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How Different Grouping Methods Can Improve Students' Mathematical Achievement in an Appropriate Setting

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HOW DIFFERENT GROUPING METHODS CAN IMPROVE STUDENTS' MATHEMATICAL ACHIEVEMENT IN AN APPROPRIATE SETTING

By

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CHAPTER ONE

Introduction

Personal Experience

I worked at a STEM-focused public charter middle school in a large metropolitan area of the Upper Midwest of the United States. It was a relatively small school with only two math teachers. We started a cooperating teacher system in which one teacher leads the class while the other teacher assists and supports the class. Mainly, the support teacher would be redirecting distractions and helping students focus while the other teacher teaches all the curriculum. I played both roles of support and curriculum teacher depending on the student's grade.

Situation

On multiple occasions, students told me after class that they were frustrated and bored because their needs were not met through the mixed grouping method currently used. Specifically, I struggled dealing with these complaints every day. Their reasons were based on the fact of the large ability spectrum. Firstly, one reason was that the more advanced students discouraged the less skilled students because they didn’t want them to feel bad if they were wrong. The less skilled students didn’t feel the courage to speak up or engage because they already knew that some other students were more skilled. The

more skilled students got bored because they often had to wait for the more thorough explanations that other students might need. Besides, some students did not reply actively and they did not want to feel like they were showing off in front of their classmates who needed some more support.

This imbalance was further perpetuated through the challenges of each student. In this school, all of the students were from very diverse backgrounds. Usually, they were facing less fortunate situations; some students were dealing with family separation, or problems with money, adoption, and more. This leads to a lack of motivation or disruptive factors for education; if a student had an issue affecting their current life at both an emotional and physical level, what would be the motivation to spend time and money learning? Moreover, there were very talented and capable students for math at this school looking for deeper content.

With this question, I had to develop curriculum for a class that targeted each end of the skill spectrum without demotivating or disengaging any of the students, while further nurturing their desire to learn. This was a challenge, which often resulted in failure, because none of the students were excited by the material in class, as it was either too challenging or too easy. These problems for each student and myself as a teacher caused an overall unmotivated class, where no students felt happy about their learning pace. I tracked the problem to the way the classes were grouped. However, the school I worked at viewed the mixed grouping method as the only good way, meaning I couldn't switch the style of the class to what best fit the students. What was imperative here, is that historically, there is a large positive emphasis on the mixed grouping method (Slavin, 1993). Slavin described that in his study, students with other grouping methods rarely

showed significant progress compared to when mixed grouping was used, emphasizing the cooperation elements of mixed grouping as a reason. Because of its associated benefits of inclusion and more cooperative learning between the students, it was a method that our school set as the standard because of multiple articles and movements that expressed that mixed grouping is the only beneficial grouping method. Nevertheless, it didn't seem to work for my class and the other math teacher as well. This situation illustrated that there was something inconclusive about the previous research done.

Changes

Because of the inconclusive research, I felt that we needed some direct change. I thought about different grouping methods of mixed ability and tracking, mainly referencing Slavin, and tried to use a method which best fit our students. It took long discussions and a lot of effort to convince and implement this method because of our school's standard of mixed grouping. This further convinced me of the importance of finding out about grouping methods and each method's relation to students in terms of effectiveness. The mathematics education at our school went through large changes, which essentially had altered methods of grouping based on the students. Our eighth grade was divided into ability grouped classes because of the wider range of ability. These changes resulted in an overall boost of self-confidence of students when they were asked during the quarter end conferences because the students felt that they were being challenged in the amount they needed in their respective classes for both the higher and lower ability students. Our 7th grade had a much narrower range of skill, so the mixed grouping method was kept, and students' progress was constantly positive because the

minimal knowledge gaps allowed students to improve and support each other. Especially, this grouping method allowed thoughtful whole class discussions and arguments from the balanced skill levels in the mixed classroom, which I, as a math teacher, was looking for. Overall, all of the students who fit the respective grouping method had positive feedback on the change or continuation. In this situation, all the changes were implemented and successfully worked. However, I realized that I needed a better approach of understanding the root of the problem not only to help myself, but to also communicate to other teachers about this success properly.

Context

To promote students' learning, the learner has to be motivated and engaged in the class. In order to do that, we, as teachers, need to challenge them appropriately with proper content. Students should work at their instructional level - not too hard, but not too easy. In order to increase students' engagement, each student should have defined, clear, and rigorous learning expectations, so that every student experiences challenge and success. Then, students can accelerate their learning or take more time depending on their academic abilities. Usually, a math teacher brings one or two tasks to class each day, which should be at the appropriate difficulty level for the students and help them learn the overall material properly. These tasks should motivate and engage students to nurture and support their curiosity in class.

Ability grouping is widely criticized for the consequences in the area mentioned above (Oakes, 1985). In its place, random or mixed grouping was popularized instead. This method of mixed grouping is used in the hope of balancing student skill levels on

both ends of the spectrum. Theoretically, the higher skilled students, as role models, would motivate the less skilled students by setting an example. Nevertheless, the overwhelming emphasis on using only this method sometimes resulted in multiple problems like a lack of adaptability of the method to the students and diversity at different school environments.

Niche

It has historically been proven that grouping methods affect the quality of education for students in the classroom, with clear differences quantitatively in exam scores for students, especially in the research Slavin (1993) provides in the literature review. Especially in the math classrooms, where the quality and advanced level of a students' mathematical education deeply influences their likelihood of earning a bachelor's degree (Trusty et al., 2003), utilizing the correct grouping method is essential. However, there is a clear gap in the previous research we have, in that all of the research on grouping methods emphasizes the importance of the grouping method, but never explains in which context it works. Many academic articles only concluded that one method was the best. Not only does this create confusing and contradictory claims, it creates misleading concepts of complete right and wrongs in educating students with mathematics, especially when this education should be adaptable to the student. The gap is created by a lack of research about the perspectives of the students, and how different grouping methods, or lack thereof, work better for different students and diverse situations at each school. This diversity in students and educational environments is a key part where I want to study grouping methods and their benefits.

The purpose of this research is to address this misconception of one grouping method being the best to promote students' learning. Throughout these chapters, I will focus on the notions of studies attempting to prove that the best mathematical education system is from mixed grouping, and provide some alternate methods and explanations to why we shouldn't use only one standard, that for each diverse group of students with various and different school situations, the grouping methods have to be diverse as well. Throughout previous research, there have only been conclusions that result in one method being the best. For instance, there are multiple studies that conclude ability grouping is the best, ignoring mixed grouping's potential in different student settings, and the same vice versa. However, in this capstone, I will implement methods that adapt to the students' needs, emphasizing the need for flexibility in methods for grouping and understanding research and providing evidence for the benefits of more than one method.

Research Question

In this research, I wanted to look at an essential part of the problem: *Can an inquiry-based discourse taught using an ability-grouping method affect 8th grade students' mathematical achievement as evidenced quantitatively through numerical self-surveys and scored standardized testing?*

It would allow me to look at another grouping method with a different perspective. This capstone thesis will also address the fundamental problem of saying one method is the best and propose solutions to these one-minded issues.

