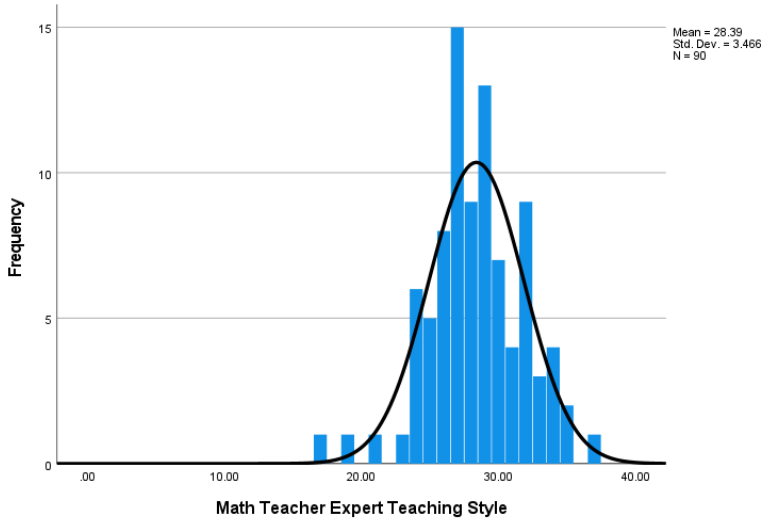
Grade Level		Mean	Standard Deviation
8th Grade			
Expert	*n* = 30	28.83	3.28
Authority	*n* = 28	26.14	3.17
Personal Model	*n* = 28	28.46	4.47
Facilitator	*n* = 29	29.03	4.29
Delegator	*n* =28	25.68	3.56

Note: Maximum scores for Expert, Authority, Personal Model, Facilitator, Delegator are 40.

Shown in Figure 11 is the score distribution of the *expert* style, resembling a normal distribution. *Expert* mathematics teaching style (*n* = 90) had a mean score of 28.39 (*Mdn* = 28.00, *SD* = 3.47) and almost 68% of the scores fall within 24.92 and 31.48. The distribution shows that most of the students appraised their teachers' teaching style as moderately *expert*.

Figure 11

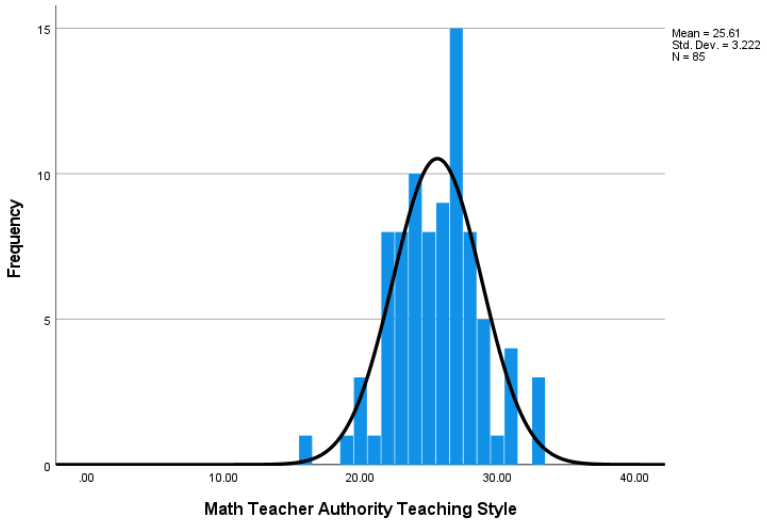
Participants Mathematics Teachers' Teaching Style Expert Score Distribution



Shown in Figure 12 is the score distribution of the *authority* style, resembling a normal distribution. *Authority* mathematics teaching style (n = 85) had a mean score of 26.60 (*Mdn* = 26.00, *SD* = 3.22) and almost 68% of the scores fall within 23.38 and 29.82. The distribution shows that most of the students appraised their teachers' teaching style as moderately *authority.*

Figure 12

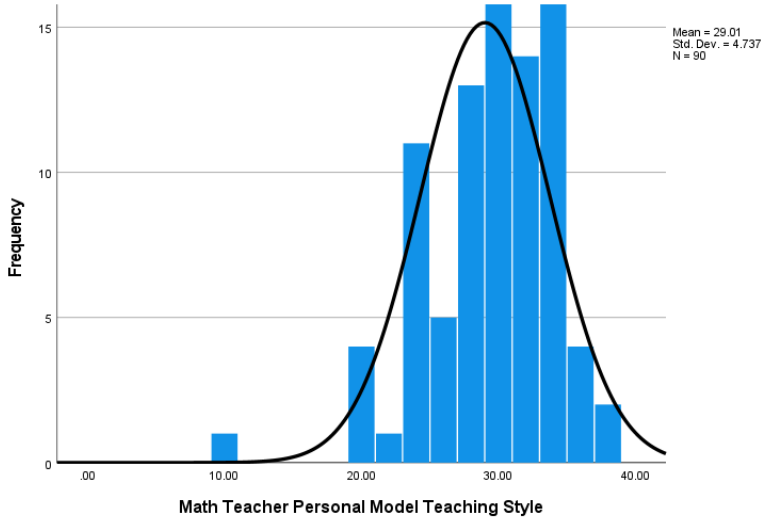
Participants Mathematics Teachers' Teaching Style Authority Score Distribution



Shown in Figure 13 is the score distribution of the *personal model* style. *Personal model* mathematics teaching style (n = 90) had a mean score of 29.01 (*Mdn* = 30.00, *SD* = 4.74) and almost 68% of the scores fall within 24.27 and 33.75. The negatively skewed distribution shows that most of the students did appraise their teachers' teaching style as moderately *personal model.*

Figure 13

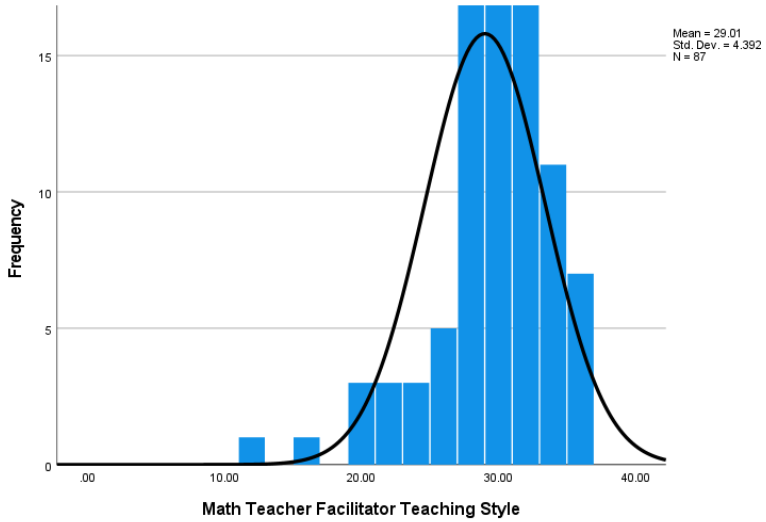
Participants Mathematics Teachers' Teaching Style Personal Model Score Distribution



Shown in Figure 14 is the score distribution of the *facilitator* style. *Facilitator* mathematics teaching style (n = 87) had a mean score of 29.01 (Mdn = 29.00, SD = 4.39) and almost 68% of the scores fall within 24.62 and 33.40. The negatively skewed distribution shows that most of the students appraised their teachers' teaching style as moderately *facilitator*.

Figure 14

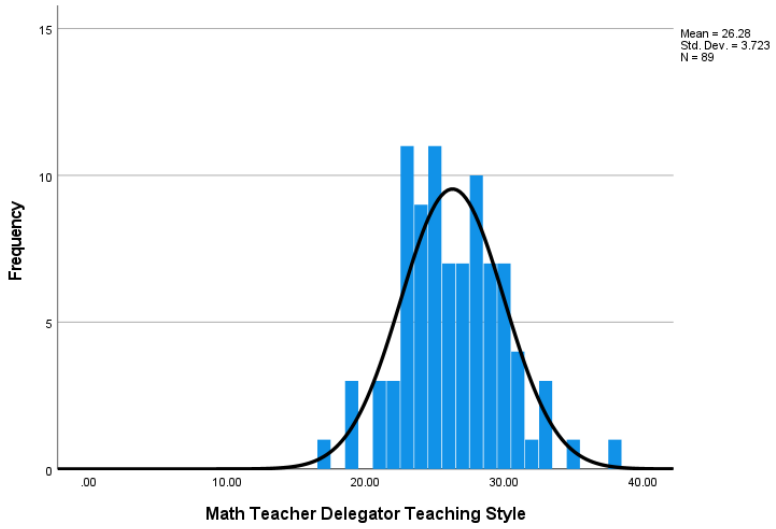
Participants Mathematics Teachers' Teaching Style Facilitator Score Distribution



Shown in Figure 15 is the score distribution of the *delegator* style. *Delegator* mathematics teaching style (n = 89) had a mean score of 26.28 (Mdn = 26.00, SD = 3.72) and almost 68% of the scores fall within 22.56 and 30.00. The slightly positive distribution has shown that most of the students did not appraise their teachers' teaching style as moderately *delegator*.

Figure 15

Participants Mathematics Teachers' Teaching Style Delegator Score Distribution



When the score distribution of the Star mathematics score was analyzed, it was noted that when disaggregated by grade level, 7th grade students had the highest mean score. In addition, the 7th grade mean score was near the 40th percentile rank while the 6th grade mean score was near the 25th and the 8th grade mean score was between the 30th and 35th. When the score distribution of the overall sample for student-teacher relationships was reviewed, it was noted that the student-teacher *satisfaction* relationship type had the highest mean score. This trend continued in that the student-teacher *satisfaction* relationship type had the highest mean score for all the grade levels when disaggregated, as shown in Table 7 (see page 77). When the score

distribution of the overall sample for mathematics teachers' teaching style was analyzed, it was noted that both *personal model* and *facilitator* had the highest mean scores. But when mathematics teachers' teaching styles was analyzed by grade level, it was noted that in 6th grade, the highest mean score was *personal model*, and in 7th and 8th grade, it was *facilitator*.

Descriptive Statistics Disaggregated by Grade Level and Gender

Table 9 contains the descriptive statistics for the eight predictor variables and one outcome variable disaggregated into categories by grade levels. It was noted the values are very comparable across grade levels in terms of student-teaching relationships and teaching styles.

