Spring 5-13-2022

The Impact of Academic Tracking and Mathematics Self-Concept on Mathematics Achievement.

Kain M. Schow
Minnesota State University Moorhead, kain.schow@go.mnstate.edu

The Impact of Academic Tracking and Mathematics Self-Concept on Mathematics Achievement.

A Project Presented to
The Graduate Faculty of
Minnesota State University Moorhead

By

Kain M. Schow

In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in
Curriculum and Instruction

May 2022

Moorhead, MN

DEDICATION

I want to dedicate this project to the memory of my Grandma Schow. She was the person who instilled early on the importance of education. She always knew I could do more and pushed me to do my best.

My wife, Hunter, you have been a constant support in my life and throughout this process. You pushed me to start this process. You always listen and give your advice. We are crazy to have done this simultaneously. Still, we are coming out the other side relieved and grateful that we shared the experience.

ABSTRACT

This study examines the effects of academic tracking, in high school math, on students' mathematic self-concept (MSC) and how that correlates to students' mathematics achievement. This study measured students' MSC through a mathematics self-concept questionnaire, and measured mathematics achievement by the students' cumulative grade report in mathematics up to the time of the study. The population included 60 students in grades 10-12 who had been or were currently enrolled in math courses in the researcher's school district. The data collected will direct the researcher and school administration on the effects of academic tracking on students, allowing for further discussion about continuing tracking in the district.

TABLE OF CONTENTS

DEDICATION……………………………………………………………………………………2

ABSTRACT………………………………………………………………………………………3

LIST OF TABLES/FIGURES…….....………………………………………………………...6

CHAPTER 1. INTRODUCTION

Introduction…………………………………………………………………………..7

Brief Literature Review……………………………………………………………...7

Statement of the Problem…………………………………………………………….9

Purpose of the Study……………………………………………………….…………...9

Research Questions……………………………………………………………….…….9

Definition of Variables ………………………………………………………………10

Significance of the Study…………………………………………………………...10

Research Ethics……………………………………………………………………..…11

Permission and IRB Approval…………………………………………………...11

Informed Consent………………………………………………………….....……11

Researcher Bias……………………………………………………...………..11

Limitations…………………………………………………………………...…….12

Conclusions…………………………………………………………………………....12

CHAPTER 2. LITERATURE REVIEW

Introduction……………………………………………………………………………13

Body of the Review

Academic Achievement…….……………………………………………………….13

Academic/Math Self-Concept……………………………………………………….13

Academic Tracking………………………………………………………………15

Effect of Academic Tracking on ASC……..……………………………………...16

Theoretical Framework…………………………………………………………..17

Research Questions……………………………………………………………...….18

Conclusions……………………………………………………………………………18

CHAPTER 3. METHODS

Introduction……………………………………………………………………………20

Research Questions……………………………………………………………..…….20

Research Design…………………………………………………………………….20

Setting………………………………………………………………………………21

Participants…………………………………………………………………………21

Sampling……………………………………………………………………21

Instrumentation……………………………………………………………………..22

Data Collection…………………………………………………………….22

Data Analysis……………………………………………………………….22

Procedures…………………………………………………………………………..24

Ethical Considerations……………………………………………………………...24

Conclusions…………………………………………………………………………24

CHAPTER 4. DATA ANALYSIS AND INTERPRETATION

Introduction…………………………………………………………………………26

Data Collection……………………………………………………………………..26

Results………………………………………………………………………………27

RQ 1………………………………………………………………………27

RQ 2……………………………………………………………………….28

Data Analysis………………………………………………………………………29

Conclusion………………………………………………………………………….30

CHAPTER 5. ACTION PLAN AND PLAN FOR SHARING

Introduction…………………………………………………………………………31

Action Plan………………………………………………………………………….31

Plan for Sharing…………………………………………………………………….31

REFERENCES………………………………………………………………………….32

Appendix A: Math Self-Concept Questionnaire………………………………………36

Appendix B: IRB Approval…...……………………………………………………….37

Appendix C: District Approval……………………………………………………….38

Appendix D: Method of Assent……………………………………………………….39

Appendix E: Informed Consent Letter..………………………………………………40

LIST OF TABLES

Table 3.1 – Research Questions Alignment………………………………………………..….23

LIST OF FIGURES

Figure 4.1 – Mathematics Self-Concept Scoring…………………………...……………………28
Figure 4.2 – Student data MSC (x) vs. MAS (y)……………………………...………………29

CHAPTER 1

INTRODUCTION

Introduction

Mathematics has become increasingly critical in today's society with its connections to engineering and computer sciences, yet math has become less popular with high school students in some school districts. In my current Minnesota School District, the students have been tracked (split at grade level based on ability/achievement) in mathematics since they were in 8th grade. The goal of tracking students was to give those in the higher (accelerated) track more opportunities to further their mathematical thinking while at the same time allowing for more differentiated instruction for students in the lower (grade-level) track. However, in my experience, this has created a divide and negative connotation towards the students in the low track, who now see themselves lower than their peers, and ultimately think that they are less capable in math. This negative self-perception or negative self-concept towards mathematics, the researcher believes, has a direct connection to students' academic achievement.

Brief Literature Review

There has been much debate over assessing academic achievement to measure the effects of different variables. Most researchers base academic achievement on two factors: teacher assessed grades and standardized or achievement tests (Marsh et al., 2016; Trautwein et al., 2006). After establishing how to measure academic achievement, it was up to the researcher to determine which variables to evaluate. In most studies, the research focused on academic self-concept and tracked schooling.

Mathematics self-concept (MSC) is a student's "ratings of their skills, ability and enjoyment and interest in mathematics" (Erdogan & Sengul, 2014, p.596). According to Chen et al. (2013) and Timmerman et al. (2017), academic, and more specifically mathematic, self-concept directly affects a student's academic achievement. The authors claim that increasing students' self-concepts in mathematics will also increase their achievement scores in mathematics (Chen et al., 2013; Timmerman et al., 2017). Not only does an increased mathematics self-concept seem to correlate to achievement in mathematics, but it also has severe implications in other academic areas and future career paths. Marsh et al. (2016) state that students with lower self-concepts typically have a fixed mindset. This concept of fixed mindset leads students to attribute their failures to ability, not on effort, which lowers self-perception even lower in the long run (Marsh et al., 2016). Additionally, Salchegger (2018) claims that lowered self-perception students sell themselves short on their career paths. Pursuing the path they could reach through less effort and less ability, therefore settling for careers that fit their idea of their lowered self-worth (Salchegger, 2018).