Conclusion

In this chapter, I discussed my personal story that motivated my research, and presented the gap in the current research available. In chapter two, I will review literature to achieve a grasp of this area of education, specifically in secondary mathematics. In chapter three, I will outline and present my project and methods for testing hypotheses, with a brief overview of the implementations and presentations to colleagues. With chapter four, I will present the data collected, and analyze it. Finally, in chapter five, I will present an analysis interpreting the results and discussing their meaning.

CHAPTER TWO

Literature Review

Context

This chapter will explore literature about the research question: *Can an inquiry-based discourse taught using an ability-grouping method affect 8th grade students' mathematical achievement as evidenced quantitatively through numerical self-surveys and scored standardized testing?*

The literature will focus on different grouping methods specific to ability from contrasting perspectives on each issue. Mixed grouping refers to the method where grouping is random, with each class being grouped with all skill levels. Ability grouping refers to the method where grouping is based on a student's ability, in a narrower spectrum of skill in class. The literature will give an overall view of three key ideas:

1. Mixed grouping effects on mathematical achievement
2. Ability grouping effects on mathematical achievement
3. Arguments against each contrasting grouping method

General Mathematics Education

It has been found on multiple occasions that the general population of American students are behind the level of students in other countries mathematically (Vidgor, 2013). Many researchers claim that the problem may stem from large class sizes or education funding limitations (Gursky, 1998). However, the main problem of focus in this literature review is balancing the positive and negative effects of different grouping methods (Pong et al., 2001). Thus, the less obvious problem that has been rising in terms of awareness is the method of grouping classes.

Grouping has the possibility to affect every student's math performance, unlocking their full potential (Slavin, 1993). A student's interactions with peers significantly affected his or her learning (Slavin, 1993). Grouping is beneficial compared to its non-grouped alternative, where grouped students on average do better than students individually (Hoffer, 1992). The class compositions that are grouped heavily influence the effectiveness of the instruction applied to the students and the learning of the individuals (Dreeben et al., 1988). Grouping methods allow teachers to best teach the students.

The type and implementations of different grouping methods are important and strongly affect the quality of mathematical achievement of students and what these students can learn as shown by the significant differences in mathematical achievement when using different grouping methods. Nevertheless, as an observation of the current research, many studies attempted to show that only one method is good in all situations. This creates two sides of argument where one argues that mixed grouping is better (with the corresponding successful statistics of students and their learning), and the other side

argues that ability grouping is better (with ability grouping's corresponding success story). To educators, it is hard to determine which grouping method is better because of the contradictory claims. Then, the educator must choose one grouping method without the context and understanding of when the grouping method works properly and produces the more intuitive learning environments for students. Therefore, this reasoning in mathematics education can be detrimental to their achievement because the students have to adapt their learning style to how the classes are decided, which will be further explored and explained in the next sections of this chapter from how different studies represent different grouping methods in their respective environments, with numerous contradictions between the corresponding impacts.

It has been observed that the effect of ability grouping isn't clear, especially whether the grouping method is comparatively better or worse than mixed grouping. Furthermore, it seems unclear why ability grouping has different effects on the students' mathematical achievement. Therefore, the current study will explore the impact of one form of ability grouping.

Mixed Grouping

Slavin's (1993) research conducted on 8th graders found that ability grouping was not effective in giving students of all skill levels an equal environment to learn the best. Thus, the study presented an alternative method of within-class grouping, which is essentially mixed grouping (Slavin, 1993). Mulkey et al. (2005) also concluded that tracked groups had significantly damaged self-concept in middle school students regarding mathematics, decreasing their overall achievement compared to untracked

(mixed) groups. Linchevski et al. (1998) argued that ability grouping didn't have any effect on mathematical achievement, but mixed grouping may increase students' positive attitudes. The concept of mixed grouping has always been based on the higher skilled students helping the less skilled students, as a sort of cooperative learning within the class. This would give the less skilled students many resources and opportunities to improve, while higher skilled students could review what they know and develop their leadership skills. Slavin proposed that mixed grouping should always be preferred over ability grouping because of his tested results in which mixed grouping outshined ability grouping in higher student achievement. He also argued that equity was maintained more in mixed grouping for the lack of division and separation by ability in this grouping method. However, it has been pointed out that equity does not mean that every student should receive identical instruction in one classroom; instead, many argued that equity demands that reasonable and appropriate accommodations be made as needed to promote access and attainment for all students (NCTM, 2000). This conflicts with the concept of equity, which Slavin proposed as basis for mixed grouping, raising the question what specific context and situations allowed mixed grouping to be successful in Slavin's testing.

In Slavin's article, the general amount of progress was higher when classes were grouped using mixed grouping. A case study expressed the advantage to lower attaining students with a small disadvantage to higher attaining students with mixed grouping (Venkatakrishnan et al., 2003). Many other articles arguing the necessity for mixed grouping in all classrooms always come up with the same conclusion: Mixed grouping allows students to be better integrated into the curriculum with the help peers who are

more skilled. Thus, through the cooperative effort of the whole class of mixed ability levels, there is less polarization of abilities in the classroom and equity is preserved. However, this may pose problems for the higher skilled students in certain situations. What the articles did not investigate, were the contexts in which mixed grouping was inferior to ability grouping. The smaller range of abilities in the whole group of students allowed for a cohesive environment for cooperative learning, as there was not a big disparity of skills between the less skilled students and the higher skilled students (Venkatakrishnan et al., 2003). It is important to note that mixed grouping does work better than ability grouping in situations where the diversity of student abilities in mathematics is contained in a manageable range.

While in the student group setting provided by Slavin, ability grouping has a minimized and sometimes negative impact on students' mathematical achievement, there appear to be contexts in which mixed grouping may be inferior to ability grouping because of a larger range of student abilities. We will investigate such a situation.

Ability Grouping

The benefits of ability grouping are opposite to the effects of mixed grouping. Ability grouping in the past has been seen as a method of separation that disadvantaged lower attaining students. Also, many critics argue that ability grouping causes students to lose student leaders, increase achievement gaps, and lower their self-esteem for students who were placed in lower classes than others (Northwestern University, 2017). However, previous research supporting this view may have been biased since the research did not address the relationship between the school’s grouping methods and the students’

enrollment (Figilio et al., 2002). Furthermore, it has been stated that good education for students requires different accommodations and systems (NCTM, 2000).

With the possibility that the grouping method would affect school choice, it has been pointed out that mixed groupings may not only prevent harm to lower attaining students' math achievement, but also increase students' progression (Kulik, 1992). In the case of future preparation and progress, these students are more likely to have stability in learning mathematics and enhanced rates of completing college (Burris et al., 2004). This is because interactions with more advanced students in a class allows everyone to benefit in the cooperation style (Hoffer, 1992).