Table 9

Predictor and Outcome Variables Descriptive Statistics Disaggregated by Grade Level

Variable	Mean	Standard Deviation
6th Grade		
Star Mathematics Score	1023.69	66.01
Student-teacher relationship		
Instrumental Help	13.00	3.61
Satisfaction	21.38	3.65
Conflict	6.55	3.12
Mathematics teacher teaching style		
Expert	28.11	3.53
Authority	25.37	3.53
Personal Model	30.10	3.95
Facilitator	28.96	3.40
Delegator	26.31	3.07

Variable	Mean	Standard Deviation
7th Grade		
Star Mathematics Score	1066.12	48.25
Student-teacher relationship		
Instrumental Help	13.12	4.77
Satisfaction	19.27	4.35
Conflict	7.64	3.14
Mathematics teacher teaching style		
Expert	28.03	3.67
Authority	25.25	3.03
Personal Model	28.16	5.50
Facilitator	28.76	5.35
Delegator	26.40	4.00
8th Grade		
Star Mathematics Score	1064.43	63.84
Student-teacher relationship		
Instrumental Help	12.00	4.48
Satisfaction	21.07	2.62
Conflict	6.27	2.52
Mathematics teacher teaching style		
Expert	28.83	3.28
Authority	26.14	3.17
Personal Model	28.46	4.48
Facilitator	29.03	4.29
Delegator	25.68	3.56

Table 10 contains the descriptive statistics for the eight predictor variables and one outcome variable disaggregated into categories by boys and girls. It was noted that the mean for the teaching style *facilitator* was higher for boys than it was for girls. It was also noted that the mean for student-teacher relationship style *satisfaction* was higher for girls than it was for boys.

Table 10

Predictor and Outcome Variables Descriptive Statistics Disaggregated by Gender

Variable	Mean	Standard Deviation
Boys		
Star Mathematics Score	1053.67	64.61
Student-teacher relationship		
Instrumental Help	12.71	4.40
Satisfaction	18.75	4.12
Conflict	7.46	3.18
Mathematics teacher teaching style		
Expert	28.24	3.21
Authority	25.15	2.83
Personal Model	28.21	4.42
Facilitator	27.90	4.53
Delegator	26.00	3.77
Girls		
Star Mathematics Score	1054.20	58.04
Student-teacher relationship		
Instrumental Help	12.88	4.20
Satisfaction	22.52	1.88
Conflict	6.11	2.60
Mathematics teacher teaching style		
Expert	28.71	3.80
Authority	26.10	3.61
Personal Model	29.82	5.07
Facilitator	20.19	4.11
Delegator	26.62	3.80

Null Hypothesis: There is no association among the level of students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style and students' Star mathematics scores.

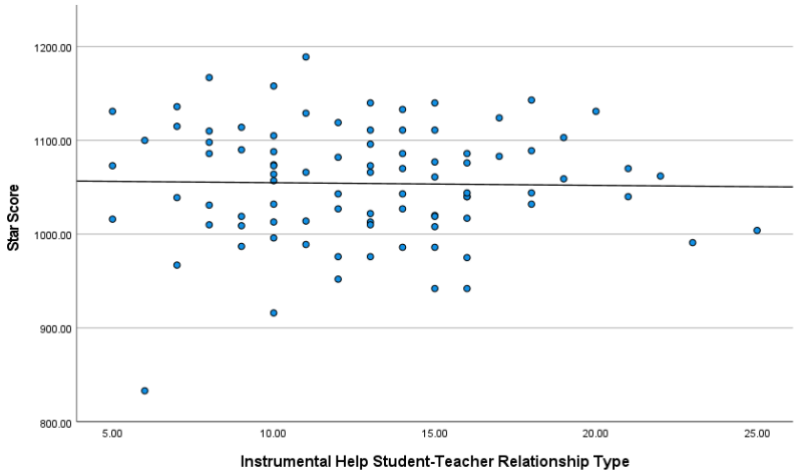
Pearson Product Moment Correlation

Assumption 1: This assumption requires that all three variables are measured at the interval or ratio level (i.e., they are continuous). The predictor variables in this study were: Student-Teacher Relationship Types (3 types total) and Mathematics Teacher Teaching Style (5 styles total). The outcome variable in this study was the Star mathematics scores. The predictor variables and the outcome variable met the first assumption of being measured with a ratio scale.

Assumption 2: Assumption 2 states that there is a linear relationship between the outcome and predictor variables. The researcher completed a scatterplot with a best fit line on SPSS database for all predictor variables and the Star mathematics scores. It was found that there was not a linear relationship based on the R square values. Figure 16 is used as a sample to provide evidence as to the lack of linear relationship between student-teacher relationship type *instrumental help* and Star mathematics scores. Due to the violation of assumption 2, the Spearman's Rank-Order Correlation test was used instead of Pearson Correlation to test the study's Null Hypothesis.

Figure 16

Pearson Product Moment Correlation of Student-Teacher Relationship Instrumental Help and Star Mathematics Score Linear Relationship



Correlational Analysis to Test the Null Hypothesis

Spearman's Rank-Order Correlation can be used to determine the strength and direction of a monotonic relationship between two continuous variables, according to Schober et al. (2018) and Laerd® (2016). The nonparametric form of the Pearson correlation coefficient was employed to assess the strength of the relationship between two given variables. Spearman's rank order calculates a coefficient of direction and strength. The coefficient is labeled as r_s or ρ (pronounced "rho"). $-1 < r_s < 1$ In the formula, d_i is the difference between the two ranks of each observation and n is equal to the number of observations. The degrees of freedom (r_s) for n-2 which is the number of data points minus 2 (Laerd®, 2022).

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$

Table 11 shows the lack of correlation between the student-teacher relationship types and Star mathematics scores. There was no correlation between teaching styles and Star mathematics scores either.

Table 11

Spearman Correlation of Student-Teacher Relationship, Teaching Styles, and Star Mathematics Scores

		Star Mathematics Correlation Coefficient
Student-teacher relationship		
Instrumental Help	*n*= 89	-.048
Satisfaction	*n*= 89	.052
Conflict	*n*= 94	.042
Mathematics teacher teaching style		
Expert	*n*=90	.089
Authority	*n*=85	.176
Personal Model	*n*=90	-.072
Facilitator	*n*=87	.046
Delegator	*n*=89	-.094

Table 12 shows the Spearman correlations of student-teacher relationships and Star mathematics scores that resulted from the disaggregated data by grade level. No correlations were found among 6th, 7th, or 8th grade students between any of the student-teacher relationships and students' Star mathematics scores.

Table 12

Spearman Correlation of Student-Teacher Relationship and Star Mathematics Scores Disaggregated by Grade Level

		Star Mathematics Correlation Coefficient
6th Grade		
Student-teacher relationships		
Instrumental Help	*n* = 29	.053
Satisfaction	*n* = 29	.087
Conflict	*n* = 29	.123

		Star Mathematics Correlation Coefficient
7th Grade		
Student-teacher relationships		
Instrumental Help	*n* = 32	.086
Satisfaction	*n* = 30	.034
Conflict	*n* = 33	.116
8th Grade		
Student-teacher relationships		
Instrumental Help	*n* = 26	-.245
Satisfaction	*n* = 28	.224
Conflict	*n* = 30	-.192

Table 13 shows the Spearman correlations of mathematics teacher teaching styles and Star mathematics scores that resulted from the disaggregated data by grade level. No correlations were found among 6th grade students.

Table 13

Spearman Correlation of Mathematics Teacher Teaching Styles and Star Mathematics Scores Disaggregated by Grade Level

		Star Mathematics Correlation Coefficient
6th Grade		
Mathematics teacher teaching style		
Expert	*n* = 27	-.174
Authority	*n* = 27	-.174
Personal Model	*n* =29	-.057
Facilitator	*n* = 27	-.289
Delegator	*n* = 29	.066

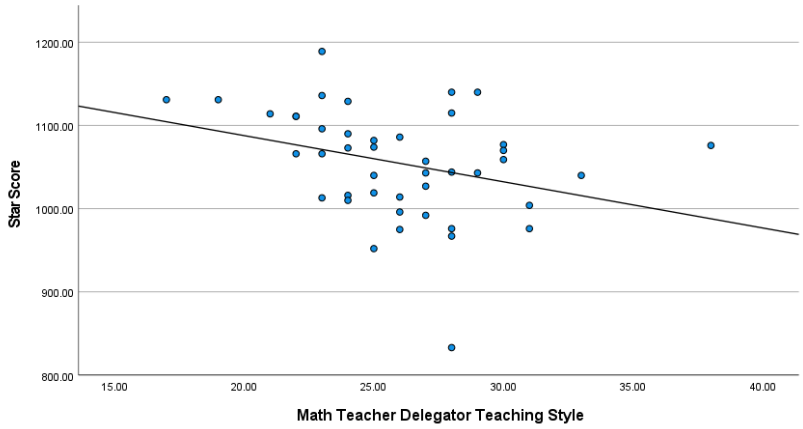
		Star Mathematics Correlation Coefficient
7th Grade		
Mathematics teacher teaching style		
Expert	*n* = 31	-.100
Authority	*n* = 28	.300
Personal Model	*n* = 31	-.229
Facilitator	*n* = 29	.028
Delegator	*n* = 30	-.428*
8th Grade		
Mathematics teacher teaching style		
Expert	*n* = 28	.428*
Authority	*n* = 28	.332
Personal Model	*n* = 28	.199
Facilitator	*n* = 29	.229
Delegator	*n* = 28	.023

Note: * Correlation is significant at the 0.05 level (2-tailed).

Among 7th graders, only the mathematics teaching style of *delegator* was found to have a statistically significant moderate negative correlation with mathematics Star scores (r_s = -.438, p < .05), see Figure 17. This indicates that for 7th grade students, when they perceive that their mathematics teachers teach in a *delegator* style, their Star mathematics scores tend to be lower. A *delegator* is described as a teacher who teaches in a student-based teaching environment and allows students to be independent learners (Grasha, 1996).

Figure 17

Negative Correlation of Teaching Style Delegator and Star Mathematics Scores for 7th Grade Students



Among 8th graders, only the mathematics teaching style of *expert* was found to have a statistically significant positive correlation with mathematics Star scores ($r_s = .428$, $p < .05$), see Figure 18. An *expert* teaching style is described as a teacher who possesses the knowledge and expertise that students need, they strive to maintain the status quo as the expert among the students by displaying their knowledge (Grasha, 1996).

Figure 18

Positive Correlation of Teaching Style Expert and Star Mathematics Scores for 8th Grade Students

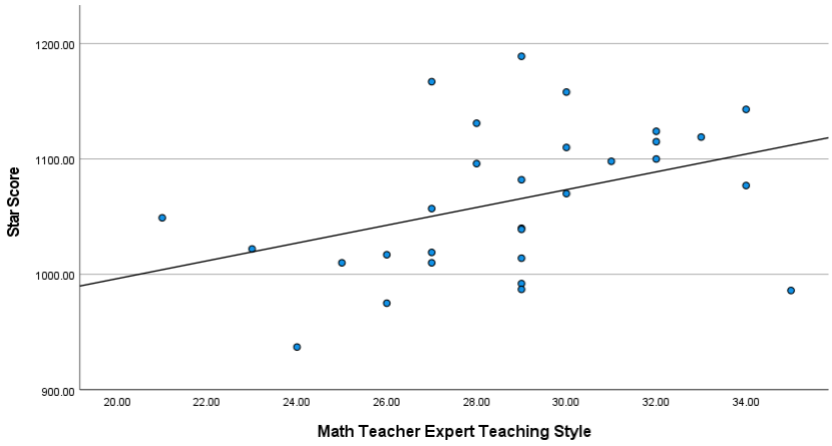


Table 14 summarizes the correlational data between the three student-teacher relationship types and Star mathematics scores for both, boys and girls. No correlations were found among boys or girls in any of the student-teacher relationships and students' Star mathematics scores.