Another factor that often plays a role in both MSC and academic achievement is whether or not students are in a tracked school. Tracking has been a constant topic of debate for decades in the world of academia. Researchers like Chiu et al. (2008) & Stiff et al. (2011) insist that tracking proves to be more beneficial for students in the higher track at the expense of those in the lower track. Whereas researchers Trautwein et al. (2006) contend that tracking is not the issue affecting students' academic/mathematic self-concepts and instead point towards the grading system placed on students as the primary effector. Then there are researchers such as Hanushek & Wößmann (2006) who believe that tracking does appear to have a role on students' self-concepts, which does lead to an achievement gap when tracking starts at an early age. In addition, Hanushek & Wößmann (2006) say that mathematics achievement is always lower in a tracked system.

Statement of the Problem

The problem that had become increasingly evident for students placed in the lower (grade-level) track view themselves lower than those in, the higher (accelerated track). Students in the lower track automatically call themselves the "dumb" math class. The difference between the two tracks is minimal in this small school setting, with students receiving the same curricula at different grade levels (e.g., 9th vs. 10th-grade geometry). Mathematics was the only subject area where students in this district were tracked and had systematic separation. As a result, students in this track had a deficit view of themselves which may directly impact their self-concept.

Purpose of the Study

The study aimed to examine the effects of tracking on students' mathematics self-concepts while also examining the effects of MSCs on student achievement. Overall, this study aimed to find a connection between tracking and mathematics achievement, with the intent to show that student self-concept was a bridge between the two. As an educator who teaches a majority of the lower track math courses, I am constantly battling their negative self-perceptions and inspiring them to push themselves, to show that they are just as capable as those "above" them.

Research Questions

1. What effect does placing a student in a track system have on that student's math self-concept?
2. What effect does a student's math self-concept have on that student's mathematic achievement?

Definition of Variables

The following are the variables of study:

Variable A (Academic Tracking): The independent variable was academic tracking in this study. "Tracking, or ability grouping, is the separation of students into different classrooms, or tracks, on the basis of ability in different subject areas" (Chiu et al., 2008, p.125). This system was already in place within my school in mathematics for grades 8-12.

Variable B (Mathematics Self-Concept (MSC)): In this study, the first dependent variable was mathematics self-concept. MSC is a student's self-perception of their abilities and their interest/enjoyment in the area of mathematics (Erdogan & Sengul, 2014). In addition, this study examined the effects of academic tracking on students' MSC using a Math Self-Concept Questionnaire (Appendix A).

Variable C (Mathematics Achievement): Mathematics achievement was the second dependent variable. Mathematics achievement was meeting grade-level standards. This study measured mathematics achievement using the students' cumulative grade reports in mathematics up to the time of the study.

Significance of the Study

Tracking is a well-known topic in education, with favorable outcomes in some situations and less than favorable in others. The significance of this study was to see if that holds true in the small school setting where the tracks are not inherently different. The intent was to show that the positive effects of the track system do not outweigh the adverse effects. Trautwein et al.’s (2006) research proved that tracking was more effective when implemented school-wide. In their study of 17,000 German 9th graders, the students were separated into tracks. The two tracks were entirely separated by physical settings, with lower-track students attending different schools than those in higher tracks (Trautwein et al., 2006). Their research shows that an effective track system does not track one subject but all subject areas.

Research Ethics

Permission and IRB Approval

In order to conduct this study, the researcher sought MSUM's Institutional Review Board (IRB) approval to ensure the ethical conduct of research involving human subjects (Mills & Gay, 2019). Likewise, authorization to conduct this study was sought from the school district where the research project will occur (See Appendix B and C).

Informed Consent

Protection of human subjects participating in research was assured. Participant minors were informed of the purpose of the study via the Method of Assent (See Appendix D) that the researcher will read to participants before the beginning of the study. Participants will know that this study is part of the researcher's Master's Degree Program and will benefit his teaching practice. Informed consent means that the participants' parents have been fully informed of the purpose and procedures of the study for which consent is sought and that parents understand and agree, in writing, to their child participating in the study (Rothstein & Johnson, 2014). Confidentiality was protected by using pseudonyms (e.g., Student 1) without utilizing any identifying information. The choice to participate or withdraw at any time was outlined both verbally and in writing.

Researcher Bias

The researcher’s viewpoint in this study was that the current system in place was not only holding the lower track students back from higher achievement, but it was also not accelerating the achievement scores of those in the higher track. The researcher recognizes this statement as an opinion and will use data from their study to draw factual conclusions.

Limitations

One limitation in this study was the relatively small sample size that the researcher used. The researcher provided the MSCQ to grade 10-12 students, or approximately 60 students. The small sample size also came with limited accessibility. The researcher had access to about half of that sample, so the researcher needed to distribute and retrieve materials in a short homeroom time at the end of the school day.

Conclusions

In this chapter, the researcher has introduced the current issue of academic tracking and how that couples with mathematics self-concept to affect student achievement in that subject area. Tracking along with students' math self-concepts has become an increasing area of concern within my own teaching experience. This study aimed to find evidence to fight for change within the researcher’s small school district. There have been numerous studies relating tracking to student achievement (both negative and positive), studies showing connections between academic self-concept and academic achievement, and studies showing the connecting between tracking and academic self-concept. In the following chapter, this study will examine past research and the most recent research to conclude the effects in each area.

CHAPTER 2

LITERATURE REVIEW

Introduction

The purpose of this study was to examine the effects of academic tracking (ability grouping) and academic self-concept (ASC) on students' academic achievement. More specifically, the study was examining the effects of academic tracking on students' math self-concept (MSC) and how that affects achievement in mathematics.

Academic Achievement

Academic achievement is a very arbitrary thing to examine in education. According to Marsh et al. (2016), "there is an ongoing concern about the relative merits of assessing achievement on the basis of school grades and standardized achievement tests" (p.1275). Marsh et al. (2016) contend that "test scores and school grades should ideally be juxtaposed as separate constructs within the same study" (p.1276). Marsh et al. (2016) also had students complete the PALMA Mathematical Achievement Test, which measures "students' modeling and algorithmic competencies in arithmetic, algebra, and geometry" (Marsh et al., 2016, p.1278). Through self-distributed achievement tests, researchers can get the most current data without backtracking through standardized test data, which might not be comparable on a national or global level. Nevertheless, some researchers still argue that standardized achievement tests are the most vital indicators of student achievement. Standardized tests "can be used to compare achievement of students in different classrooms" (Trautwein et al., 2006, p.792).