These benefits of ability grouping rely upon flexible grouping strategies within it (Allan, 1991). Flexibility in ability grouping represents a system where students aren't just stuck to one group level; they can move around in the group levels depending on how well they do in tests summarizing overall improvement (Tieso, 2003). Without some kind of flexibility, ability grouping would be too divided, leading to a lack of the overall necessity of inclusion within learning. Thus, ability grouping only functions well because of its implementations in a flexible way of division.

Ability grouping is not the same as tracking in the modern classroom. While it could be called flexible tracking, it is called ability grouping because of the flexibility considering teachers evaluations and student placement (Tieso, 2003). This is an important difference to make because tracking is harmful in its methods and implementations due to its lack of flexibility. Tracking is similar to ability grouping because it tested students into classes by skill (Mulkey, 2005). However, a key element in tracking is locked down classes, where a student would be stuck to the one level, without

possibility to move across the classes. In ability grouping, students could move class levels between quarters by effort and engagement for classwork, homework, quizzes, or tests. The students in the tracking method would never have the chance to be re-evaluated, and would be permanently stuck to their "tracks" set by their initial evaluation. This is dangerous because students no longer need the motivation or any desire to improve because they would always be limited by the tracked classes (Mulkey, 2005). However, tracking was still implemented because it attracted many high ability students to public schools and maximized attendance (Epple, 2002). This method ultimately ignored lower ability students because of the lack of improvement the method allowed for them.

Furthermore, ability grouping goes beyond the practice of tracking because of its flexible approach to grouping (Tieso, 2003). This flexibility, as per the previous paragraph, is why ability grouping works in situations where student skill levels are spread widely in the whole group. The ability to move around classes and fluidly be part of the curriculum based on the student's skill and effort without a complete lockdown is why ability grouping work for when abilities vary a lot in a group of students. Without ability grouping for these students, they would be limited in an environment which is not engaging, too challenging, or too easy. While tracking is harmful because of its permanent effects for students where they can never escape the tracks they have been placed in, ability grouping in modern classrooms works very well for student progress and achievement (Tieso, 2003). However, the benefits are centered around the more advanced students. From previous research, high ability and gifted students tend to benefit the most from ability grouping, as it provides them with access to more advanced

knowledge, with teachers not being forced to divide their teaching energies among widely diverse levels of ability and achievement (Rogers, 1998).

This is key, as Rogers further explains the more specific ways in which ability grouping works (1998). It works only when the students can flexibly be moved around groups without consequences. Each group provides students with peers of similar ability. Higher ability students can benefit from enrichment and more complex concept discussions with their peers. For lower ability students, it allows a safe climate where support can be more targeted by the teachers rather than having to spread the support around a wide ability level in one class. With a more homogenous learning environment, it's easier for teachers to match their instruction to a student's needs and the students benefit from interacting with comparable academic peers (Northwestern University, 2017). These three things seem to be requirements throughout all the previous literature for ability grouping to be most successful.

However, there are some doubts with ability grouping, as Belfi et al. (2012) notice that ability grouping is beneficial for stronger students in mathematics, but can sometimes be detrimental for students who had a weaker mathematical foundation. In contrast, Preckel et al. (2010) indicate that in some cases, ability grouped students who were in gifted classes with a stronger mathematical foundation decreased in their academic strength at time went on.

In answer to the research question, it seems that while mixed grouping does have its benefits in specific student settings, ability grouping can sometimes be even more beneficial for students' mathematical achievement in some student settings than what the stigma around ability grouping implies. Especially with tracking and its negative effects,

mixed grouping was favored in those situations. However, ability grouping does have clear achievement benefits in students in certain situations. What this emphasizes is that previous data refuting ability grouping benefits is biased in most instances, and needs revisiting. Going back to the research question of whether ability grouping can work better, we will investigate a middle school classroom in both mixed and ability grouped settings.

Central Issues and Niches

From the previous explanations, there is a heavy emphasis on deciding which grouping methods to use. Articles on both sides of the grouping debate focus on crowning one method as the victor. However, there are many different situations. The studies solely presenting mixed grouping as the best grouping are only valid assuming students were not biased in enrolling at a school because of the method of grouping used in classes (Figilio et al., 2002). Ability grouping is only beneficial when the chosen groups can be changed flexibly (Allan, 1991). Both conclusions showed that for any method to properly benefit all students, there needs to be adaptability for each class and its unique characteristics. Rather than announcing one method as the sole method that works, educators need to adapt the grouping method for each situation. There are issues in the current math classroom because of the belief that only one grouping method is the best, when we should actually use different ones. Based on the available information, both grouping methods are inadequate. How do teachers advantage all students, no matter their skill level? In the best case, a solution involving grouping methods can effectively increase academic achievement at a low cost and can benefit millions of students in U.S.

school systems, according to the study, published in Review of Educational Research (Northwestern University, 2017). An overall conclusion is that it differs for students and situations at each school, and it is the teacher's or administrator's decision to choose the best grouping method depending on what the students need based on the educational situation, in order to achieve a significant positive effect on student achievement in mathematics.

As reviewed, the majority of articles attempt to prove that their corresponding grouping method of ability or mixed grouping is the best for all students and their mathematical achievement. Therefore, it creates a clear gap in the current information and analysis of the information. Popular research articles of grouping methods usually do not emphasize the context in which the students benefited because of the articles' attempts to show a grouping method without problems and as the perfect option for everyone. However, as we analyze and review the research and the available information of contexts in which a study was performed, evidently, both ability and mixed grouping methods have their advantages. Thus, it is necessary as educators to analyze the specific situation in which a grouping method works, and implement it properly in the classroom.

Frameworks

Some key frameworks and theories for each grouping method are described below.

Effective teaching and learning. Beyond grouping methods, each method requires different tasks and activities for different levels. Not all tasks give the same amount of challenge or opportunity to every student (Hiebert et al., 2009). That's why

students benefit the most when the tasks given consistently encourage higher-level student thinking rather than being procedural or tasks that are more set in stone (Boaler and Staples, 2008). Tasks with high cognitive demands are the most difficult to implement well and are often transformed into less demanding tasks during instruction (Stigler and Hiebert, 2004). In these implementations of tasks, grouping methods will be key in the different ways both mixed and ability grouping work.

In order to build shared understanding of mathematical ideas by analyzing and comparing students approaches and arguments, it is imperative to facilitate discourse among students for effective teaching of mathematics (NCTM, 2015). To benefit the students the most mathematically, it is necessary to focus on discourse that promote reasoning and problem solving (Michaels, O'Connor, and Resnick, 2008). It is because skills used in discourse such as the ability to learn to articulate and justify students own mathematical ideas, reason through their own and others' mathematical explanations, and provide a rationale for their answer help develop a solid math foundation for their future success in mathematics and related fields (Carpenter, Franke, and Levi, 2003). To have effective discourses in whole class discussion, Smith and Stein (2011) emphasize five practices:

- Anticipating student responses prior to the lesson
- Monitoring students' work on and engagement with the tasks
- Selecting particular students to present their mathematical work
- Sequencing students' responses in a specific order for discussion
- Connecting different students' responses and connecting the responses to key mathematical ideas

According to Hufferd-Ackles et al. (2004), it is critical how teachers and students proceed through levels in shifting from a classroom in which teachers play the leading role in pursuing student mathematical thinking to one in which they assist students in taking on important roles. The framework describes growth in five components (Hufferd-Ackles et al., 2004):

- How the teacher supports student engagements
- Who serves as the questioner and what kinds of questions are posed
- Who provides what kinds of explanations
- How mathematical representations are used
- How much responsibility students share for the learning of their peers and themselves

The next Table 1 shows a table created by Hufferd-Ackles et al. (2004) on page 88 to explain the levels of classroom discourse through which teachers and their students advance.