Table 14

Spearman Correlation of Student-Teacher Relationship and Star Mathematics Scores Disaggregated by Gender

		Star Mathematics Correlation Coefficient
Boys		
Student-teacher relationships		
Instrumental Help	$n = 45$	.19
Satisfaction	$n = 44$	.148
Conflict	$n = 46$	.038
Girls		
Student-teacher relationships		
Instrumental Help	$n = 44$	-.155
Satisfaction	$n = 41$	-.108
Conflict	$n = 42$	.161

Table 15 summarizes the correlational data between five teaching styles and Star mathematics scores for both boys and girls.

Table 15

Spearman Correlation of Teaching Styles and Star Mathematics Scores Disaggregated by Gender

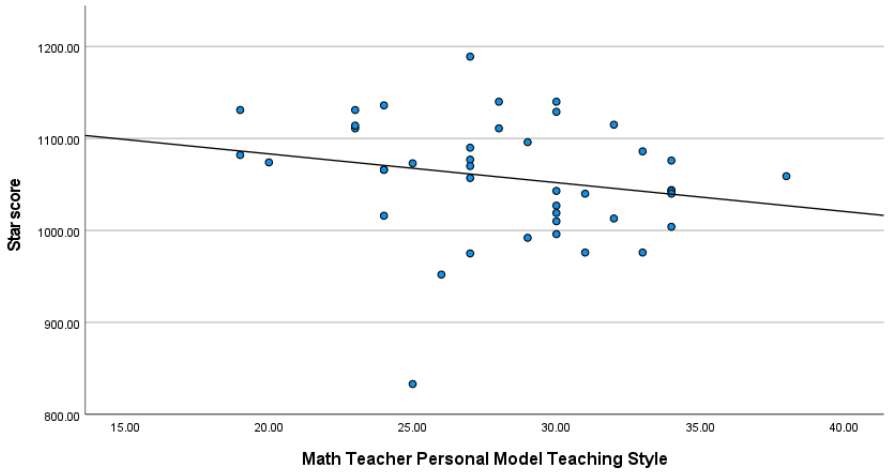
		Star Mathematics Correlation Coefficient
Boys		
Mathematics teacher teaching style		
Expert	*n*= 45	-.072
Authority	*n*= 41	.118
Personal Model	*n*= 42	-.313*
Facilitator	*n*= 41	-.088
Delegator	*n*= 44	-.366*
Girls		
Mathematics teacher teaching style		
Expert	*n*= 44	.182
Authority	*n*= 41	.233
Personal Model	*n*= 44	.054
Facilitator	*n*= 42	.070
Delegator	*n*= 42	.124

Note: * Correlation is significant at the .05 level (2-tailed).

Two teaching styles were found to have a statistically significant negative correlation with mathematics Star scores. These were 1) *personal model* (r_s = -.323, $p < .05$) and *delegator* (r_s = -366, $p < .05$). See Figures 19 and 20, respectively.

Figure 19

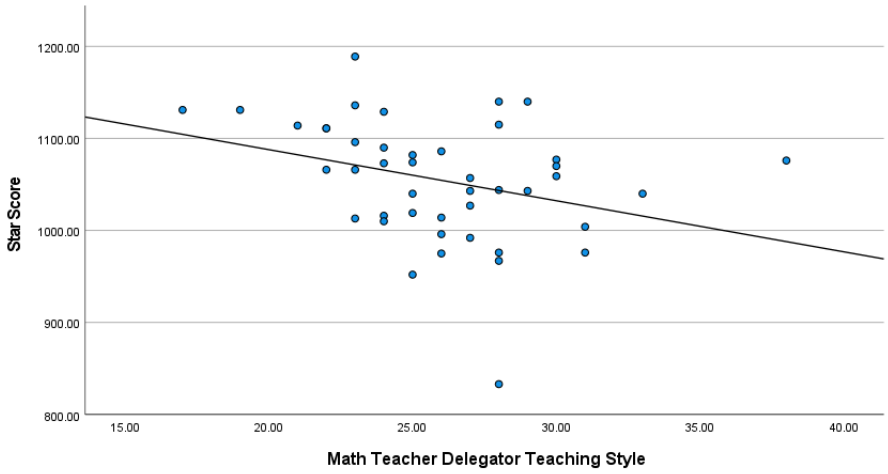
Negative Correlation of Teaching Style Personal Model and Star Mathematics Scores for Boys



This indicates that if a boy student perceives their mathematics teacher to teach with a *personal model* or *delegator* style, the boy may show a lower Star mathematics test score. A *personal model* is described as a teacher who encourages students to observe how their peers perform their academic tasks and work together, while a *delegator* is considered a teacher who works in student-based environments and allows students to work independently (Grasha, 1996). No statistically significant correlations were found among girls. The students that identified as prefer not to say (1), other (2), and nonbinary (1) were not included in the disaggregation as there were not enough participates in each category.

Figure 20

Negative Correlation of Teaching Style Delegator and Star Mathematics Scores for Boys



***Null Hypothesis*- There is no association among the level of students' perceived student-teacher relationship, students' perceived teachers' mathematics teaching style and students' Star mathematics scores.**

Based on the results, the null hypothesis has been accepted. While there was no correlation between any of the three student-teacher relationship types nor any of the eight mathematics teaching styles with students' Star mathematics scores as a whole group, 4 correlations were found when data were disaggregated by demographic variables (i.e., gender, grade level).

Conclusion

Overall, it was found that there was no correlation between any of the three student-teacher relationship variables, nor the five mathematics teacher teaching styles and students' Star mathematics scores. Demographically, it was found that girls also had no correlation between the eight independent variables and students' Star mathematics scores. In comparison, boys had a

negative correlation between mathematics teachers' teaching style of *personal model* and students' Star mathematics scores, and mathematics teachers' teaching styles of *delegator* and students' Star mathematics scores. It was also found that there was a negative correlation between mathematics teachers' teaching style of *delegator* and students' Star mathematics scores among 7th grade students. Lastly, there was a positive correlation between mathematics teachers' teaching styles of *expert* and students' Star mathematics scores for 8th grade students.

The discussion of these results, the recommendations for practice, and future research will be presented next, in Chapter 5.

Chapter V: Conclusions, Implications, and Recommendations

Many factors have an impact on middle school students' mathematical academic achievement; variables such as peer relationships, positive communication with teachers and parents, family structure, instruction, and instructional feedback have impacted students' academic achievement in mathematics (Hattie, 2009; Oz & Dolapcioglu, 2019; Weghlage 1990). Because the author is a middle school mathematics teacher, two factors that have been of particular interest to the author are the student-teacher relationships and the teachers' teaching styles (Masko, 2018; Scales et al., 2020; Roorda et al., 2017; Ryan & Deci, 2000).

Depending on the program preparation that teachers attended, which will undoubtedly influence a future teacher's instructional style, the literature shows that there are many well-established and studied teaching styles (Grasha, 1994; Ridwan et al., 2019; Thornton, 2013). For example, from teacher-centered transitioning to student-centered all the way to lecturer, authoritative, demonstrator, coach, blended or hybrid styles, facilitator or activity style, delegator or group style, to inquiry-based style, and finally to cooperative style (Lathan, 2023.; Persaud, 2022). Teachers and school district leaders are interested to explore all possible factors that may positively impact students' mathematical academic achievement.

The purpose of this study was to investigate the association between students' perceived student-teacher relationship, students' perceived mathematics teachers' teaching styles, and students' Star mathematics scores. This study sought to gain an understanding of how student-teacher relationships with their mathematics teacher and mathematics teachers' teaching styles may impact students' Star mathematics scores. The topic of this study is especially pertinent in today's middle school education due to the consistent decline in mathematical achievement in middle school students in North Dakota (Cognia, 2020). This has created a sense of urgency for

teachers and school district leaders to explore the role that different factors play in students' mathematical academic achievement.

The literature has an abundance of studies exploring the role that the student-teacher relationship plays on academic achievement (e.g., Hattie, 2009; Oz & Dolapcioglu, 2019; Scales et al., 2020; Weghlage, 1990), the role that mathematics teachers' teaching styles plays on academic achievement (e.g., Bender, 2012; Dever, 2011; Hattie, 2009; Levy, 2008), and studies focusing on students' mathematical achievement in more general terms (e.g., Athappilly et al., 1993; Baker et al., 2002; Ding & Davidson, 2005). Additionally, many studies have primarily focused on elementary or high school students' academic achievement (Arslan, 2018; Roorda et al., 2017) or have explored students' academic achievement based exclusively on the teachers' perspective (Gafoor et al., 2012; Hattie, 2009). This study was meant to bridge an existing gap in the literature by exploring mathematics performance from the students' perspective and giving students' voice to appraise their student-teacher relationships, their mathematics teachers' teaching styles, and perform on a valid and reliable mathematics assessment.

Summary of Study Methodology

The researcher used a positivist lens to formulate a correlational quantitative study to address mathematical performance among middle school students at a mid-west school. A single research question was formulated to explore the existence of two possible associations explaining mathematics performance: 1) the students' perception of their student-teacher relationship in association to their Star mathematics scores, and 2) the students' perceptions of their mathematics teachers' teaching style in association to their Star mathematics scores. Data were gathered from the Fall benchmark of the Star Mathematics Assessment; and inputted into SPSS using the students' scale scores. The second data set included data taken from a Qualtrics

questionnaire (Appendix A). The Qualtrics questionnaire was composed of data taken from sixty-three questions organized in three sections; 1) Demographic data, 2) Student Version of *The Student-Teacher Relationship Inventory* (Ang et al., 2020), and 3) *The Teaching Styles Inventory* (Grasha, 1996).

The participant group included 6th, 7th, and 8th grade students from a Midwestern public school who had taken the Star Mathematics Assessment in the Fall 2022 benchmark window. There were 94 students who participated in the study by parents providing written consent, the student accepting the statement of assent, and completing the Qualtrics questionnaire. Due to the violation of the statistical assumptions, specifically the absence of a linear relationship, the study data were analyzed using the non-parametric inferential test: Spearman's Correlation (See Chapter 4, page 88 for more information).

Summary of Findings

The study sought to investigate the relationship that students' perceptions of student-teacher relationships and students' perceptions of mathematics teachers' teaching styles had with their Star mathematics scores. These relationships were studied in consideration to moderating demographic factors such as the students' gender and grade level. The results indicated that for participants in this study there was no statistically significant relationship between students' perceived student-teacher relationship and students' Star mathematics scores. Likewise, there was no statistically significant relationship between students' perceived mathematics teachers' teaching styles and students' Star mathematics scores. The discussion of these findings and conclusions are presented by each one of the main variables of this study.