Academic/Math Self-Concept

Academic self-concept is (ASC) defined as "students' self-perceptions of competence in academics" (Arens et al., 2017, p.621). Similarly, mathematics self-concept (MSC) is a student's "ratings of their skills, ability and enjoyment and interest in mathematics" (Erdogan & Sengul, 2014, p.596). The idea of MSC is synonymous with mathematics achievement. When examining the domain of self-enhancement, "academic self-concept it a determinant of academic achievement, and enhancing academic self-concept improves academic performance" (Chen et al., 2013, p.172). Timmerman et al. (2016) state that there is a "bidirectional relationship; increases in academic self-concept lead to increases in academic achievement and vice versa" (Timmerman et al.,2016, p.90). Through their study Timmerman and colleagues (2016) were able to find a positive correlation between math self-concept and math achievement, meaning "students who have a greater belief in … their own math skills and achievement achieve higher results" (Timmerman et al., 2016, p.98).

The research by Lou et al. (2014) aimed to see how student self-construal (self-concept) related to student motivation, specifically achievement goals. Their findings show that achievement goals are mediating variables directly related to math self-concept, math anxiety, and overall math achievement (Lou et al., 2014). Another factor that had shown a correlation in past research is student achievement in other domains. For example, according to Marsh et al. (2018), students with high achievement in verbal skills will often detract from high math self-concept. This constant remains true even if a student had good math achievement, but their verbal achievement is higher in comparison, they will still maintain a lower MSC (Marsh et al., 2018).

According to Salchegger (2018), "students' academic self-concepts have important implications for their futures" (p.405). mainly since high achieving students tend to feel less competent, and low achieving students are more competent than those in ability groups. These ideas of self-misconception often "shape students' educational and occupational careers" (Salchegger, 2018, p.405). According to Marsh et al. (2016), students that carry a fixed mindset are more likely to point towards outcomes to showcase their ability. Meanwhile, those with a growth mindset are more likely to view outcomes as a showcase of effort (Marsh et al., 2016); this leads to a negative effect on ASC as students who fail with a fixed mindset do not believe that there is anything that they can do to remedy the situation. Whereas students with growth mindsets can realize that they need to make more effort to remedy the situation, their ASC may not be as affected.

Academic Tracking

Tracking or ability grouping is the idea of splitting students into homogenous groups. According to Guill et al. (2017), grouping students occurs in two distinct ways: grouping students by ability based on a single course (e.g., math) or tracking and grouping students by ability group across all content areas. The primary determinant of student placement is student achievement, therefore creating ability groups (Trautwein et al., 2006). Tracking has been in place for decades, with the idea that it would benefit both students who need more rigorous coursework and those who find the coursework too challenging (Stiff et al., 2011). Although, according to Stiff et al. (2011), "tracking benefits those placed in the higher tracks, many students placed in the lower tracks find themselves in an educational downward trajectory" (p.63). According to Gamoran (1992), a comparatively "productive tracking system is one that results in higher average achievement than a less productive one" (p.813). Gamoran (1992) contends that track systems affect educational inequality, citing multiple sources that found that students placed in the higher tracks have more learning opportunities than students in lower tracks. Although students choose which track they are in on occasion, school officials influence their decision (Gamoran, 1992). Stiff et al. (2011) further state that students placed into tracks often do not have the chance/opportunity to change tracks as they progress through school.

Becker et al. (2012) assert that one way to measure the effects of tracking is to examine psychometric intelligence (PI). Becker et al. (2012) concluded academic-track students showed a more significant increase in PI than nonacademic-track students in grades 7-10. Hanushek & Wößmann (2006) examined the effects of early tracking on student achievements scores compared to a non-tracked school system in a multi-country cross-comparison. The results seem to demonstrate that mathematics achievement is always lower in a tracked system versus the non-tracked (comprehensive) system (Hanushek & Wößmann, 2006). Thus, they contend that students do not earn higher average achievement scores. However, the distribution of outcomes is lesser to the extent that they deem early tracking unbeneficial (Hanushek & Wößmann, 2006). One final effect that tracking seems to place on students is their likelihood to seek help. In a study done by Butler (2008), the author found that students in a tracked school were much less likely to seek help, particularly in math. Butler (2008) alludes that students in higher tracks tend to have higher self-concepts and therefore do not want to seek help in fear of ruining their image. Meanwhile, students in lower tracks are more likely to ask for help than those in the higher track but often have lower self-concepts and do not improve upon that self-construal (Butler, 2008).

Effect of Academic Tracking on ASC

According to Chiu et al. (2008), based on their study of 170 7th-grade students, the effects of tracking on students' ASC are always differing. The authors state that some research indicates a positive correlation between high-track students and high self-concept. In contrast, there is a positive correlation between low-track students and low self-concept. However, other research has indicated the opposite to be true. In fact, according to Trautwein et al. (2006), in their studies consisting of nearly 17,000 German 9th-grade students found, there is no effect of track level on self-concept when the analysis controlled for student grades. However, Trautwein et al. (2006)

also state that there is a need to develop cognitive (academic achievement) and non-cognitive (self-concept) functions. Wouters et al. (2012) further attest to the difficulties with studying tracking related to self-concept because so many variables could play a part in the study. Alluding to the research, students in lower tracks tend to receive lower grades and, therefore, have a lower self-concept as they connect it to their achievement, not just because they are in the lower track. Another variable that could attribute to differing self-concepts is the gender variable, where girls have shown lower academic self-concept than boys of the same age range (Wouters et al.,2012).

Theoretical Framework

Most research behind academic self-concept and its relationship to academic achievement can be attributed to Herbert Marsh and John Parker's model of Big-Fish-Little-Pond Effect (BFLPE) (1984). This model assumes that academic self-concept is determined by comparing academic performance with immediate peers (Wouters et al., 2012). The research related to academic self-concept is built on two assumptions: a) students compare their academic ability with their peers' academic ability, and b) students use their perceived ability to measure their self-concept (Marsh & Parker, 1984). According to Wouters et al. (2012), there has been a positive correlation with student self-concept when moved down from a higher track into a lower track. Students who initially are tracked higher gain a boost to their self-concept as now they are higher achievers ("big fish") when moved into a lower track ("small pond"). BFLPE has an adverse effect when someone has been tracked low but shows high enough achievement to jump to the higher track now realizes they are just a "small fish" in a "bigger pond," reducing their self-concept. According to Salchegger (2016), "the stronger the BFLPE, the less realistic students' self-perceptions of their own abilities" (p.405). This quote means that high achieving students placed into higher tracks tend to have lower self-concepts than those who are low achieving that have been placed into a lower track. The results from Salchegger's research suggest that BFLPE is more evident in schools that track students earlier. Tracking earlier allows the students' perception to fit the BFLPE model over time, affirming that students' track placement may directly affect their self-perception but not necessarily their achievement.