Table 1: Levels of Discourse in Classroom by Type

	Teacher role	Questioning	Explaining mathematical thinking	Sources of Mathematical ideas	Building student responsibility for their learning
Level 0	Teacher is at the front of the room and dominates conversation.	Teacher is only questioner. Questions serve to keep student listening to teacher. Students give short answers and respond to teacher only.	Teacher questions focus on correctness. Students provide short answer-focused responses. Teacher may give answer.	Representations are missing, or teacher shows them to students.	Culture supports students keeping ideas to themselves or just providing answers when asked.
Level 1	Teacher encourages the sharing of math ideas and directs speaker to talk to the class, not to the teacher only.	Teacher questions begin to focus on student thinking and less on answer. Only teacher asks questions.	Teacher probes student thinking somewhat. One or two strategies may be elicited.	Students learn to create math drawings to depict their mathematical thinking.	Students believe that their ideas accepted by the classroom community. They begin to listen to one another supportively and to restate in their own words what another student has said.
Level 2	Teacher facilitates conversation between students, and encourages students to	Teacher asks probing questions and facilitates some student-to-student talk.	Teacher probes more deeply to learn about student thinking. Teacher elicits	Students label their math drawing so that others are able to follow their	Students believe that they are math learners and that their classmates are important. They listen

	ask questions of one another	Students ask questions of one another with prompting from the teacher.	multiple strategies. Students respond to teacher probing and volunteer their thinking. Students begin to defend their answers.	mathematical thinking.	actively so that they can contribute significantly.
Level 3	Students carry the conversation themselves. Teacher only guides from the periphery of the conversation. Teacher waits for students to clarify thinking of others.	Student-to-student talk is student initiated. Students ask questions and listen to responses. Many questions ask "why" and call for justifications may still guide discourse.	Teacher follows student explanations closely. Teacher asks students to contrast strategies. Students defend and justify their answers with little prompting from the teacher.	Students followed and help shape the descriptions of others' math thinking through math drawings and may suggest edits in others' math drawing.	Students believe that they are math leaders and can help shape the thinking of others. They help shape others' math thinking in supportive, collegial way and accept the same support from others.

Mathematical discourse in whole class discussions is critical for students' meaningful learning of mathematics. In ability grouping, the divided classes by ability allow students to discourse at a higher level because the grouping method supported the students' conversation meaningfully and thoughtfully to each other in the smaller skill range. Meanwhile, mixed grouping in a group of students with a large achievement gap was not able to develop effectively as the difference of math background knowledge could not support mutually among students. However, with mixed grouping in the smaller range of skills, these implementations of tasks for discussion improves students' abilities because students can cooperatively discuss in an engaging way. In the situations where both of these grouping methods work, these tasks that provide discussion will give the highest amount of learning to the students when used effectively.

Ability grouping. The overall theory is that students would benefit most from ability grouping if they need the flexibility and the targeted curriculum ability grouping provides. It permits students to collaborate with peers at similar levels (Tieso, 2003). Thus, ability grouping allows for a more focused way for teachers to implement specific concepts which need improvement, allowing for a better foundation. However, it is important to note that students would most benefit from this flexibility and targeted curriculum for each group only when the overall skill levels for the students are variable. Then, in this situation, it would reduce overall failures to engage or challenge the students. It would maintain interest and incentive, because lower level students would be engaged at where they need, and higher-level students would not be bored by being properly challenged. Furthermore, slower students would participate more when not eclipsed by more skilled peers. However, in spite of the large differences between

tracking group and ability group, self-esteem for students who are in lower level group could be lower, operating to discourage the students in these sections from the competitive implications by ability grouping.

Mixed grouping. The overall theory is that students' skill levels would be narrower, and mixed grouping would help bring the average progress levels up from before. Because of mixed grouping cooperative aspects, students who need a broader understanding and are generally uniform in their mathematical skills would benefit a lot. The inclusiveness of this grouping allows for better discussions and overall development and progress (Slavin, 1990). Students of higher level would be good examples for students who are less skilled when they are all in one class. However, differentiated or targeted instruction for each level would be extremely hard for teachers for one place at the same period without an overall smaller gap of skill in the whole group compared to ability grouping, implying the requirement of less variable skill levels for mixed grouping to work. In general, both theories are based on students and the concentration of previous experience. However, they both propose that different groups of students (in terms of their current age) would best benefit from different types of grouping.

The importance of grouping methods is shown by the significant positive or negative differences in student achievement that results by simply changing grouping methods for a group of students. However, in the current literature, there has not been a clear indication of which grouping method an educator should switch to. There is a gap in the current research on both sides of the mixed and ability grouping issue where both argue for the respective method's superiority in mathematical achievement without representing why the method was better in the study's situation.

Thus, after reviewing the existing literature, my research question is: *Can an inquiry-based discourse taught using an ability-grouping method affect 8th grade students' mathematical achievement as evidenced quantitatively through numerical self-surveys and scored standardized testing?*

Diversity is really wide in the educational system. Each individual student comes from different backgrounds with different factors as part of their lives.

It is not clear what compatible conditions would allow for the success from a grouping method. It is necessary to observe every aspect of each student's mathematical ability and overall progress academically, but also in terms of cooperation skills and whole ability spectrum for the students. With the understanding of the gap in the current research and why it is there, there is still some real-world implementations that need to be tested. We still need to see if the understanding and concepts actually work practically rather than theoretically. Therefore, we propose such an implementation based on flexible ability grouping.

Conclusion

The majority of articles try to only frame one grouping method as superior and better to be used. However, to optimize student achievement, it seems as though using the grouping method that best fits the group of students is instead the better method.

Chapter three focuses on the project, with information on the overall implementations based on the ideas the literature presented. With the information from the literature review, chapter three will help provide real world context to help answer the research question.

CHAPTER THREE

Methods

Context

Chapter two provided a rationale for the grouping methods in the math classroom and general math education through the review of existing literature, while emphasizing the situations where a specific grouping method has worked, and how the grouping methods served to improve all of the students' abilities in the specific environment. This chapter will provide an overview and analysis, review the main emphases, and learning from chapter two while applying them to a project about my research question: *Can an inquiry-based discourse taught using an ability-grouping method affect 8th grade students' mathematical achievement as evidenced quantitatively through numerical self-surveys and scored standardized testing?*

In sections, this chapter will state the thesis main concepts of the methods, including research paradigm, setting, and participants. The section of setting is one of the most major sections of this chapter as it gives the proper story behind understanding how the grouping methods worked in my own school's situation.