Star Mathematics Scores (Academic Achievement)

Mathematical Achievement is defined as the competency shown by the student in the subject of mathematics (Bhairab Datt Pandey, 2017). For the current study, the measure used for mathematics academic achievement was the participants score on the Star mathematics assessment on the Fall benchmark. When looking at students' Star mathematics scores, the researcher was unable to find a percentile rank for the entire sample as they were in different grades and the percentile ranks and scores are based off grade levels. It was found that 6th grade students' mean score was that of the 30th percentile, 7th grade students' mean score was that of the 40th percentile, and 8th grade students' mean score was between the 30th and 35th percentile. Therefore, the participating students were scoring at a low achievement level based off their Star mathematics scores.

In the state of North Dakota and in this mid-west school district, there are not state standard requirements or grade requirements for elementary or middle school level children to continue to the next grade level. Therefore, students with continued low achievement in mathematics are able to move onto the next grade level. At many North Dakota school districts, the option of summer school is not at the hands of the school district but rather the guardians of the students and whether they would like their children to attend. Many school districts have adopted curriculum such as Language! and TransMath to try help students with low achievement (Hines, 2017).

A demographic variable that was not accounted for during the study was the student attendance rates. It was found that in North Dakota during the 2019-2020 school year, K-12 students were attending school at a 96% attendance rate, while in the 2021-2022 school year the attendance rate dropped to 93%. In addition, in a 2022 study completed by Cattan et al., it was

found that the more days students were gone, that the more long-term academic effects it had on them.

However, a continued factor for North Dakota school districts is the national teacher shortage. In 2019, every subject area was deemed to be a critical shortage area (North Dakota Education Standards and Practices Board, 2019). The reason for this critical shortage was due to enrollment growth, retirements, teachers entering other professions, fewer young people entering the profession, and more recently the stress of COVID-19, and school safety (North Dakota Department of Public Instruction, 2021). During the beginning of the teacher shortage, nearly 50% of emergency permits and nonconventional licenses were in the STEM (Science, Technology, Engineering, and Mathematics) and Special Education areas (Dee & Goldharbor, 2017). At this point in 2019, three or more positions in the state were either 1) unfilled, or 2) filled by a teacher who was certified by a provisional, temporary, or emergency license (North Dakota Standards and Practices Board, 2019).

The teacher shortage has forced a variety of new terminology to the world of education. “Teacher shortage” is used to describe the number of openings in a school district. While “teacher turnover” describes the number of teachers that come and leave a specific school district or location. This definition does mean that this teacher is still staying in the profession, just not in that location, which requires the school district to find a new applicant. While “teacher attrition” reflects teachers leaving the school district and location but not leaving the profession all together, this requires the school district to also find a new application. Finally, there is “teacher retention,” reflecting teachers staying at the same school district they are currently employed at without leaving.

One of the solutions to this was allowing more alternative access teaching licenses. Another solution was allowing teachers who had not met all of their full credentials, such as a student-teaching. Alternate access teaching license are described as those who do not have a teaching degree but do have a bachelor's degree in a content area that has a vacancy that exists throughout the school. It is expected that the applicant will work with a university to complete their education requirements over the next three years (North Dakota Education Standards and Practices Board, 2019). There is a total of twelve teacher preparation institutions in the state of North Dakota. Unfortunately, for mid-west school districts, graduates are heavily condensed to the eastern quarter of the state. Out of 701 graduate programs, only 258 were from institutions located west of Jamestown (United States Department of Education, 2019).

During the 2018-2019 school year, there were 312 FTE (full-time equivalent) mathematics positions throughout the state of North Dakota (North Dakota Education Standards and Practices Board, 2019). A total of 152 college students from North Dakota institutions received degrees in mathematics education between 2013 and 2016 (North Dakota Educations Standards and Practices Board, 2019). This is added into the statistic that, from 2006 to 2016, there were 384 students that graduated with a mathematics education degree; while, from 1994 to 2016, there were 677 students that graduated with a mathematics education degree (North Dakota Educations Standards and Practices Board, 2019).

When underqualified teachers and teacher turnover is reported, lower student academic achievement is observed (Loeb et al., 2012). It was found that there was between a 7.4% to a 9.6% decrease in mathematical academic achievement when substantial teacher turnover occurs (Béteille et al., 2012). In addition, many teachers leave their positions when they are shown that their students constantly have low academic achievement, which causes more teacher turnover.

Student-Teacher Relationships

Ang et al. (2020) defined a student-teacher relationship as a close and supportive relationship between a student and a teacher, that is conflict-free, and serves as a "safe haven" and a buffer from stress. The present study focused on the student-teacher relationship types assessed by *The Student-Teacher Relationship Inventory* (Ang et al., 2020). The three types of student-teacher relationships are: *satisfaction*, *instrumental help*, and *conflict*. A *satisfaction* student-teacher relationship is characterized by warmth, support, and affection by the teacher toward the student (Ang et al., 2020). An *instrumental help* student-teacher relationship is characterized by the transmitting of knowledge, providing of instruction and advice (Ang et al., 2020). Lastly, a *conflict* student-teacher relationship is characterized by unpleasant, conflictual, and overall negative feelings (Ang et al., 2020). The minimum scores for each of the student-teacher relationship types were 0, while the maximum scores for *instrumental help* and *satisfaction* were 25, and *conflict* was 20. Participants in this study reported a high mean score for the student-teacher relationship type classified as *satisfaction*, a moderate mean score for the student-teacher relationship type classified as *instrumental help*, and a low mean score for the student-teacher relationship type classified as *conflict* in their appraisal of the relationships they had with their mathematics teachers.

It is crucial to emphasize that in this study no correlations between student-teacher relationships and students' mathematical academic achievement were found. Overall, students did perceive their relationships with their teachers to be positive. The reason this is important to highlight is due to the demographics of this Midwestern school district and community. On average, the school district experiences the change of one-third of its population every year, which means that every year there is an influx and efflux of 33% of students who are leaving or

arriving throughout the school year. Teachers and schools administrators must respond to the needs of what is clearly very fluid student demographic characteristics.

Throughout the school year, the administration, staff, teachers purposefully build a culture of "we all succeed together" and "we are all in this together." For this purpose, different activities are conducted each month, quarterly, and throughout the school year (e.g., monthly by grade level leader of the pack awards; collective daily points for engaging in pro-social behaviors like cleaning up the lunchroom or classroom; school-wide recycling project where children and adults participate; school principal organizing winners to go to an outside location where they spend the day to celebrate their accomplishment).

This Midwestern school district works exceptionally hard to create positive student-teacher relationships because they understand the constant influx and high mobility of students. Students at a given month may not be with them for too long, consequently, it is critical that they make a big impact on each student for the length of their stay by creating the best possible nurturing culture at school. This study has shown that these practices are working given the positive student-teacher relationship perception by students who filled out the questionnaire.

The literature is consistent in identifying that students who have a feeling of positive attachment to either family, teachers, peers, or any other adult figure tend to perform better academically (Weghlage, 1990; Oz & Dolapcioglu, 2019). Therefore, the researcher aimed to explore whether a significantly positive correlation between the student-teacher relationship type *satisfaction* and students' Star mathematics scores existed. Likewise, the exploration was directed to determine whether a significantly negative correlation between the student-teacher relationship type *conflict* and students' Star mathematics scores existed. Interestingly, it was found that there was no correlation between any of the student-teacher relationship types and the

students' Star mathematics scores. Further, data disaggregation by grade level or gender did not generate any significant correlations.

When students completed *The Student-Teacher Relationship Inventory* (Ang et al., 2020), students appraised their relationships to be predominately positive. The mean scores being 12.88 for *instrumental help,* 22.52 for *satisfaction,* and 6.11 for *conflict*. In a 2019 study, it was found that while students perceived there to be a student-teacher relationship and the teacher to be providing instructional feedback, it was not found to have a significantly positive correlation on students' mathematics academic achievement (Yıldırım & Yıldırım, 2019). Additionally, in a longitudinal study across grades 1, 3, and 5, it was found that there were increased student-teacher conflict scores from grades 1 to 5 (Mason et al., 2017). It was also found that when students got to grade 3 and 5, no correlations were able to be found between the student-teacher relationship scores and their mathematics and reading achievement (Mason et al., 2017).

This study was conducted due to the dilemma plaguing North Dakota students' declining mathematics academic achievement. The participants' mean Star scores in this study were below the benchmark average, with 6th grade in the 30th percentile, 7th grade in the 40th percentile, and 8th grade between the 30th-35th percentile. This information is comparable to the 2021-2022 state mathematics achievement scores where the 5th grade students (now 6th grade students) tested 22% novice, 34% partially proficient, 30% proficient, and 13% advanced (Insights ND, n.d.). Additionally, the 6th grade students (now 7th grade students) tested 24% novice, 38% partially proficient, 30% proficient, and 10% advanced (Insights ND, n.d.). Lastly, the 7th grade students (now 8th grade students) tested 29% novice, 35% partially proficient, 28% proficient, and 9% advanced (Insights ND, n.d.). It has been discussed that one of the largest causes of this decline in achievement is due to the COVID-19 school year. It was found that while students did show

academic gains in mathematics during the 2020-2021 school year, it was far lower than a typical year and the fall benchmark scores were dramatically lower than in past years (Hoofman & Secord, 2021; Kuhfeld et al., 2022). Lastly, it was noticed that students with parents who were unable to assist them with homework and learning had an even larger learning gap throughout the COVID-19 school year (Kuhfeld et al., 2022).

Furthermore, when the mean scores for student-teacher relationships were disaggregated by gender, it was found that girls had a higher *satisfaction* score at 22.52 compared to boys at 18.75. Boys had a higher *conflict* score at 7.46 compared to girls at 6.11. In the 2017 longitudinal study by Mason et al. it was established that from grades 1 to 3 to 5, boys' student-teacher relationship *conflict* type grew per grade, while girls stayed at the same constant level. However, girls' and boy's student-teacher relationship *closeness* type stayed the same across all grade levels (Mason et al., 2017). Interestingly, boys perceive their relationships with teachers lower in closeness and higher in conflict beginning in later elementary until early high school (Hamre & Pianta, 2001; Jerome et al., 2008; O'Connor, 2010; Saft & Pianta, 2001). Due to the nature of the quantitative study and the absence of open-ended questions, there was no opportunity to collect student answers for interpretation. This eliminated the opportunity to collect data on why students may have felt conflict or satisfaction with their student-teacher relationship.

When the student-teacher relationship scores had been disaggregated by grade level, it was established that 8th grade students saw their teachers as significantly less of a student-teacher relationship *instrumental help* type at 12.00 compared to 7th grade at 13.12 and 6th grade at 13.12. While 7th grade was significantly lower in the student-teacher relationship *satisfaction* type at 19.27 compared to 8th grade at 21.07 and 6th grade at 21.38. Lastly, 7th grade had a significantly higher student-teacher relationship *conflict* type at 7.64 compared to 8th grade at

6.27 and 6th grade at 6.55. Through grades 4-11, the largest decline in school compliance, school identification, valuing of school, respecting of relationships with peers and teachers occurs in 7th grade (Kosir & Tement, 2013; Wang & Eccles, 2012). These findings are consistent with the current study, and the increase in student-teacher relationships scores in the *conflict* type in 7th grade.