This study followed a pragmatist paradigm. The underlying ideas of academic achievement and the influences of tracking and academic self-concept are constantly being debated and shifted decade after decade; this study aimed to examine the effects of these influences on the students in my small school setting. The research aimed to show that the system already in place does not lead to higher achievement. The study implemented surveys and student grades to examine the quantitative and qualitative data needed to conclude the success or failure of the system. From this data, it may be beneficial to readjust and conduct action research to find a solution to the underlying problem of student achievement.

Research Questions

1. What effect does placing a student in a track system have on that student's math self-concept?
2. What effect does a student's math self-concept have on that student's mathematic achievement?

Conclusions

Overall the research points towards a strong connection between academic self-concept and student achievement. Several variables affect students' self-concept, and one of the significant variables was whether or not students are in an academically tracked school system. The tracked system places more pressure on students in higher tracks to outperform others in their track, while those placed in the lower track feel that they are shoved to the bottom and typically are not given challenges by their teachers or peers to reach higher. Studies have shown that students feel more inadequate when this happens no matter which tracks they are in, overall lowering their self-concept and potentially lowering overall average achievement by all students. In the following chapter, the researcher will discuss how student grades, and questionnaire results was used to gather data on this topic.

CHAPTER 3

METHODS

Introduction

Tracking has been a highly contested topic in education over the last 20 years. Research has shown that tracking had both positive (Trautwein et al. 2006, Becker et al. 2012) and negative (Chiu et al. 2008, Stiff et al. 2011, Hanushek 2006, Gamoran 1992) effects, yet none can agree on the factors that make for effective tracking within the school system. Furthermore, the same research shows that tracking is not a one-size-fits-all model and that school districts may need to adapt their system based on student population needs or based on staff availability. This study provided further research by examining the effects of tracking on student self-concepts in mathematics. When couched within the track system, how does that affect student achievement in mathematics?

Research Questions

1. What effect does placing a student in a track system have on that student’s math self-concept?
2. What effect does a student’s math self-concept have on that student’s mathematic achievement?

Research Design

This study followed a pragmatist paradigm and lends itself to the correlational research design. In this study, the research examined the correlation between tracking (independent variable) and students' math self-concepts (dependent variable); the data for math self-concept was collected through the Math Self-Concept Questionnaire (MSCQ) (Appendix A). The study also examined the correlation between tracking and student achievement (dependent variable); the data for student achievement was collected from the student's cumulative grade reports in mathematics up to the time of the study. The independent variable was already in place within the school district so that the study occurred without experimentation.

Setting

This study took place in a rural community in North West Minnesota. The local population was about 765 people and employs roughly 300 residents, with 16% healthcare, 13% retail, and 12% agriculture. Unfortunately, the community also has a high poverty rate compared with the state, with 16% of residents living below the poverty line, compared to the state average of 9%. In addition, the local diversity was minimal, with 94% of the residents being White/Caucasian, 1% Black, 1% two or more (Non-Hispanic), and the others having under 1% representation.

Participants

The students participating in this study were in grades 10-12, encompassing about 60 students. The student population at the high school (grades 7-12) consists of 43% female, 55% male, and 2% non-binary students. The student population ethnicity reports 83% White, Native American, Hispanic, and those identifying as two or more, each representing about 6% of the population. Roughly 39% of students received free/reduced lunch in high school, and 16% fell under special education services.

Sampling

A purposive sampling of students in the high school was done. The research focused on students in grades 10 – 12 as they were the most familiar with the tracking system and could reflect on more experiences.

Instrumentation

For this study, the researcher created a Math Self-Concept Questionnaire (MSCQ) (May, 2009), (Appendix A) to calculate student math self-concept (MSC). The students answered 30 items by rating their answers on a scale of 0 (1) (no response) to 5 (6) (usually); students also had the option to not respond to any item on the questionnaire. The student response numbers from the MSCQ were averaged to find their MSC score; average scores of 1 or 2 were considered low MSC, 3 or 4 neither high/low MSC, and 5 or 6 high MSC. Students whose questionnaires consisted of mostly “no response” were not considered in the final data analysis.

Data Collection

In this study, the researcher collected data through the Math Self-Concept Questionnaire (MSCQ), available on paper (Appendix A) and an online version (Google Form). The students answered each item on the MSCQ, and the online data was automatically stored in Google Drive. The researcher collected and tallied the paper copies and combined them with the online score data. In addition, student achievement data was collected from student grade reports which the researcher had access to through the online grade book system within the school district.

Data Analysis

For the data collected from the Math Self-Concept Questionnaire (MSCQ), the mean, median, and standard deviation response scores were calculated for each student and stored in an excel sheet based on their track placing (advanced or grade level). Next, the researcher compared scores to see a correlation between student Math Self-Concept (MSC) and track placement. Similarly, the MSC scores were compared to student math grades to see if there was a correlation between the two; a scatterplot will demonstrate the type of correlation, if any, that exists.

Ultimately, if there was a correlation between MSC and math grades, the researcher looked to show a transitive correlation between student track level and math grades.

Research Questions and System Alignment

Table 3.1 below describes the alignment between the study's Research Questions and the methods used in this study to ensure that all study variables have been accounted for adequately.

Table 3.1:
Research Questions Alignment

1 Research Paradigm	2 Research Design	3 Research Question	4 Variables	5 Instrument(s)	6 Source(s) and expected Sample Size	7 Data Analysis
Quantitative	Comparative Study	What effect does placing a student in a track system have on that student's math self-concept?	IV: Track System DV: Math self-concept	IV: Student are tracked in grades 8-11, with an accelerated track and grade level track DV: Math self-concept Questionnaire (MSCQ) (See Appendix A)	Students grades: 10 – 12 Sample Size: Approximately 60 students	The MSCQ scores for each student was calculated and entered into an Excel spreadsheet. Mean score values was calculated by accelerated track and grade level track separately. Students with lower mean scores was considered to have low MSC
Quantitative	Correlational Study	What effect does a student's math self-concept have on that student's mathematic achievement?	IV: Track System DV: Math achievement	IV: Student are tracked in grades 8-11, with an accelerated track and grade level track DV: Students Latest Reported Grades	Students grades: 10 – 12 Sample Size: Approximately 60 students	Students' grades was compared to their MSC scores to see if there was a correlation.