Research Paradigm

The research paradigm is based around the research question. The main perspective is that ability grouping can be beneficial in many situations over mixed grouping, and under the assumption that the historically negative traits of tracking do not have any correlation with modern ability grouping by reasons stated in the literature review. For mixed grouping, all the classes were made sure not to have large gaps in skill, randomly, proportionally choosing students with generally more advanced math skills and students with generally a bit weaker math abilities. This allowed for all the classes to have mixed abilities.

Setting

This research would be implemented in an urban tuition free charter middle school offering a unique STEM-focused, and girl-focused educational experience, grades 5 - 8. Students learn through rigorous study, by asking questions, solving problems, and participating in the community. The school's teaching model provides students with the experiences and skills that result in academic and personal success to help students become critical thinkers and leaders. The school welcomes all students, regardless of gender, race, religion, sexual orientation, ability, or economic status. There are about twenty-five to thirty students for each grade level where about 40% are Caucasian, 29% are African American, and less than 10% are Asian by school records. Students in 8th grade are learning algebra, while students in 7th grade are learning pre-algebra.

Specifically, in the math department, the other math teacher has taught two years of 6th grade math, and she joined here this school year of 2018-2019. One teacher who is

teaching 5th grade math also teaches language arts classes too. The school's leadership team consists of one science teacher, one social studies teacher, one social worker, one peer coach, and one coordinator from the school office. They have a meeting twice a week and discuss problems and solutions in the school. The science teacher leads this group, and has been working at this school teaching science since the beginning of this school for more than ten years.

Participants Demographics

The participants are all the 7th and 8th grade students at this school. The 7th grade students were mostly 12 years old, with a few 11 and 13-year old students. 8th grade was made up of mostly 13-year old students, with a few 12 and 14-year old students. In terms of racial diversity, about 40% was Caucasian, 25% African American, 10% Hispanic, 7% Asian, with the rest being one or more race. About 50% are considered lower income class, with the other 50% about middle class. All speak English as their first language, while some students also speak their ethnic language with their family at home as a second language.

Methods

Implementations of the different methods would be decided based on the students and their characteristics, but would attempt to represent an improvement from previous grouping methods that were exactly the same, no matter who the students were. This improvement would be measured quantitatively through two methods.

The first approach is through anonymous survey data (on a numerical scale) comparisons. This method would have all present students in math class to fill out surveys before and after the change of mixed grouping to ability grouping. There would be twenty questions about students' engagement for their math class. For example, the survey would ask how students felt about the relationship between them and the teacher, their assignments, their level of understanding, their efforts, etc. Then, students would reply on a scale of one (Totally Untrue) to five (Totally True) for each question (see Figure 1 below; full survey see Appendix A).

Figure 1: Sample Survey Questions

10. In this class, I learn a lot almost every day.

1	2	3	4	5
Totally Untrue	Mostly Untrue	Somewhat	Mostly True	Totally True

11. The work that I do for this class makes me really think.

1	2	3	4	5
Totally Untrue	Mostly Untrue	Somewhat	Mostly True	Totally True

12. This teacher encourages me to use my thinking skills, not just memorize things.

1	2	3	4	5
Totally Untrue	Mostly Untrue	Somewhat	Mostly True	Totally True

13. This teacher has high expectations for me.

1	2	3	4	5
Totally Untrue	Mostly Untrue	Somewhat	Mostly True	Totally True

14. In class, this teacher expects our full effort.

1	2	3	4	5
Totally Untrue	Mostly Untrue	Somewhat	Mostly True	Totally True

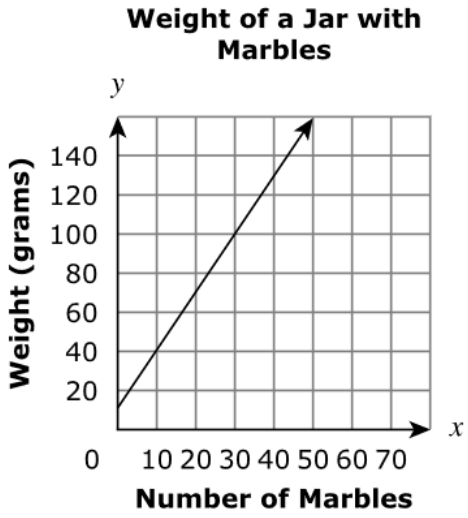
Anonymity would be maintained to limit any response bias because without anonymity, students could fear identification and then repercussions for their answers and instead

give biased survey data. This method would occur right before and after one semester for the change in grouping methods.

The second method is through standardized test result comparisons. With the quantitative data of scores from standardized tests before and after the change, state standardized tests, from specifically MCA in Minnesota, would be used to give an accurate, state-recognized method of gaining a quantitative view of students' mathematical achievement. The MCA test is the Minnesota Comprehensive Assessments Series III (MCA III's). This test includes sections about reading, mathematics, writing and science, that are taken through a laptop. This test is held once per year, usually in April or May at school to measure students' progress based on the mathematics academic standard established by Minnesota Education Association. For instance, the question would be: "Which sequence is arithmetic?" Then, students should choose one item out of multiple choices. Or the question could be showing a graph of weight and number of marbles asking what y-intercept the graph represents. Then, students can pick one answer from multiple items. These questions include short answer and multiple-choice formats (sample given on next page with Figure 2 from http://minnesota.pearsonaccessnext.com/item-samplers/math/).

Figure 2: Sample Test Questions

Jayda makes a graph to show the weight of a jar when it contains different numbers of marbles.



What does the y-intercept represent?

- A. The weight of each marble
- B. The weight of the jar by itself
- C. The number of marbles when the weight is 0 grams
- D. The number of marbles when the weight is 10 grams

Lisa has 5 more green marbles than blue marbles. She has a total of 40 green and blue marbles. Which system of equations represents this situation if x is the number of green marbles and y is the number of blue marbles?

- A. $\begin{cases} y = x + 5 \\ x + y = 40 \end{cases}$
- B. $\begin{cases} x = y + 5 \\ x + y = 40 \end{cases}$
- C. $\begin{cases} y = x + 5 \\ y = x + 40 \end{cases}$
- D. $\begin{cases} x = y + 5 \\ x = y + 40 \end{cases}$

This method would occur before the students were in a mixed group and one semester after the change for the grouping method.

Overview of The Procedure

At my school, the seventh grade had a narrow range of math skill ability, and the mixed grouping worked; however, the 8th grade had problems with the mixed grouping because the students in eighth grade had a larger variance of ability, where one third of the students exceeded standard math skills for eighth grade, while another one third did not meet the minimum requirements. The rest of the grade had a few students who partially met the standards, and a few students who met near the average math level. This large variance caused problems when using mixed grouping because, as the literature explains, it was often hard to target the specific skills for everyone without losing some students' interest.