In 2022, Lei et al., published a study titled, *Student-Teacher relationship and academic achievement in China: Evidence from a three-level meta-analysis.* The meta-analysis discusses that as students get older, they become more likely to capitalize on the opportunity to have a student-teacher relationship as they are more willing to see the benefits having positive relationships with teachers (Lei et al., 2022). In addition, content areas played a role in the relationship as it was found that relationships with English teachers had the strongest correlation between student-teacher relationships and academic achievement, while teachers of mathematics and science had the weakest (Lei et al., 2022).

It is crucial to note and understand the types of student-teacher relationships that are created or expected by American teachers and school districts. A large factor found in the American student-teacher relationship status is that students' do not hold their teachers to the same level of respect that in many other countries due to the low status that America holds the teacher profession (Wu, 2019). Additionally, in other countries teachers are required to have high level of schooling emphasizing the professional honor of teaching, it is believed that the quality of schooling and teachers determines the quality of future talents (Ma, 2008; Wu, 2019). *The Student-Teacher Relationship Inventory* (Ang et al., 2020), did not include any questions involving if students respected their teachers or if they felt their teachers had high quality schooling but rather just if they were knowledgeable about their content area.

Additionally, American school districts are more than likely to be strictly against policy to allow teachers to have physical contact with students, such as embracing students in hugs. Goldstein (1999) argues that physical contact can be used as a tool to create a warm, caring, and interpersonal culture throughout the classroom and school building. It has been reported that throughout the 21st century the concept of physical touch and affection in the classroom has become a more foreign concept to school boards and administrators as policies have become stricter (Andrzejewski & Davis, 2008; Thompson & Beamish, 2019). This contrasts with the fact that policies on physical touch in other countries are beginning to shift to allow for the emotional, physical, intellectual, and social benefits (Johansson et al., 2021; Owen & Hillentine, 2010; Dobson et al., 2002).

This study was framed around Bowlby's (1988) Attachment Theory. Bowlby's (1988) Attachment Theory is grounded on the premise that students' having a positive and supportive relationship with an adult will provide stability and secure a healthy development. Referencing Figure 2 (p. 45), teaching styles and parenting styles are both impactful for children's internal working model (Bowlby, 1988). Additionally, constitutional, and environmental risk factors, and children's observed behaviors also impact the internal working model. Hattie (2009) and Weghlage (1990) stated that the feeling of attachment results in meaningful and healthy relationships with adults which can lead to positive and educational gains. However, this was not supported by the data. Due to the COVID-19 pandemic, many relationships changed for students. Approximately 33% of high school students and middle school students at the time of the school system shutdown, felt that they were unable to make peer relationships as easy as they were before the shutdown (Anderson et al., 2022). Larson (2022) found that students in grades 4-6 felt

an 8% decrease in teacher support, a 13% decrease in-home support, and a 12% decrease in caring friends during the COVID-19 years.

The current study focused on student-teacher relationships and did not ask any questions about peer relationships. Therefore, it may be possible to draw the conclusion that middle school students do not consider student-teacher relationships to be the most important relationships to make during the school day, preferring to focus on the relationships they have with peers, as a result of the change in students' relationships with home support and peers during the COVID-19 pandemic (Larson, 2022).

Mathematics Teacher Teaching Styles

Teaching styles are defined as the continuous and consistent behaviors of teachers in their interaction with students during the teaching-learning process (Grasha, 2001). The Qualtrics questionnaire, component three, was adapted from *The Teaching Styles Inventory* (Grasha, 1994), the original inventory was intended for adults and was adapted for middle school students. This inventory focused on five teaching styles: 1) expert, 2) authority, 3) personal model, 4) facilitator, and 5) delegator. Participants in this study reported a moderate mean score for each of the five teaching styles. These results do not support the literature on teaching styles (Grasha, 1996).

The instrument used in this study was originally intended to be used by adults, and was adapted for student usage, it may be possible that the reading level was not adequate for participants regardless of the adaptations made to the statements (which resulted from field-testing) and these revised versions may have still been unable to reflect students' true experience. There was, however, a correlation when students' self-appraised how confident they were about their mathematics skills and students' Star academic achievement. Students' self-appraisal of how confident they were about their mathematics skill, may be impacted by the narratives at

home and in school, in addition to how much they liked the subject. This is a goal for teachers to help students reach but it is also something that happens at home, where parents who like mathematics will play with numbers and make calculations as part of their regular daily living routine and will invite their kids to participate. These parents will also feel more comfortable with supporting their children academically, which in turn will impact their children' internal narrative about mathematics in a very positive way. The present study was conducted with middle schoolers, whose internal narratives were still quite susceptible to what others say (e.g., Shelden et al., 2010; Lee & Bowen, 2006). As discussed in a 2021 study, there are many factors that impact the teaching styles of mathematics teachers, that may change their teaching style from class to class such as curriculum, learning styles, student personality, class attitudes, and behaviors (Fisher et al., 2006; Wolf & Fraser, 2008). In addition, the perceptions of adolescent students on teachers' teaching styles are a topic that has not received much attention in the literature.

There were no overall score correlations between any of the five teaching styles and students' Star mathematics scores. These results contradicted the literature on teaching styles and the instrument used (Grasha, 1996). This may be due to the instruments original design and intent being for adults and teachers with an understanding of teaching styles and the pedagogy behind the styles rather than adolescents and their understanding of teaching styles (Martin, 2019). Little to no research has been done on adolescent perceptions of teachers' teaching styles and academic growth to be able to support the findings in the current study. There are no articles reporting on middle school students and their perceptions of teaching styles, the closest studies that have been conducted are with college students and therefore those have been used for reference. There have been many studies completed on adult participants and their perceptions of

teachers' teaching styles, the two most noteworthy have the following findings. Gifford (1992) investigated how teachers and pupils perceived various teaching philosophies, 519 adult students and 34 teachers participated in this study. Gifford found that there were differences in how professors and students viewed various teaching philosophies. Similarly, Cothran et al. (2000) investigated 84 faculty members and 585 college students' views of teaching styles and revealed that teachers' and students' perceptions of teaching styles differed significantly. This could be taken as a relative point of reference to infer that adolescent students may not have fully grasped the concept of what teaching style were before taking the questionnaire and therefore were just selecting answers without useful criteria to adequately appraise teachers' teaching style. The data confirmed the fact that students appraised their teachers' teaching styles in different ways, but that there was no association to their Star mathematics performances.

The instrument was designed to appraise teaching style as a cluster of styles rather than focusing on a single continuum (i.e., low, high). In cluster 1, the primary teaching styles being used are expert and authority. This is inclined towards a traditional mathematics teaching style. In contrast, in clusters 3 and 4, the primary teaching styles being measured are *facilitator*, *personal model*, and *delegator* inclined towards a cooperative learning or active learning. Figure 21 displays four clusters that Grasha (1996) discussed.

Figure 21

Anthony Grasha's Four Teaching Style Clusters

CLUSTER 1	CLUSTER 3
Primary styles:	*Primary styles:*
Expert/formal authority	Expert/facilitator/personal model
Secondary styles:	*Secondary styles:*
Personal model/facilitator/delegator	Formal authority/delegator
Lectures	Small group discussion
Term papers	Laboratory projects
Tutorials	Instructor-designed group projects
Guest presentations	Student teacher of the day
Video/audio presentations of content	Self-discovery activities
Guest speakers	Learning pairs/debates
Teacher-centered class discussions	Case studies
Strict standards/requirements	Role plays/simulations
Grades/tests emphasized	Problem-based learning
	Practicum/guided readings
CLUSTER 2	**CLUSTER 4**
Primary styles:	*Primary styles:*
Expert/personal model/formal authority	Expert/facilitator/delegator
Secondary styles:	*Secondary styles:*
Facilitator/delegator	Formal authority/personal model
Demonstrating ways of thinking/doing things	Student-designed group projects
Coaching/guiding students	Independent study
Illustrating alternatives	Independent research projects
Sharing personal viewpoints	Position papers
Sharing thought processes involved in obtaining answers	Student journals
Using personal examples to illustrate content points	Modular instruction
Having students emulate the teacher's example	Self-discovery learning projects
	Contract teaching
	Cooperative learning activities

Note. Grasha, A. F. (1996). Teaching with style: a practical guide to enhancing learning by understanding teaching and learning styles. San Bernardino, CA: Alliance Publishers.

The Qualtrics questionnaire: component three was adapted from *The Teaching Styles Inventory* (Grasha, 1994), that was published over twenty years ago. Therefore, while teaching styles have not changed much, additional teaching styles have been added that may be more applicable to the twenty-first-century mathematics curriculum. Throughout the twenty-first-century and more recently with the COVID-19 pandemic, technology has become a prevalent part of education. Terms such as smart classrooms, flipped classrooms, blended classrooms, distance learning, and personalized learning are all terms that educators and students are now

familiar with (Rajkumar, 2016). With this in mind, the need for a 21st century mathematics teaching style framework would be beneficial.

Middle school students in this study appraised their mathematics teachers' teaching style as being moderately *expert*, moderately *authority*, moderately *personal model*, moderately *facilitator*, and moderately *delegator*. In essence, middle school students did not differentiate between any of the teaching styles as a whole. There were, however, some discrepancies throughout teaching styles between genders. Including boys appraising teachers lower in *authority* at 25.15 compared to girls at 26.10. Similarly, also appraised teachers lower in *personal model* at 28.21 compared to girls at 29.82. While girls appraised teachers dramatically lower in *facilitator* at 20.19 compared to boys at 27.90. In a 2003 study by Honigsfeld and Dunn, boys tended to be strong kinesthetic learners, while girls tended to be stronger auditory learners. *Authority* is a teaching style that is more teacher-centered where the teacher feels responsible for providing and controlling the content the student will receive (Evans & Cools, 2009). This is a type of teaching style that kinesthetic learners struggle with as they are not able to touch and move to receive content and information (Chetty et al., 2019). While on the contrary, a *facilitator* teaching style emphasizes a more student-centered learning and encouraging students taking responsibility for their learning (Evans & Cool, 2009). This departs from the reported auditory and rote type of learning style that many girls tend to be strong at (Honigsfeld & Dunn, 2003).

Additionally, there were some small discrepancies throughout teaching styles across grade levels. Such as that 8th grade students' highest mean score was *facilitator* at 29.03, which coincided with 7th grade students' highest mean score was also for *facilitator* at 28.76, while 6th grade students reported *personal model* as the highest mean at 30.10. As a *facilitator* teaching style is student-centered, concentrates on the learning standards of each individual student, and

encourages students to take ownership of their own learning (Grasha, 2001). As a *personal model* teaching style is teachers continually watch over, direct, and educate their students by demonstrating how to accomplish the standard (Grasha, 2001).

When analyzing the overall results, no correlations were found between any of the teaching styles and students' Star mathematics scores. The goal of the twenty-first century is knowledge generation and application; therefore, instructors must change from their traditional role as information transmitters to that of learning facilitators. It is believed that a shift in new and twenty-first-century curriculum and teaching styles is difficult for many veteran teachers, in terms of technology (Ertmer & Ottenbreit-Leftwich, 2010). It is also found that many veteran teachers feel that by having old curricula, materials, and answer keys that they are able to scribe on the board is much easier than creating new technological lesson plans and activities that require adjusting to new teaching styles (Ertmer & Ottenbreit-Leftwich, 2010). It is believed that being the expert in content areas is the most important aspect of teaching, but being able to reach students in student-centered activities and new innovative teaching is becoming the preferred way for middle school teaching.