Procedures

The researcher gathered letters of consent from students, over a two-week time period. After the two weeks, students were given the Math Self-Concept Questionnaire (MSCQ) in paper or online forms and asked to complete it. The students were given another two weeks to complete their questionnaire and return (submit) it to the researcher. The students in this study's school district were already tracked into two groups, advanced and grade-level, and remained that way for the duration of the study. Then, the researcher analyzed, based on track level, the data collected from the MSCQ.

After the first data set had been analyzed, the researcher looked at the second piece of data collected, student math grades. The researcher then followed a similar process for analyzing student grades and determining correlation scores between student tracks and student Math Self-Concept (MSC) scores. The researcher used approximately 2-3 weeks to analyze student data before determining the final correlations between the independent variable (tracking) and dependent variables (MSC and Mathematic Achievement).

Ethical Considerations

Most of the participants in this study were students under 18, so informed consent (Appendix E) from parents/guardians was a requirement. Through this informed consent, the participants and guardians understood that this study was strictly for research and did not affect the students' education whether they chose to participate in the research or not. In addition, all participants in this study were kept anonymous through pseudonyms.

Conclusions

This chapter's objective was to give the reader an insight into the student demographics and population demographics of the surrounding area present in this study. This chapter also examined the logistical elements of the study and how the researcher intended to determine a correlation between the independent and various dependent variables. The chapter concluded by delving into the research procedures and what ethical decisions had been considered. Finally, the chapters to follow will examine the research results conducted in this study.

Chapter 4

DATA ANALYSIS AND INTERPRETATION

Introduction

The issue at hand in this study was that students placed into academic tracks, particularly in mathematics, seem to suffer setbacks when placed in the lower (grade-level) track. At the same time, those placed in the upper (advanced) track are not gaining much from being separated. Tracked students' self-perceptions seem to wane; some feel like "big-fish" and do not realize that they were just in a small pond, while others see themselves as "small-fish" in an even smaller pond, not believing there is any room for growth.

This study aimed to determine if students tracked in math courses since grade 8 experienced any adverse effects. The study first examined whether being placed in the grade-level track versus the upper-level track has affected students' perception of their abilities as math students (Mathematics Self-Concepts (MSC)). The study then examined whether there was a correlation between a student's MSC score and their overall Mathematics Achievement Scores (MAS), the culmination of their math letter grades up to the time of the study. The study's hypothesis was that tracking students in mathematics was having a transitive effect on students' MAS.

Data Collection

The researcher delivered and gathered letters of consent from students over two weeks. All students were then given the Mathematics Self-Concept Questionnaire (MSCQ) through Google Forms and asked to complete it. The students had two weeks to complete their questionnaire. The students in this study's school district were already tracked into two groups, upper-level, and grade-level, and remained that way for the duration of the study. Then, the researcher analyzed the data collected from the MSCQ.

The researcher looked at the second piece of data collected, student math grades. Being a teacher in the school district allowed the researcher to pull student grades directly from the grade book system. The researcher then followed a similar process for analyzing student grades and determining correlation scores between student tracks and student Math Self-Concept (MSC) scores. The researcher used approximately two weeks to analyze student data before determining the final correlations between the independent variable (tracking) and dependent variables (MSC and Mathematics Achievement).

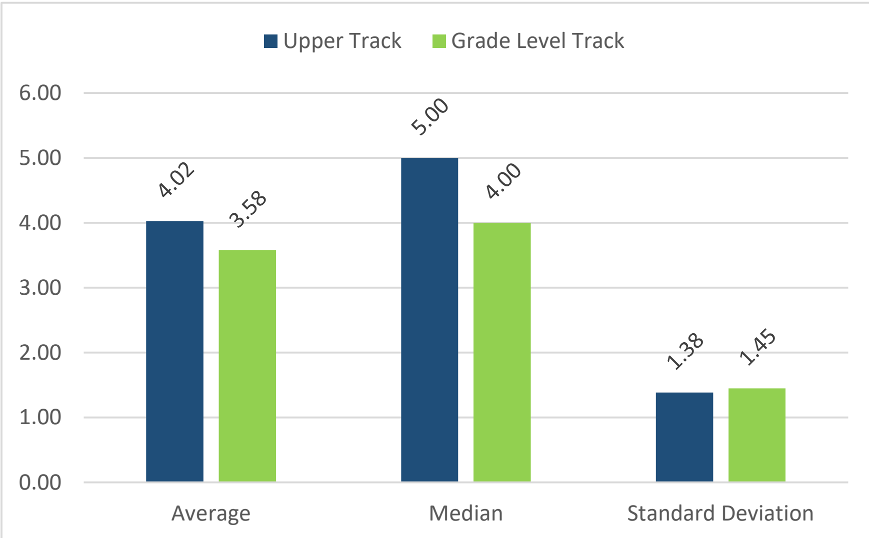
Results

RQ 1: What effect does placing a student in a track system have on that student's math self-concept?

Figure 4.1 represents the average and median math self-concept scores for both the upper track and the grade level track students. Also, included in Table 1 is the standard deviation for both data sets. The average response score for the upper track was 4.02, the median score was 5 and with a standard deviation of 1.38. The average response score for the grade level track was 3.58, the median score was 4 and with a standard deviation of 1.45.