I implemented ability grouping for the 8th graders from the second semester, because of the larger spectrum of skill and variance of previous knowledge. Here, I was able to take advantage of the flexibility of ability grouping because even though students might have less previous knowledge, some students had a lot of potential in which ability grouping allowed them to move around levels to learn the best.

I kept mixed grouping for 7th graders from the quarter two. I and my cooperating teacher started the year with a large 7th grade class with twenty-eight students at the beginning of this school year. As a control group to roughly compare the resulting data, it would allow for a better understanding and analysis. These results will be described more in depth and specifically in chapter four.

For all of the data that would be represented, I chose a class from both 7th and 8th grade during 2018-2019 school year that would best represent how the grouping method affected their engagement and standardized testing scores quantitatively by selecting the

class nearest to the middle in both comparative categories. Furthermore, I chose from classes that I taught to make sure that the teaching style from different teachers was not part of the difference in students' engagement or scores.

Ethics

I obtained permission from the school to use and handle these anonymous surveys for this research thesis. There were also standardized test scores from MCA that were given by the school with permission to be used in this thesis. All names were removed, and all the data was given as an anonymous set of data with permission from the school.

Summary

This chapter described findings and procedure in detail about my research question. Each of sections connected what I learned from the literature review to how it could be implemented and tested at my school.

The settings section focuses mainly on understanding the rest of the sections (especially methods) as it sets the foundation for choosing methods and implementations. It was the context of the setting that influenced what grouping method to test to see the different.

The next chapter reports the data of my research for results and discussion about grouping methods. It first notifies the highlights of this project from my literature review and my implementations, and then it provides a context for the reader by restating my research question as it was described throughout my paper. Then, there will be multiple sections analyzing and explaining the data in both general and specific viewpoints.

CHAPTER FOUR

Results

Introduction

The elements stated in chapter three provided representations of the procedure and ideas behind the methods that were going to be used in the testing to address the central research question: *Can inquiry-based discourse taught using an ability-grouping method affect 8th grade students' mathematical achievement as evidenced quantitatively through numerical self-surveys and scored standardized testing?*

After the implementation of the multiple methods shown in chapter three, to triangulate the process about my school's specific setting, chapter four will briefly re-describe the methods and present the organized results and findings. This chapter is focused on providing the primary data and analyzing it to directly take the predictions from the literary analysis in chapter two and see if the predictions can be replicated in real world testing.

The main parts of this chapter will review the methods and explain what happened after their implementations. Within these sections, the primary quantitative data will be presented and analyzed statistically, with a brief conclusive statement to summarize the analysis.

Standardized Test Scores

We can compare these two groups even though their grade levels are different, because the complexity and level of difficulty of the associated grade level curriculum levels the playing field for both grades, thus allowing for comparison.

This data was initially matched with the student, but was anonymized for protection of their identities for this research. The first set of test scores was taken before the change for 8th graders from mixed grouping to ability grouping, and then about a semester after this change as well. Both 7th and 8th graders took this test, with 7th graders serving as a very rough control group. All of the standardized test scores were from the MCA, a Minnesota-recognized method of standardized testing of measuring student progress in subjects (including mathematics for their grade). A copy of the Excel sheet recording the data/scores for both grades can be found at this link: https://drive.google.com/drive/folders/1fZSCPPRZwdzQN3FZQBCduTQ5AImh2j1Q?usp=sharing.

7th Grade. 7th grade was taught with mixed grouping before and after the change of grouping methods happened in 8th grade but with smaller groupings; there were random assignments of students to a class without distinction between the abilities of the students in mathematics. two students with the negative differences in scores before and after (students 1 and 9) were excluded from the analysis. On these two outliers, we can identify that student 9 with a score of 29 before was barely within 1 standard deviation from the average score for 7th graders, and that student 1 with a score of 73 before was barely within 2 standard deviations from the average score. Thus, both outliers with sudden negative differences in before and after scores could be associated with being at

the two extreme ends of mathematical achievement in terms of quantitative measures. The two students had frequent absences in this school year, so it seems to me that they both were not progressing well what they need to learn this year. Therefore, because of their large distinction from the rest of the data and the calculated average, we can consider these two outliers which was not due to the mixed grouping methods.

The data is represented in Table 2.

Table 2: 7th Grade MCA Results before and after 8th Grader Switch to Ability Grouping

Student	Before	After	Difference
2	25	34	9
3	39	40	1
5	40	45	5
6	42	47	5
8	43	45	2
4	50	58	8
7	58	65	7
SD	14.59	13.92	4.87
Means	44.33	47.56	3.22

Considering the whole of the data, we can recognize a substantial increase of 5.29 percent average excluding outliers. This can be attributed to the standard progress of students during the year that should happen by curriculum as students over time will develop skills and improve. To test if grouping method matters in the progress of the students and their development, we have used the above set of data from 7th graders as a rough control group to compare with the scores of the experimental group of 8th graders after the change of their grouping method from mixed grouping to ability grouping. Each student improved their math performance little by little but not much dramatically like the 8th grade students below.

8th Grade. 8th grade was taught with mixed grouping before, and was changed to ability grouping. The relevant data is represented in Table 3.

Table 3: 8th Grade MCA Results before and after 8th Grader Switch to Ability Grouping

Student	Before	After	Difference
4	54	64	10
7	54	65	11
8	57	68	11
9	59	69	10
5	60	68	8
2	64	71	7
3	67	80	13
1	69	73	4
6	71	81	10
SD	6.36	6.04	2.65
Averages	61.67	71	9.33

The calculation of standard deviations indicated that no student falls out considerably enough to classify them as outliers.

Looking at the whole table of data, we can notice that the students with 10 or more increase in differences between their before and after scores are the students with the generally lower scores. There are a lot of improvements for students' math performance, especially students marked in the lower scores before switching to the ability group. Furthermore, the average positive point difference of 9.3 is less variable with a smaller standard deviation. Therefore, the positive average increase in score points of 9.3 is more consistent in the experimental group of 8th graders than the control group's standard deviation of 4.9 for increase in scores.

Anonymous Student Surveys

Anonymous student surveys were asked to be filled out by the 7th and 8th grade students both before and after the grouping method change for the 8th graders. If there wasn't anonymity, students' fear of their grades that their grades would be lowered for a negative answer might have been a factor. These were used to gain a better understanding of what the students felt without any response bias. As stated in chapter three, a positive sentiment was shown by choosing a score close to 5, a more negative sentiment by choosing a score close to 1. A copy of the Excel printout sheet of survey data can be found at https://drive.google.com/drive/folders/1fZSCPPRZwdzQN3FZQBCduTQ5AImh2j1Q?usp=sharing with the questions found in the Appendix A.

Viewing the survey data spreadsheet, there are more students in the "Before" table than the "After" table for both 7th and 8th grade. While 7th grade's grouping methods were not changed, their class sizes were reduced as a necessary requirement by the school for both 7th and 8th grade. Thus, the variability of the control group (i.e. 7th graders) may be affected by the smaller class sizes, which could increase the positive survey data. Meanwhile, 8th grade data now can be influenced by both the smaller class sizes and a better matching grouping method. To assume a proper conclusion in a positive increase in the student survey data with the better matching grouping method tested for the 8th grade, there would have to be significantly more positive change than 7th grade as control group to best avoid taking into account the error from the class size difference between the two groups.