When disaggregated by grade level or gender, four correlations were found. There was a negative correlation between the teaching style *delegator* and Star mathematics scores for 7th grade students. In a *delegator* teaching style, teachers are a source of knowledge that students may turn to when they need assistance to satisfy their requirements (Grasha, 1996). Students are encouraged to work independently on assignments and participate in groups as members with distinct roles. During the use of the *delegator* teaching style, students find themselves to be independent and capable. Students may experience indirect anxiety and worry as a result of this predicament while they attempt to complete the assignments set out by the lecturers (Sim &

Mohd Matore, 2022). Thus, it should be considered a weakness because pupils could not possess the necessary capacity to carry out their autonomous tasks (Sim & Mohd Matore, 2022). In addition, kids can require strict monitoring and constant support to get over their anxieties and adjust to new learning standards. Therefore, students may find this teaching style to be anxiety creating and do not get much work done due to the need of constant support.

The data disaggregation also showed that there was a positive correlation between the teaching style expert and Star mathematics scores for 8th grade students. According to Grasha (1996), instructors who use the *expert* teaching style are knowledgeable and skilled about what pupils desire to learn. By demonstrating precise and thorough knowledge, the *expert* teaching style encourages teachers to preserve their status as experts among their pupils. In order for pupils to acquire learning abilities, teachers who use the expert teaching style urge them to confront difficult situations. Teachers, who are professionals, have a part to play in imparting knowledge to pupils, who are then expected to master content and use it to their benefit (Sim & Mohd Matore, 2022). Instructors are cautious while imparting knowledge and making sure that pupils are prepared for learning. Therefore, students will respect their teachers as they see them as an expert in their field. (Wu, 2019).

Interestingly, the data resulted in a negative correlation between the teaching style delegator and Star mathematics scores for boys. In a *delegator* teaching style, teachers are a source of knowledge that students may turn to when they need assistance to satisfy their requirements (Grasha, 1996). Students are encouraged to work independently on assignments and participate in groups as members with distinct roles. Studies have found that many boys prefer a kinesthetic learning experience and prefer to work with manipulatives rather than taking notes (Honigsfeld & Dunn, 2003). Therefore, with a teaching style requiring students to work

independently and that does not allow students to touch manipulatives as part of the learning process, may impede student learning.

Lastly, a negative correlation between the teaching style *personal model* and Star mathematics scores for boys was observed. Grasha (1996) explains that the *personal model* teaching style refers to teachers who teach based on their own example. The need for direct observation and imitation is a main strength of the *personal model* teaching style. However, it has been found that some personal model teachers believe that their approach to teaching is the best and consequently makes students feel they have low capabilities and capacities and cannot meet standards and expectations (Chetty et al., 2019). Therefore, they could feel demoted and less confident in their abilities (Chetty et al., 2019).

Feelings and Confidence about Mathematics

The original intention of the current study was to find any correlations between students' perceived student-teacher relationships, students' perceived mathematics teachers' teaching styles, and students' Star mathematics scores. The researcher decided to two add ratio questions about students' feelings about mathematics (i.e., 0 representing "hate math," 10 representing "love math") and students' confidence in their mathematics skills (i.e., 0 representing "not confident," 10 representing "very confident"). As expected by the researcher, it was found, that the scores on both questions strongly correlated positively to students' Star math scores.

Self-esteem is defined as "confidence in one's worth or abilities" (Dictionary, n.d.). Therefore, students having high self-esteem or confidence in their worth or ability in mathematics skills allow students to feel that they are capable of completing the mathematics standards provided to them in middle school. In a 2021 study completed by Zhao et al., it was reported and heavily discussed that self-esteem and engagement impact academic achievement

for adolescents. Additionally, teachers and parents can help students by actively guiding and narrating their success in mathematics (Zhao et al., 2021).

Furthermore, it has been noted that students' interest in mathematics can be rooted in the narrative used by teachers and parents (Jay et al., 2018). There was a positive correlation found between parents that have a positive narrative about mathematics, are able to help with mathematics homework, and have the willingness to be involved and students' mathematical academic achievement (Jay et al., 2018). Unfortunately, there was limited literature on the topic of parent and teacher narratives and the impact of students' academic achievement for middle school students.

Implications for Practice

Although, this study did not find significant correlations with the overall results between the student-teacher relationships, instrumental help, satisfaction, or conflict, and students' Star mathematics scores. Students still scored their student-teacher relationship type with their mathematics teacher and found a generally high mean score for satisfaction, which demonstrates that a majority of the participants found their student-teacher relationship to be a satisfactory or positive one. Teachers may still benefit from being provided the results and seeing that students do notice the student-teacher relationships that are formed, even if they do not correlate to students' Star mathematics scores.

The second predictor variables were mathematics teachers' teaching styles, and there were no correlations with the overall results. Mathematics teachers and school districts may benefit from understanding that students scored their mathematics teachers' teaching style as moderate for all five of the teaching styles provided in the inventory (i.e., expert, authority, personal model, facilitator, and delegator). In addition, mathematics teachers may benefit from

completing an inventory, such as *The Teaching Styles Inventory* (Grasha, 1994), to find out what teaching style they predominately use. Once that is complete, they would be able to look at Figure 21, the four teaching clusters, and find out what other teaching styles accompany their dominant teaching style. They would be able to create lesson plans and units around the activities they are most comfortable with in their clusters to further help their students. Furthermore, these mathematics teachers could broaden their teaching experiences by trying activities that don't fit in their cluster, then look at the achievement level on the formative and summative assessments to find out what is best for students.

Lastly, through the data collected on two ratio questions inquiring about students' feelings regarding math and confidence about their math skills, it becomes quite clear that the narratives used by mathematics teachers about students being capable of doing well in mathematics and making mathematics fun be two ongoing components in mathematics classrooms. Language is a powerful tool for teachers to use, therefore the language should be encouraging, hopeful, positive about the wonders of mathematics and the students' abilities to learn mathematics. Students will be significantly influenced by that. This study has shown that students' internal narrative about mathematics is indeed strongly associated to their academic performance, while teaching styles and student-teacher relationships were not.

Limitations

There were several limitations to this study. This study used a cross-sectional survey utilizing a census method, the survey was from a pre-determined population at a Midwestern middle school. While the potential pool of participants was very large (the middle school contained around 450 students), the sample represents only a small percentage of students from the middle school.

A second limitation is related to *The Teaching Style Inventory* (Grasha, 1994). Grasha's inventory focused only on five teaching styles, while there are multiple types of teaching styles out there to be considered. During Grasha's inventory, it was not discussed whether teachers can have a mixture of teaching styles or if they must only remain in one type of teaching style. In the literature, it was found that active learning has many benefits, such as maximized participation and real-life connection (Bonwell & Fison, 1991; Ladousse, 1987; McKeachie, 1999; Schaftel & Schaftel, 1976; Van Ments, 1994), but an active teaching style was not a teaching style that was a variable in the Grasha inventory survey.

The third limitation is also related to *The Teaching Style Inventory* (Grasha, 1994). The original inventory questionnaire was made for teachers; therefore, the length of the questions and the number of questions were not a concern. When the intended participants for the instrument were changed from adults to children, the inventory was piloted and modified. In addition, the instrument was created in 1994, over twenty years ago. It was also thought that a different instrument meant specifically for mathematics teachers focusing on active learning, student-centered learning, and teacher-centered learning would be more beneficial for the current study.

Another limitation is the limited amount of data points. Both the questionnaire and the Star mathematics test were only given once, during the Fall benchmark time zone. With this in consideration, it is unknown if students' Star mathematics scores went up from Fall to Winter benchmarks, if their student-teacher relationship improved as the school year went on, or if they began to understand the way their teacher taught the mathematics class and how it would help to teach them the mathematics content.

The last limitation was, for the most part, the data was self-reported using a questionnaire that required reliance on the participant to provide an honest appraisal of their student-teacher

relationship and their mathematics teachers' teaching style. It was assumed that the students participating answered honestly, however, there is no way to be certain of the truthfulness of their responses.

Recommendations for Future Research

This study was conducted in a Midwestern school district, it must be acknowledged that this system has specific characteristics that make it unique, therefore the finding may not be transferable. Thus, the first recommendation is to replicate this study in a different region with different student demographics, being of especial interest to explore the impact that districts with less mobility experience in regards to the student-teacher relationships. This would allow the opportunity to see how the culture of the school district impacts the perceptions of student-teacher relationships. It would also allow for compare and contrasting the regions and their overall correlations in teaching styles and student-teacher relationships when the data was disaggregated by gender and grade level.

A second recommendation is to do a similar study that includes a robust qualitative research component with a focus group or individual interviews of students at different grade levels. It would explore what types of activities teachers use during their lessons to categorize their teaching style. For example, a mixed method study that investigates mathematics teachers' teaching styles including activities used during lessons to help define the teaching style. In addition, a qualitative component that explores what types of interactions happen between teacher and student to help categorize the student-teacher relationship (i.e., positive feedback, high expectations for students, connecting with students, and student engagement). This exploration would add a qualitative component to the quantitative correlation.

Due to having only one Star mathematics benchmark score and one set of Qualtrics questionnaire results, there was no opportunity to see growth for the Star mathematics benchmark scores between the Fall and Winter benchmark nor see if there was a change in students' perception of their student-teacher relationship or their mathematics teachers' teaching style. The data points that were collected for this study were collected in the Fall of the school year; therefore, students may not have scored at their highest on the Star mathematics test. Additionally, they may not fully know their mathematics teacher at that point to be able to have a positive student-teacher relationship with them or be able to classify their teaching style.

A fourth recommendation would be to include teachers in the study and have them take *The Student-Teacher Relationship Inventory* (Ang, 2005) from the teacher's perspective. This would also allow the teachers to be able to take *The Teaching Style Inventory* (Grasha, 1994), which was intended for teachers. This may lead to a different set of results as teachers may know more about what teaching style they aim to reach and use during their lessons, while students are answering based on only their perceptions of what they see in the classrooms.

Lastly, looking for a teaching style survey that was originally made for students and did not have to be modified for their use would be a future recommendation. The change regarding the teaching style survey also has to do with the length of each question and the number of questions students had to answer. Taking a different approach to the teaching style survey may yield a different variety of teaching styles in the survey as well rather than the five teaching styles used in *The Teaching Style Inventory* (Grasha, 1994).

Conclusion

This study sought to identify how factors, such as student-teacher relationships and teaching styles, are related to Star mathematics scores. It looked at students' self-reported

perception of their student-teacher relationship and mathematics teacher teaching style. The study found that there was no correlation between students' perception of student-teacher relationships, mathematics teachers' teaching styles, and Star mathematics scores.