Figure 4.1

Mathematics Self-Concept Scoring



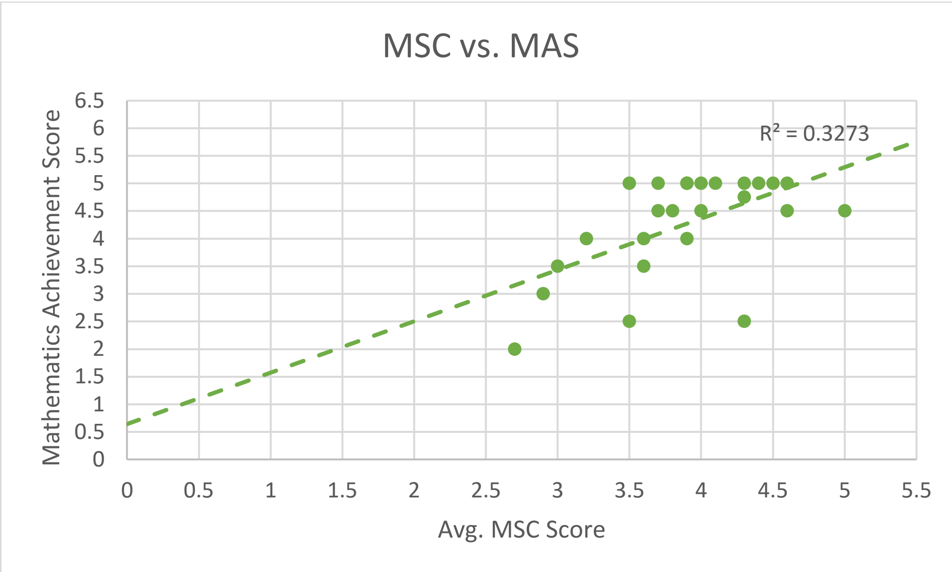
Note. Upper Track Responses = 17, Grade Level Track Responses = 8, total (N) = 25

RQ 2: What effect does a student's math self-concept have on that student's mathematic achievement?

Figure 4.2 shows the correlation data for all students' average mathematics self-concept (MSC) scores compared to the students' mathematical achievement scores (MAS). The chart appears to show a positive correlation based on the linear regression model, which also shows a coefficient of determination to be 0.3273, resulting in a correlation coefficient of 0.5721.

Figure 4.2

Student Data MSC (x) vs. MAS (y)



Data Analysis.

The results shown in Figure 4.2 suggest a correlation between a student's math self-concept and a student's mathematical achievement level. However, it does not suggest that tracking students is a leading cause to lower math self-concept scores.

Looking at the data presented in RQ 1**,** the average MSC scores between the tracks only differ by 0.44, with both scores (4.02 and 3.58) falling into the neither high, students who scored between 5-6 nor low, students who scored between 1-2 on MSC score range. The median between the tracks differs by 1, placing students in the upper track with a median score of 5 in the high MSC score range. Meanwhile, students in the lower track with a median score of 4 remain in the neither high/low MSC score range. The results are not entirely unexpected. Wouters et al. (2012) attest that it is difficult to conduct studies connecting tracking to self-concept because so many variables could play a part in the study. Alluding to the research, students in lower tracks tend to receive lower grades and, therefore, have a lower self-concept as they connect it to their achievement, not just because they are in the lower track. Likewise, Trautwein et al. (2006) suggest that the most significant variable for students' self-concepts is not the track on which they are placed; it is their perception of their mathematical achievement based on their school marks.

The data presented for RQ 2 was a somewhat expected result. Students with higher MSC scores also tend to have higher MAS. According to Chen et al. (2013), academic self-concept and academic achievement are synonymous. Students who have higher self-perception tend to do better in those areas academically. Likewise, research done by Marsh and Parker (1984) suggest students fall into a Big Fish Little Pond Effect (BFLPE), where they may see themselves as a high achiever "big fish" in their respective track. However, when moved into another, they might realize they were only part of a "small pond." This BFLPE leads students to have a higher self-concept when they can quickly compare their abilities to those of their peers and assess whether they are the higher achiever. This assessment may also have an adverse effect and lead some students to shrink back as "small fish" when they realize they are not the top achiever, which lowers the MSC scores and MAS. The data shows the variables MSC scores and MAS were moderately-positive in correlation, $r(23) = .57$, $p = .0028$. This data means that there are tendencies for high X-variable (MSC) scores to go with high Y-variable (MAS) scores (and vice versa).

Conclusion

Based on the results from this study, mathematics self-concept shares a moderately strong connection to mathematic achievement. The results showed that students with higher self-perceptions tended to have higher achievement scores. However, at the time of the study, it was inconclusive whether or not students' track level had a significant effect on the students' self-perceptions. The study was only able to look at a small sample of the intended population, yet there are still meaningful results to support this conclusion.

Chapter 5

IMPLICATIONS FOR PRACTICE

Introduction

This study aimed to determine if students' mathematics self-concepts (MSCs) were affected by their mathematics track placement. The study also looked to connect MSC and mathematics achievement, which could ultimately imply that tracking students may affect their achievement. Although the research presented above suggests that MSC does affect students' achievement, there was not enough evidence to support that a student's track placement is the primary variable in high/low MSC scores.

Action Plan

There is not enough evidence to support the need to end tracking in math courses. However, the researcher believes that moving forward, it will become increasingly important to examine and work towards improving students' self-perceptions. The results from this study are a strong indicator that to raise mathematics achievement overall, it comes down to building up students' confidence in their mathematical abilities. The goal coming out of this study is to research and incorporate strategies to build students' self-concepts, especially in math. The long-term goal for success is to eliminate the stigma about being or not being a "math person," stopping the effects it has when it comes to trying math and finding success in the math classroom.

Plan for Sharing

The researcher will share this information with all teachers within the district. This research does need not only apply to math courses. Academic self-concept is sure to play a significant role in all other courses, so the focus will be to examine other subject areas to see if similar conclusions can be made, to further discussion about ways to raise student achievement scores in all subjects.

REFERENCES

Arens, A. K., Marsh, H. W., Pekrun, R., Lichtenfeld, S., Murayama, K., & vom Hofe, R. (2017). Math Self-Concept, Grades, and Achievement Test Scores: Long-Term Reciprocal Effects Across Five Waves and Three Achievement Tracks. *Journal of Educational Psychology*, 109(5), 621–634. https://doi.org/10.1037/edu0000163

Becker, M., Lüdtke, O., Trautwein, U., Köller, O., & Baumert, J. (2012). The differential effects of school tracking on Psychometric Intelligence: Do academic-track schools make students smarter? *Journal of Educational Psychology*, *104*(3), 682–699. https://doi.org/10.1037/a0027608

Butler, R. (2008). Ego-involving and frame of reference effects of tracking on elementary school students' motivational orientations and help seeking in math class. *Social Psychology of Education*, 11(1), 5–23. https://doi.org/10.1007/s11218-007-9032-0

Chen, S.-K., Yeh, Y.-C., Hwang, F.-M., & Lin, S. S. J. (2013). The relationship between academic self-concept and achievement: A multicohort–Multioccasion Study. *Learning and Individual Differences*, *23*, 172–178. https://doi.org/10.1016/j.lindif.2012.07.021