7th Grade. 7th grade was taught with mixed grouping before and after the change for grouping methods happened in 8th grade but with smaller groupings after the change. Students were assigned randomly to a class without distinction between the abilities of the students in mathematics. The data is represented in Table 4.

Table 4: 7th Grade Student Satisfaction results before and after 8th Grader Switch to Ability Grouping

	Before	After	Difference
Average	3.86	4.38	0.52

There was not a large increase in how students felt about their classes. The increase of 0.5 may be due to smaller classes, as most of the questions addressed whether the students felt like they could ask questions and whether other students were not distracting them during work time in different perspectives. Smaller classes would limit distractions, in a general sense, which will not be explored further, however, as it is beyond the scope of the current study.

8th Grade. 8th grade was taught with mixed grouping before, and was changed to ability grouping. The relevant data is represented in Table 5.

Table 5: 8th Grade Student Satisfaction Results before and after 8th Grader Switch to Ability Grouping

	Before	After	Difference
Average	2.41	4.26	1.86

We can observe a distinctive change after using the ability grouping for the students of 1.9 between before and after the change from mixed grouping to ability grouping. Because the factor of "smaller classes" may have influenced the results, we can

assume that subtracting the amount of change in 7th grade students' sentiment from the difference in 8th grade students' sentiment change will be a reasonable adjustment to the amount of change in sentiment based on the grouping method change. After this step to account for the different class size factor, there is still a noticeable increase of 1.4. Put in perspective relative to the 1 to 5 score range, there was a 28% increase in how 8th graders felt about their classroom learning environment and experience.

Conclusion

In this chapter, the quantitative data with corresponding average or standard deviation computations were presented and discussed. I indicated that I used 7th grade as a control group and kept them with mixed grouping because it worked for them, 7th grade started at an initially higher average positive sentiment of 3.9. I also outline that 8th graders were chosen as the experimental group, since mixed grouping didn't work for the large range of abilities in 8th grade. Thus, 8th grade started at a much lower positive sentiment score of 2.4.

From the data analysis, we can conclude that there was a substantial increase in mathematical development in students after switching from mixed grouping (which was set without understanding of what environment the students would best succeed in) to ability grouping (which was set after analyzing the students and the potential better benefits in ability grouping than mixed grouping). After comparing the quantitative data for 8th grade with 7th grade, there is a clear indication that choosing the grouping method would work best with the group of introductory students.

In the next chapter, I will explain the benefits from this project to teachers or administrators.

CHAPTER FIVE

Conclusion

Overview

We investigated the following research question: *Can an inquiry based discourse taught using an ability-grouping method affect 8th grade students' mathematical achievement as evidenced quantitatively through numerical self-surveys and scored standardized testing?*

In this chapter, we will revisit the literature we reviewed in chapter two and how it filled the gap in the current research, while connecting the data analysis from chapter four for general discussion. We will also talk about the implications and limitations of this research based on the unique situation, environment, and students that were included in this testing. Furthermore, there will be a statement about the future research how schools including teachers and administrators need to make the crucial decision to notice when a grouping method isn't working, and adapt the grouping methods to the specific situation. I will discuss how I disseminated this newfound information to others as well. Ultimately, we will reflect and conclude upon the whole capstone.

Discussion

From the data in MCA, we had a substantial increase of 5.29 percent average excluding two outliers in 7th grade class after switching 8th grade class from mixed group to ability group as the 7th class also were divided into smaller two mixed groups from the one large mixed group. However, we noticed that there are many students in 8th grade class who made 10 or more increase in differences between their before and after scores in MCA. Besides, the average increasing points of 9.3 in 8th grade has much smaller standard deviation, which means more consistent than the control group, 7th grade class.

Furthermore, through the satisfaction survey, the data showed positive increase in both 7th and 8th grade classes as it may be affected by the smaller class sizes, but 8th grade data can be influenced by both the smaller class sizes and a better matching grouping method.

With this data and the corresponding analysis, we can conclude that choosing and utilizing the correct grouping method does have a clear and significant effect in improving student opinions about how efficient and how engaging the classroom learning experience becomes (questions can be viewed in Appendix A). We observed a substantial increase in student mathematical achievement on both the test score level and on the level of how students feel about their classroom learning environment after the grouping method change in 8th grade. From these collective conclusions, we can assume that changing grouping methods to one that fits the context of the group of students and their needs did have a positive impact (in this case, mixed grouping to ability grouping), rather than assuming that one grouping method works for all.

Our results indicate that there was a substantial increase in mathematical development in students after switching from mixed grouping to ability grouping. After comparing the quantitative data for 8th grade with 7th grade, there is a clear indication that choosing the grouping method would work best with the group of introductory students. Contrary to the popularized mixed grouping method for benefits in student mathematical learning (Slavin, 1993), we can observe that ability grouping (not to be confused with tracking as Tieso articulates in 2003) can work and even exceed the effectiveness of mixed grouping. Evidenced through our testing, we saw that with a group of students with a large range of mathematical abilities, ability grouping may help focus on the necessary learning required for each ability, which does not appear to be the case with mixed grouping.

Similarly, the survey data suggests that choosing and utilizing the correct grouping method does have a clear and substantial effect in improving student opinions about how efficient and how engaging the classroom learning experience becomes, in accordance with Tieso (2003), who describes that ability grouping can't be labeled only as bad. We observed a substantial increase in student mathematical achievement on both the test score level and on the level of how students feel about their classroom learning environment after the grouping method change in 8th grade. This fills in the current research gap where studies like the one by Slavin (1993) try to represent one grouping method as the best for everyone. However, as we saw with the results, the answer is not so set in stone.

Again, we come back to the question in mathematical education of why the majority of American students are generally behind other countries (Vidgor, 2013). One

of the solutions may be adapting the grouping, as the problems with grouping students is an identified problem of current mathematics education (Gursky, 1998). Adaptation is necessary. However, we see that each method only succeeds in different situations, and that is why understanding the grouping methods is necessary for benefiting the students' achievement. All the methods have benefits and consequences. As Slavin (1993) pointed out, there was controversy around the negative social effects of ability grouping. However, sometimes ability grouping works better depending on the students (Tieso, 2003). Our research findings support the idea that we need grouping method adaptation in math classrooms.

Our study takes the perspectives of both sides of the grouping method sides (of mixed and ability sides) and suggests that the best grouping method changes for different groups of students and their different backgrounds.

The main theme throughout this chapter is the essential idea found and learned from all of the previous chapters: the group of students' contexts is important in adapting a grouping method to the students. As we have concluded, grouping methods are important and do affect students' mathematical achievement. However, more specific and focused research still needs to be done, regarding the different grouping methods, the most suitable contexts for these grouping methods, and the explanation for differences in grouping methods. This allows researchers to improve grouping methods and educational administrators to understand how to maximize each student's potential.