The study did show that when disaggregated by various demographic variables, there were a few correlations. When disaggregated by the grade level variable, there were two correlational relationships. It was found that there was a negative correlation between teaching style delegator and Star mathematics scores for 7th grade students. There was a positive correlation between teaching style expert and Star mathematics scores for 8th grade students. The second disaggregation was by the gender variable, and there were two correlational relationships found as well. A negative correlation between the teaching style personal model and Star mathematics scores for boys. Lastly, a negative correlation between the teaching style delegator and Star mathematics scores for boys.

Based on the findings, recommendations were included. These were: a) replicating the study in another school district to see how the result compare, (b) creating a similar study with an additional robust qualitative component, (c) creating a second data point for a Winter Star mathematics benchmark score and a Winter Qualtrics questionnaire data point, d) include teachers in the study and add *The Student-Teacher Relationship Inventory* (Ang, 2005) from the teacher perspective and *The Teaching Style Inventory* (Grasha, 1994), and e) finding a new teaching style survey where the intended participants were students rather than it adults and being modified.

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Appendix A

Qualtrics questionnaire

MS Questionnaire - Real project

Start of Block: Default Question Block

Your parents have given permission for you to participate in a research project I am doing, but you can still decide whether you would like to participate or not. If you do not wish to participate, there will be no consequences with your grade, our relationship, or in regards to your school day. This is completely voluntary. The only impact this study will have is to help me better understand how student-teacher relationships and teachers' teaching styles can help you learn. Here's exactly what will happen. You will come to mathematics class, I will have you take a survey. You will also take your STAR Mathematics benchmark test as normal. I want to find out some better ways to help students learn and do better. Are there any questions?

- ○ I accept
- ○ I do not accept

Please type your four-digit lunch code

_____

Page Break

To which gender do you most identify?

- ○ Boy
- ○ Girl
- ○ Non-binary
- ○ Prefer not to say
- ○ Other _____

Indicate your grade level

- ○ 6
- ○ 7
- ○ 8

How old are you

	10	11	12	13	14	15
Age						

How would you describe your race/ethnicity?

- ○ American Indian or Alaska Native
- ○ Asian
- ○ Black or African American
- ○ Native Hawaiian or other Pacific Islander
- ○ Hispanic or Latino/a
- ○ White
- ○ Other _____

How would you describe your family?

- ○ 2 parents/Live together
- ○ 2 parents/Don't live together
- ○ 1 parent
- ○ Other _____

Do you receive any extra academic services? (Check all that apply)

- ☐ ELL
- ☐ Special Education
- ☐ 504 Plan
- ☐ Other _____

Page Break

On a scale of 0-10 (0 being hate, 10 being love) how do you feel about mathematics?

0 1 2 3 4 5 6 7 8 9 10

Hate

On a scale of 0-10 (0 being not confident, 10 being very confident) how confident are you about your mathematics skills?

0 1 2 3 4 5 6 7 8 9 10

Not confident

Page Break

For this study student-teacher relationships are defined as "a close and supportive relationship with a teacher, that is conflict-free, and serves as a “safe haven” and a buffer from stress” (Ang et al., 2020).

• Read each statement carefully.
• There are no right or wrong answers, so please be honest with your responses.
• Think of **your Mathematics Teacher** when you answer the following statements in this section.

	Almost never true	Rarely true	Sometimes true	Often true	Almost always true
I enjoy attending the class of this teacher	○	○	○	○	○
If I have a problem at home, I will ask this teacher for help	○	○	○	○	○
My relationship with this teacher is positive	○	○	○	○	○
This teacher frustrates me more than other teachers who teach my class	○	○	○	○	○
If this teacher retires or leaves the school, I will miss him/her	○	○	○	○	○
I share about my personal life with this teacher	○	○	○	○	○
I cannot wait for this year to be over because I do not want to be taught by this teacher again	○	○	○	○	○

If this teacher is absent, I feel relieved	○	○	○	○	○
If I need help, I will go to this teacher	○	○	○	○	○
If I need someone to listen to me, I will go to this teacher	○	○	○	○	○
If I am not taught by this teacher, I will be able to enjoy my class more	○	○	○	○	○
I depend on this teacher for advice	○	○	○	○	○
I am happy with my relationship with this teacher	○	○	○	○	○
I like this teacher	○	○	○	○	○

On a scale of 0-10 (0 meaning no relationship, 10 meaning one of the best relationships with a teacher) how would you describe your relationship with your mathematics teacher?

	0 1 2 3 4 5 6 7 8 9 10
No relationship	

Page Break

For this study, teaching style is defined as "continuous and consistent behaviors of teachers in their interaction with students during the teaching-learning process" (Grasha, 2002).

- Read each statement carefully.
- There are no right or wrong answers, so please be honest with your responses.
- Think of **your Mathematics Teacher** and his/her teaching style when you answer the following statements in this section.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
In this class, my teacher feels facts, views, and mathematics rules are the most important things to learn.	○	○	○	○	○
In this class, my teacher sets high goals for the class.	○	○	○	○	○
In this class, my teacher models' good ways to think about problems in mathematics.	○	○	○	○	○
In this class, my teacher's goals and methods use a variety of skills.	○	○	○	○	○
In this class, students usually work on course projects alone and with little supervision from the teacher.	○	○	○	○	○
In this class, my teacher values sharing their knowledge and ability.	○	○	○	○	○

In this class, my teacher gives negative feedback when work is unsatisfactory.	○	○	○	○	○
In this class, activities encourage students to create their own ideas about mathematics.	○	○	○	○	○
In this class, my teacher spends time discussing with students how to improve their work on individual and/or group projects.	○	○	○	○	○
In this class, activities help encourage students to create their own ideas.	○	○	○	○	○
In this class, what my teachers says about a topic helps students create new ideas.	○	○	○	○	○

In this class, I would describe my teacher's goals and expectations as somewhat strict and not flexible.	○	○	○	○	○
In this class, my teacher typically shows students how and what to do to master the subject.	○	○	○	○	○
In this class, small group discussions are used to help students grow their ability to think critically.	○	○	○	○	○
In this class, students design one or more self-directed learning experiences.	○	○	○	○	○
In this class, my teacher wants students to leave well prepared for further work in mathematics.	○	○	○	○	○

In this class, my teacher feels it is their responsibility to define what students must learn and how they should learn it.	○	○	○	○	○
In this class, examples from my teacher's personal experiences are often used to explain the material.	○	○	○	○	○
In this class, my teacher guides students' work on projects by asking questions, exploring options, and suggesting different ways to do things.	○	○	○	○	○
In this class, an important goal of my teacher's is developing the ability to think and work by yourself.	○	○	○	○	○
In this class, lecturing (the teacher talking) is normally how my teacher teaches the class.	○	○	○	○	○

In this class, my teacher provides very clear guidelines/rules for how they want tasks completed.	○	○	○	○	○
In this class, my teacher shows students how they can use various mathematics rules and ideas to solve the problems.	○	○	○	○	○
In this class, course activities encourage students to take the lead and responsibility for their learning.	○	○	○	○	○
In this class, students take responsibility for helping to teach part of the class.	○	○	○	○	○
In this class, my teacher's knowledge is typically used to settle disagreements or questions about content issues.	○	○	○	○	○

In this class, there are very specific goals and objectives my teacher wants students to complete.	○	○	○	○	○
In this class, students often receive verbal and/or written comments on their projects, tests, or homework.	○	○	○	○	○
In this class, my teacher asks for student help about how and what to teach in this course.	○	○	○	○	○
In this class, students set their own pace for completing independent and/or group projects.	○	○	○	○	○
In this class, students might describe the teacher as the "center of knowledge" who gives the fact, views, and mathematics rules students need.	○	○	○	○	○

In this class, my teacher's goals for what students need to do are clearly defined in the syllabus or objectives.	○	○	○	○	○
In this class, many students begin to think like the teacher about the subject.	○	○	○	○	○
In this class, students can make choices between activities to complete class requirements.	○	○	○	○	○
In this class, my teacher's thoughts on teaching are similar to a manager of a workgroup who assigns tasks and responsibilities.	○	○	○	○	○
In this class, there is more information than my teacher has time available to cover.	○	○	○	○	○

In this class, my teacher's goals and rules help students develop the control they need to learn.	○	○	○	○	○
In this class, students might describe the teacher as a "coach" who works closely with students to correct problems in how they think and behave.	○	○	○	○	○
In this class, my teacher gives students a lot of personal support and encouragement to do well.	○	○	○	○	○
In this class, my teacher takes on the role of a resource person who is available to students whenever they need it.	○	○	○	○	○

On a scale of 0 to 10 (0 being terrible, 10 being fantastic) how would you describe the way your mathematics teacher teaches you mathematics?

	0	1	2	3	4	5	6	7	8	9	10
Terrible											

End of Block: Default Question Block

Appendix B

IRB Approval Letter

Institutional Review Board

MINNESOTA STATE UNIVERSITY MOORHEAD

DATE:	August 26, 2022
TO:	Ximena Suarez-Sousa, PhD, Principal Investigator
FROM:	Dr. Robert Nava, Chair Minnesota State University Moorhead IRB
ACTION:	**APPROVED**
PROJECT TITLE:	[1789134-4] Student-Teacher Relationships, Teaching Styles and Their Association With Student Achievement on Star Renaissance Math Scores at the Middle School Level
SUBMISSION TYPE:	Amendment/Modification
APPROVAL DATE:	August 23, 2022
EXPIRATION DATE:	
REVIEW TYPE:	Exempt Review

Thank you for your submission of Amendment/Modification materials for this project. The Minnesota State University Moorhead IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Exempt Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to the Minnesota State University Moorhead IRB. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to the Minnesota State University Moorhead IRB.

This project has been determined to be a project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of .

Appendix C

Consent Form

Institutional Review Board

MINNESOTA STATE UNIVERSITY MOORHEAD

Consent Form

Please read this consent agreement carefully before agreeing to participate in this study.

Title of Study: Student-Teacher Relationships and Their Association on Student Achievement on Mathematics STAR (Renaissance) Scores at the Middle School Level.

Purpose of the study: The purpose of this research is to look into the association between student-teacher relationships and willingness to learn, engagement, motivation, and ultimately their academic achievement. This will allow the author to share the results and further help teachers create meaningful relationships with students.

Study Information: The study will compare perceived student-teacher relationships and their academic achievement on the STAR benchmark test. The study will include approximately seventy students in sixth, seventh, and eighth grade. The students will complete a survey that collects data on their perception of student-teacher social relationships. The students will take the beginning of the school year STAR (Renaissance) Mathematics benchmark test, they will then take a second benchmark test before Christmas after a relationship is usually formed. The study will look at the correlation between positive perceived student-teacher relationship and improved academic achievement on the STAR Mathematics.

Time required: The participants will complete this study during the students' mathematics class. This study will take place during the Fall of 2022.

Risks: Participation in this study involves minimal risk.

Benefits: Participants will provide their perceived thoughts on their relationships with their teachers. Teachers will be able to understand how students perceive these relationships and help create a more understanding and beneficial learning environment.