Chiu, D., Beru, Y., Watley, E., Wubu, S., Simson, E., Kessinger, R., Rivera, A., Schmidlein, P., & Wigfield, A. (2008). Influences of Math Tracking on Seventh-Grade Students' Self-Beliefs and Social Comparisons. *The Journal of Educational Research* (Washington, D.C.), 102(2), 125–136. https://doi.org/10.3200/JOER.102.2.125-136

Erdogan, F., & Sengul, S. (2014). A Study on the Elementary School Students' Mathematics Self Concept. *Procedia, Social and Behavioral Sciences*, 152, 596–601. https://doi.org/10.1016/j.sbspro.2014.09.249

Gamoran, A. (1992). The variable effects of high school tracking. *American Sociological Review*, *57*(6), 812. https://doi.org/10.2307/2096125

Guill, K., Lüdtke, O., & Köller, O. (2016, October 28). Academic tracking is related to gains in students' intelligence over four years: Evidence from a propensity score matching study. Retrieved from https://www.sciencedirect.com/science/article/pii/S0959475216301633

Hanushek, E. A., & Wößmann, L. (2006). Does Educational Tracking Affect Performance and Inequality? Differences- in-Differences Evidence Across Countries. *The Economic Journal (London)*, 116(510), C63–C76. https://doi.org/10.1111/j.1468-0297.2006.01076.x

Luo, W., Hogan, D., Tan, L. S., Kaur, B., Ng, P. T., & Chan, M. (2014). Self-construal and students' math self-concept, anxiety and achievement: An examination of achievement goals as mediators. *Asian Journal of Social Psychology*, *17*(3), 184–195. https://doi.org/10.1111/ajsp.12058

Marsh, H. W., & Parker, J. W. (1984). Determinants of student self-concept: Is it better to be a relatively large fish in a small pond even if you don't learn to swim as well? *Journal of Personality and Social Psychology*, *47*(1), 213–231. https://doi.org/10.1037/0022-3514.47.1.213

Marsh, H. W., Pekrun, R., Lichtenfeld, S., Guo, J., Arens, A. K., & Murayama, K. (2016). Breaking the double-edged sword of effort/trying hard: Developmental equilibrium and longitudinal relations among effort, achievement, and academic self-concept. *Developmental Psychology*, *52*(8), 1273–1290. https://doi.org/10.1037/dev0000146

Marsh, H. W., Pekrun, R., Murayama, K., Arens, A. K., Parker, P. D., Guo, J., & Dicke, T. (2018). An integrated model of academic self-concept development: Academic self-concept, grades, test scores, and tracking over 6 years. *Developmental Psychology*, 54(2), 263–280. https://doi-org.trmproxy.mnpals.net/10.1037/dev0000393.supp (Supplemental)

May, Diana K. (2009). Mathematics Self-Efficacy and Anxiety Questionnaire. University of Georgia.

Mills, Geoffrey E., & Gay, L.R (2019). *Educational Research: Competencies for Analysis and Applications.* Pearson.

Rothstein, Laura F., & Johnson, Scott F. (2014). Special Education Law. SAGE Publications, Inc

Salchegger, S. (2016). Selective School Systems and academic self-concept: How explicit and implicit school-level tracking relate to the big-fish-–little-pond effect across cultures. *Journal of Educational Psychology*, *108*(3), 405–423. https://doi.org/10.1037/edu0000063

Stiff, L. V., Johnson, J. L., & Akos, P. (2011). Chapter 6 Examining What We Know for Sure: Tracking in Middle Grades Mathematics. In Disrupting Tradition: Research and Practice Pathways in Mathematics Education 63-9. Reston, VA: National Council of Teachers of Mathematics.

Sung, Y.-T., Huang, L.-Y., Tseng, F.-L., & Chang, K.-E. (2014). The aspects and ability groups in which little fish perform worse than big fish: Examining the big-fish-little-pond effect in the context of school tracking. *Contemporary Educational Psychology*, *39*(3), 220–232. https://doi.org/10.1016/j.cedpsych.2014.05.002

Timmerman, H. ., Toll, S. W. ., & van Luit, J. E. . (2017). The relation between math self-concept, test and math anxiety, achievement motivation and math achievement in 12 to 14-year-old typically developing adolescents. *Psychology, Society & Education*, 9(1), 89–103. https://doi.org/10.25115/psye.v9i1.465

Trautwein, U., Lüdtke, O., Marsh, H. W., Köller, O., & Baumert, J. (2006). Tracking, Grading, and Student Motivation: Using Group Composition and Status to Predict Self-Concept and Interest in Ninth-Grade Mathematics. *Journal of Educational Psychology*, 98(4), 788–806. https://doi.org/10.1037/0022-0663.98.4.788

Wouters, S., De Fraine, B., Colpin, H., Van Damme, J., & Verschueren, K. (2012). The effect of track changes on the development of academic self-concept in high school: A dynamic test of the big-fish–little-pond effect. *Journal of Educational Psychology*, *104*(3), 793–805. https://doi.org/10.1037/a0027732

Appendix A

In order to better understand what you think and feel about your mathematics courses, please respond to each of the following statements on a scale of 1 to 5.

	Question	No Response	Never	Seldom	Sometimes	Often	Usually
1.	**I have been able to understand mathematics**	**NR**	**1**	**2**	**3**	**4**	**5**
2.	**I have done well in my mathematics courses.**	**NR**	**1**	**2**	**3**	**4**	**5**
3.	**I have enjoyed mathematics.**	**NR**	**1**	**2**	**3**	**4**	**5**
4.	**I am the type of person who is able to learn mathematics well.**	**NR**	**1**	**2**	**3**	**4**	**5**
5.	**I have been happy in my mathematics courses.**	**NR**	**1**	**2**	**3**	**4**	**5**
6.	**Mathematics instructors have been willing to help me learn the material.**	**NR**	**1**	**2**	**3**	**4**	**5**
7.	**I have asked questions in my mathematics classes.**	**NR**	**1**	**2**	**3**	**4**	**5**
8.	**I have sought help from mathematics instructors outside of class.**	**NR**	**1**	**2**	**3**	**4**	**5**
9.	**I have set goals in my mathematics classes.**	**NR**	**1**	**2**	**3**	**4**	**5**
10.	**I have worked with other students in my mathematics classes.**	**NR**	**1**	**2**	**3**	**4**	**5**
11.	**I have worked hard in mathematics classes.**	**NR**	**1**	**2**	**3**	**4**	**5**
12.	**I regularly do assigned homework in my mathematics classes.**	**NR**	**1**	**2**	**3**	**4**	**5**
13.	**Working on mathematics homework is stressful for me.**	**NR**	**1**	**2**	**3**	**4**	**5**
14.	**I worry I will not be able to understand the mathematics.**	**NR**	**1**	**2**	**3**	**4**	**5**
15.	**I get nervous when asking questions in class.**	**NR**	**1**	**2**	**3**	**4**	**5**
16.	**I get tense when I prepare for a mathematics test.**	**NR**	**1**	**2**	**3**	**4**	**5**
17.	**I believe I can do the mathematics in a mathematics course.**	**NR**	**1**	**2**	**3**	**4**	**5**
18.	**I believe I am the kind of the person who is good at mathematics.**	**NR**	**1**	**2**	**3**	**4**	**5**
19.	**I worry that I will not be able to do well on mathematics tests.**	**NR**	**1**	**2**	**3**	**4**	**5**
20.	**I worry that I do not know enough mathematics to do well in future mathematics.**	**NR**	**1**	**2**	**3**	**4**	**5**
21.	**I believe I can get an "A" when I am in a mathematics course.**	**NR**	**1**	**2**	**3**	**4**	**5**
22.	**I worry that I will not be able to get a good grade in mathematics courses.**	**NR**	**1**	**2**	**3**	**4**	**5**
23.	**I believe I can learn well in a mathematics course.**	**NR**	**1**	**2**	**3**	**4**	**5**
24.	**I believe I can think like a mathematician.**	**NR**	**1**	**2**	**3**	**4**	**5**
25.	**I believe I can complete all of the assignments in a mathematics course.**	**NR**	**1**	**2**	**3**	**4**	**5**
26.	**I get nervous when I have to use mathematics outside of school.**	**NR**	**1**	**2**	**3**	**4**	**5**
27.	**I believe I can understand the content in a mathematics course.**	**NR**	**1**	**2**	**3**	**4**	**5**
28.	**I believe I can do well on a mathematics test.**	**NR**	**1**	**2**	**3**	**4**	**5**
29.	**I am anxious when mathematics Instructors are lecturing.**	**NR**	**1**	**2**	**3**	**4**	**5**
30.	**I worry that I will have to use mathematics in my future career.**	**NR**	**1**	**2**	**3**	**4**	**5**

Appendix B

Institutional Review Board

MINNESOTA STATE UNIVERSITY MOORHEAD

DATE:	January 26, 2022
TO:	Kristen Carlson, Principal Investigator Kain Schow, Co-investigator
FROM:	Dr. Robert Nava, Chair Minnesota State University Moorhead IRB
ACTION:	**APPROVED**
PROJECT TITLE:	[1865431-1] The Impact of Academic Tracking and Mathematics Self-Concept on Mathematics Achievement
SUBMISSION TYPE:	New Project
APPROVAL DATE:	January 26, 2022
EXPIRATION DATE:	
REVIEW TYPE:	Exempt Review

Thank you for your submission of New Project 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

NORMAN COUNTY EAST
SCHOOL DISTRICT #2215

Dustin Flaten, High School Principal
P.O. BOX 420
TWIN VALLEY, MN 56584-0420
PHONE: (218) 584-5151 FAX (218) 584-5170

January 14, 2022

To whom it may concern,

This letter is to grant Kain Schow permission to conduct an action research study at Norman County East School during the 2021-2022 academic year. I understand that this study poses no risk to those persons involved or to the Norman County East School District. I also understand that all information received will be kept confidential and will only be used for the purposes of this study

Sincerely,

Dustin Flaten

Principal, Norman County East School

Appendix D

Method of Assent

I will explain to the participates, “I am currently finishing my Master’s degree at MSUM. Part of my requirements for completing my degree is to conduct my own research project. For my project I have chosen to assess if being placed in the upper math or the lower math track has effected how you feel about your math self, and whether that has had an impact on your overall math achievement. I am doing this study to advocate for your learning. I have sent letters home to your family asking for their permission to allow you to participate in the study. If your parents/guardian signed and returned the consent letter, they have agreed to let you participate in the study. However, you as the student/participant have the choice on whether you would like to be a part of the study or not. Your only role in this study is to complete a questionnaire about your math self-concept. By completing the questionnaire, you are agreeing to participate in the research, however, if you choose to not complete the questionnaire there will be no consequences effecting your grade, or our relationship moving forward. Are there any questions about any information I have presented to you?”

Appendix E

Dear Parent or Guardian,

Your child has been invited to participate in a study to see if academic tracking and/or if their math self-concept is affecting their overall academic achievement in math.

Your child was selected because he/she/they are part of the math program at NCE. If you decide to participate please understand that your child will be asked to do the following assessments, outside of their normal classwork, but do not involve any risk to your student's academic standing.

1. Your student(s) will be asked to answer a survey on their own math self-concept, meaning how do they feel about their own abilities in math.
2. Your student(s) will be asked to answer a survey on their perception of math achievement.
3. Your student(s) grade reports may be used as data in this study.

Although Principal Dustin Flaten has granted me permission to conduct this study, since this information is being used to help me complete my master's degree at Minnesota State University Moorhead (MSUM), I need to have parental consent to use this information in my final research paper as that is required as part of my degree. If I didn't need this information to complete my master's degree, I would conduct this research in my everyday classroom. If you sign this form, you are giving me consent to use the information that I gather. All information will be completely confidential, and no student names will be used. Please also note, that your student can choose not to participate at any time without any consequences.

Please feel free to ask me any questions you have regarding this study. You may contact me here at the school 218-584-5151, or kains@nce.k12.mn.us. You may also contact my adviser, Dr. Kristen Carlson at kristen.carlson@mnstate.edu. Any questions about your rights may be directed to Dr. Robert Nava, Chair of the MSUM Institutional Review Board, at 218-477-2134 or by email at irb@mnstate.edu.

You will be offered a copy of this form to keep. You are making a decision whether or not to participate. Your signature indicates that you have read the information provided above and have decided to participate. You may withdraw your consent at any time without prejudice after signing this form should you choose to discontinue participation in this study.

____ ____________________

Signature of Parent or Guardian Date

____ ____________________

Signature of Investigator Date