Confidentiality: Participant's identity will not be shared with anyone beyond the principal investigator, Dr. Ximena Suarez-Sousa, and the co-investigator, Sydney Lund. All individual responses to surveys and assessment scores will be recorded and tracked under an identification number and not the participant's name.

Appendix D

Method of Assent

Statement of Assent:

I will explain to the students that "your parents have given permission for you to participate in a research project I am doing, but you can still decide whether you would like to participate or not. If you do not wish to participate, there will be no consequences with your grade, our relationship, or in regards to your school day. This is completely voluntary. The only impact this study will have is to help me better understand how student-teacher relationships can help you learn. Here's exactly what will happen. You will come to math class, I will have you take a survey. You will also take your STAR Mathematics benchmark test as normal. I want to find out some better ways to help students learn and do better. Are there any questions?"

Appendix E

Phase I Questionnaire Pilot Response

Original and Updated Item	Teacher 1	Teacher 2	Teacher 3	Teacher 4	Teacher 5	Teacher 6
Facts, concepts, and principles are the most important things that students should acquire. In this class, my teacher feels facts, views, and mathematics rules are the most important things to learn.	~~facts, concepts, and principles~~ mathematics facts, concepts, and rules	~~acquire~~ learn	~~acquire~~ gain	~~principles~~ mathematics rules ~~concepts~~ views	~~principles~~ rules	~~acquire~~ can learn
I set high standards for students in this class. In this class, my teacher sets high goals for the class.	~~standards~~ goals	~~standards~~ goals	~~set~~ sets	--	~~in~~ for	~~set~~ sets
What I say and do models appropriate ways for students to think about issues in the content. In this class, my teacher models' good ways to think about problems in mathematics.	~~the content~~ in mathematics	~~appropriate~~ good	~~say and do~~ say and does	~~issues in the content~~ problems in mathematics	--	~~appropriate ways~~ good ways
My teaching goals and methods address a variety of student learning styles. In this class, my teacher's goals and methods use a variety of skills.	--	~~student learning styles~~ problem solving skill	~~teaching~~ teacher's	--	~~address~~ use	~~student learning styles~~ skills

Students typically work on course projects alone with little supervision from me. In this class, students usually work on course projects alone and with little supervision from the teacher.	--	~~typically~~ usually	--	~~typically~~ normally	--	--
Sharing my knowledge and expertise with students is very important to me. In this class, my teacher values sharing their knowledge and ability.	~~is very important to me~~ my teacher values	~~expertise~~ ability	--	~~very important~~ values	--	~~expertise~~ skill
I give students negative feedback when their performance is unsatisfactory. In this class, my teacher gives negative feedback when work is unsatisfactory.	--	--	--	--	--	--
Activities in this class encourage students to develop their own ideas about content issues. In this class, activities encourage students to create their own ideas about mathematics.	~~content issues~~ mathematics	~~develop~~ start	--	~~develop~~ create	--	--
I spend time consulting with students on how to improve their work on individual and/or group projects. In this class, my teacher spends time discussing with students how to improve their work on individual and/or group projects.	--	~~consulting~~ asking	--	--	--	~~consulting~~ discussing

Activities in this class encourage students to develop their own ideas about content issues. In this class, activities help encourage students to create their own ideas.	~~content issues~~	help	~~develop~~ create	~~about content issue~~	--	--
What I have to say about a topic is important for students to acquire a broader perspective on the issues in that area. In this class, what my teachers says about a topic helps students create new ideas.	~~to acquire a broader perspective on the issues~~ get new ideas	~~to acquire a broader perspective on the issues~~	~~is important for students to acquire a broader perspective on the issues in that area~~ helps students create new ideas in mathematics	~~acquire~~ create	~~acquire a broader perspective~~ find new ideas	~~issues in that area~~ problems in mathematics
Students would describe my standards and expectations as somewhat strict and rigid. In this class, I would describe my teacher's goals and expectations as somewhat strict and not flexible.	~~standards~~ goals	~~rigid~~ not flexible	--	~~standards~~ goals	--	~~rigid~~ not flexible

I typically show students how and what to do in order to master course content. In this class, my teacher typically shows students how and what to do to master the subject.	~~master course content~~ master the subject	--	~~master course content~~ master the mathematics problem	--	--	---
Small group discussions are employed to help students develop their ability to think critically. In this class, small group discussions are used to help students grow their ability to think critically.	~~develop~~ grow	~~employed~~ used	--	~~employed~~ utilized ~~develop~~ evolve	--	~~develop~~ grow
Students design one of more self-directed learning experiences. In this class, students design one or more self-directed learning experiences.	--	--	--	--	--	--
I want students to leave this course well prepared for further work in this area. In this class, my teacher wants students to leave well prepared for further work in mathematics.	~~this course~~	~~in this area~~ in mathematics	~~this course~~ this class	~~this course~~	~~in this area~~ in mathematics	--
It is my responsibility to define what students must learn and how they should learn it. In this class, my teacher feels it is their responsibility to define what students must learn and how they should learn it.	--	--	--	--	--	--

Examples from my personal experiences often are used to illustrate points about the material. In this class, examples from my teacher's personal experiences are often used to explain the material.	~~--~~	--	~~illustrate points~~ explain	--	~~illustrate~~ show	--
I guide students' work on course projects by asking questions, exploring options, and suggesting alternative ways to do things. In this class, my teacher guides students' work on projects by asking questions, exploring options, and suggesting different ways to do things.	--	~~alternative~~ different	--	~~alternative~~ different options	~~alternative~~ other	--
Developing the ability of students to think and work independently is an important goal. In this class, an important goal of my teacher's is developing the ability to think and work by yourself.	~~independently~~ by yourself	--	--	--	--	~~independently~~ alone
Lecturing is a significant part of how I teach each of the class sessions. In this class, lecturing (the teacher talking) is normally how my teacher teaches the class.	define lecturing	~~significant~~ mostly used	define lecture ~~significant~~ large part	~~significant part of how I teach~~ normally how my teacher teaches	~~class sessions~~ mathematics class	~~class sessions~~ class

I provide very clear guidelines for how I want tasks completed in this course. In this class, my teacher provides very clear guidelines/rules for how they want tasks completed.	~~in this course~~	--	~~in this course~~ in mathematics class	~~guidelines~~ rules	--	--
I often show students how they can use various principles and concepts. In this class, my teacher shows students how they can use various mathematics rules and ideas to solve the problems.	~~use various principles and concepts~~ use various mathematics rules and ideas to solve the problems	~~principles~~ mathematics rules	--	~~principles and concepts~~ mathematics rules and ideas	--	--
Course activities encourage students to take initiative and responsibility for their learning. In this class, course activities encourage students to take the lead and responsibility for their learning.	~~initiative~~ lead	~~initiative~~ action	~~initiative~~ lead	~~initiative~~ lead	~~initiative~~ lead	~~initiative~~ lead
Students take responsibility for teaching part of the class sessions. In this class, students take responsibility for helping to teach part of the class.	~~teaching part of~~ helping to teach part	~~class sessions~~ mathematics class	--	~~class sessions~~ class	~~teaching part of~~ helping teach	--

My expertise is typically used to resolve disagreements about content issues. In this class, my teacher's knowledge is typically used to settle disagreements or questions about content issues.	~~expertise~~ knowledge	~~expertise~~ understanding knowledge	~~resolve~~ settle	~~disagreements~~ disagreements or questions	~~resolve~~ answer	--
This course has very specific goals and objectives that I want to accomplish. In this class, there are very specific goals and objectives my teacher wants students to complete.	~~accomplish~~ complete	--	--	--	~~accomplish~~ complete	--
Students receive frequent verbal and/or written comments on their performance. In this class, students often receive verbal and/or written comments on their projects, tests, or homework.	~~performance~~ tests	--	~~frequent~~ often	~~performance~~ projects, tests, and homework	--	--
I solicit student advice about how and what to teach in this course. In this class, my teacher asks for student help about how and what to teach in this course.	~~solicit~~ ask ~~student advice~~ student help	~~solicit~~ get student opinion	~~solicit~~ have students vote	~~solicit~~ question students	~~solicit~~ ask ~~student advice~~ student help	~~solicit~~ discuss

Students set their own pace for completing independent and/or group projects. In this class, students set their own pace for completing independent and/or group projects.	--	--	--	~~independent~~ ~~alone~~	--	--
Students might describe me as a "storehouse of knowledge" who dispenses the fact, principles, and concepts they need. In this class, students might describe the teacher as the "center of knowledge" who gives the fact, views, and mathematics rules students need.	~~storehouse of knowledge~~ center of knowledge or holds all knowledge	~~dispenses the fact, principles, and concepts they need~~ gives information students need	~~dispenses~~ gives	~~they~~ students	~~principles~~ views ~~concepts~~ mathematics rules	~~fact, principle, and concepts~~ fact, views, and mathematics rules
My expectations for what I want students to do in this class are clearly defined in the syllabus. In this class, my teacher's goals for what students need to do are clearly defined in the syllabus or objectives.	~~syllabus~~ syllabus or objectives (we don't have syllabus)	~~syllabus~~ objectives	~~expectations~~ goals	~~expectations~~ goals	~~syllabus~~ objectives (we don't use a syllabus)	~~syllabus~~ board objectives
Eventually, many students begin to think like me about course content. In this class, many students begin to think like the teacher about the subject.	--	--	~~course content~~ mathematics	--	~~course content~~ subject	--
Students can make choices among activities in order to complete course requirements. In this class, students can make choices between activities to complete class requirements.	--	~~course~~ mathematics class	--	~~among~~ between	--	~~course~~ class

My approach to teaching is similar to a manager of a work group who delegates tasks and responsibilities to subordinates. In this class, my teacher's thoughts on teaching are similar to a manager of a workgroup who assigns tasks and responsibilities.	~~is~~ are ~~subordinates~~	~~delegates~~ assigns ~~subordinates~~	~~approach~~ thoughts ~~is~~ are	--	~~approach~~ attitude ~~subordinates~~	--
There is more material in this course than I have time available to cover it. In this class, there is more information than my teacher has time available to cover.	--	~~material~~ information	--	--	--	~~material~~ curriculum
My standards and expectations help students develop the discipline the need to learn. In this class, my teacher's goals and rules help students develop the control they need to learn.	~~discipline~~ control	~~standards~~ goals	--	~~standards~~ goals ~~expectations~~ rules	~~discipline~~ order	--
Students might describe me as a "coach" who works closely with someone to correct problems in how they think and behave. In this class, students might describe the teacher as a "coach" who works closely with students to correct problems in how they think and behave.	--	--	--	~~with someone~~ with students	~~with someone~~ students	~~in how they think and behave~~ in problem solving
I give students a lot of personal support and encouragement to do well in this course. In this class, my teacher gives students a lot of personal support and encouragement to do well.	~~in this course~~ in mathematics	--	~~in this course~~	--	--	~~in this course~~ in mathematics class

I assume the role of a resource person who is available to students whenever they need help. In this class, my teacher takes on the role of a resource person who is available to students whenever they need it.	--	~~assume~~ accept	~~assume~~ takes	--	--	--