Thus, we come back to the initial research question: *Can an inquiry-based discourse taught using an ability-grouping method affect 8th grade students'*

mathematical achievement as evidenced quantitatively through numerical self-surveys and scored standardized testing?

The simple answer that we found was that yes, it can, because the 8th graders that this study was performed on had a small range of mathematical abilities. However, in my own future research and with this capstone, I hope to instigate more investigation into grouping methods and how to utilize them beneficially and personally learn more about how a student's context within a group of students is important in a grouping method.

Implications and Limitations

The large implication was the idea of adaptability. Adapting the method to the students was hard, which ultimately limited their learning. Even if adaptation was attempted, the limited understanding of the adaptations was shown because of the debate around crowning a single grouping method as the winner. From this lack of understanding, the clear limitation is the lack of specificity for the type of students that would benefit the most from each grouping method. However, the unique characteristics of students prevent this specificity. The overall message learned was that I had to broadly target the students. Nevertheless, even with each method, there were limitations in how it targeted the students properly. Sometimes, the method didn't work out perfectly with every student. In any case, this leads me to research further on different grouping methods, and specifically educational environments.

In terms of limitations, this study was done in a school that is smaller than the general public school in the United States, with a different classroom and financial

situation. These are key things to keep in mind as there is a possibility that these factors do apply in utilizing the study within this capstone.

The broader and more important answer and major theme that recurs throughout this whole thesis is that ability grouping and mixed grouping can both work, but they can only effectively boost students' mathematical achievement for specific contexts. For example, one corresponding context for using each grouping method highlighted in this thesis was that ability grouping worked better in groups of students with a large range of ability and that mixed grouping worked better in groups of students with a concentrated range of ability. Different situations where the limited findings of context for each grouping method explored in this thesis may not apply will have to be investigated.

Future Research

From here, a topic that has risen up is the different contexts in which each grouping method efficiently maximizes student mathematical achievement including their self-engagement and scores. Research involving this topic would be important and powerful in furthering the foundation provided by this thesis of how schools or academic administrators and teachers need to utilize and know in what situation and how to apply different grouping methods. This would boost general student achievement because the grouping method adapted to the student rather than the student needing to work to adapt to the grouping method.

My personal plan is to use this capstone as a basis of furthering different research in the branches provided by this capstone. Specifically, as I have stated above, my plan is to focus on the situations in which each grouping method works best and why they work

best in those situations, possibly evolving to a question of whether there is a better grouping method that can be created and utilized. I plan to continuously keep researching and compiling a set of information around this topic, later narrowing everything down to the specific branches of the topic and research question presented by this capstone as stated above.

Application

Some recommendations on future projects are all centered around the stigma of grouping methods, and researching into more types of grouping. These would all help in the idea of adaptability because it would give a clearer understanding, and more possibilities for the diversity in situations. Even as students in the classroom become more diverse, the grouping methods should become more precise as well to fit the increase in diversity. This would benefit the students in large ways of matching each student's needs and advantages to a grouping method. Furthermore, it would allow to match situations and contexts (of the students) with each grouping method, as this is key in allowing the student to feel more engaged and progress more mathematically.

Some important things learned is primarily how important the grouping methods are in student mathematical learning. Furthermore, the responsibility of choosing the right method was something significant. Throughout the whole capstone process, I learned that there isn't just one method that I could easily use for a class. It took careful reviewing of the benefits for each class, and noticing the differences between groups of students, which would ultimately decide on the grouping method. A broad implication I realized was that as teachers, we have to decide and adapt the education and its

implementations properly to students. I learned the key to this was adapting the grouping methods for each group of students based on different educational environments.

Dissemination

I will use a PowerPoint presentation to present my findings to the school and my colleagues. A PowerPoint presentation is effective as it can provide a visual representation of the data collected in a more interactive way in which theories and project setup can be easily diagrammed. Making my presentation more interesting through the use of multimedia can help engage the audience. PowerPoint allows me to use images, audio and video to have a greater practical effect of understanding. These visual and audio cues may also help a presenter be more improvisational and interactive with the audience.

The project is meant to inform other mathematics teachers or administrators about the importance of grouping methods and choosing the right one for their educational environment considering all aspects of obstacles, limitations, or students' spectrums. I am planning to present these findings of my research using a PowerPoint presentation at a professional development day at my school, as a clear method to share research results and hopefully prompt some change. A PowerPoint allows them to focus on key words and some visuals while we can openly discuss about it as well. While this communication is limited, I hope to communicate more about the importance of grouping methods and the questions we ask to improve students' mathematical achievement with different grouping method through this capstone as well to the general academic audience.

Reflections

In the beginning, the research question was: *Can an inquiry-based discourse taught using an ability-grouping method affect 8th grade students' mathematical achievement as evidenced quantitatively through numerical self-surveys and scored standardized testing?*

Throughout this capstone project, I found that we shouldn't focus on one grouping method and its effects. In a direct answer to the question, it can improve all students' learning if they require the flexibility and targeting provided by ability grouping. In a better answer, it could affect the students' mathematical achievement well; however, I should also consider that there are other grouping methods that could work better for the students' progress. I realized that teachers should not only consider the effects of grouping methods on students; I should also focus on creating the best possible learning environment for students, without limiting their needs or potential.

Conclusion

Based on the MCA results and satisfaction surveys for the control group (7th grade) and the experimental group (8th grade), we discussed that switching grouping methods based on the context of the students influenced students' mathematical achievement effectively and considerably. Also, we saw that after the grouping method for the class adapted to the students, the students felt better in class and were more engaged. Thus, the idea of adaptability is a clear implication for grouping methods; however, there also a limitation in how to target the students properly. To do this, the research would need to study further on each different grouping method with unique

educational environments including socioeconomic and demographic factors. However, throughout the whole capstone process, we learned that a proper grouping method is one of the most critical elements to support for improving students' math achievement. Therefore, I will focus continuously on better grouping method based on different educational environments, in order to maximize students' math learning.

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APPENDICES

Appendix A

Student Perception Survey of Student Engagement

Sample: Students in this class are friendly. 1 Totally Untrue 2 Mostly Untrue 3 Somewhat 4 Mostly True 5 Totally True	
1.	Our class stays busy and does not waste time. 1 Totally Untrue 2 Mostly Untrue 3 Somewhat 4 Mostly True 5 Totally True
2.	Students know what they are expected to do and learn in this class. 1 Totally Untrue 2 Mostly Untrue 3 Somewhat 4 Mostly True 5 Totally True
3.	This teacher treats students in this class with respect. 1 Totally Untrue 2 Mostly Untrue 3 Somewhat 4 Mostly True 5 Totally True
4.	Students in class treat this teacher with respect. 1 Totally Untrue 2 Mostly Untrue 3 Somewhat 4 Mostly True 5 Totally True
5.	In this class, students help each other learn. 1 Totally Untrue 2 Mostly Untrue 3 Somewhat 4 Mostly True 5 Totally True

6. This teacher encourages students to keep trying even if the work gets hard.

1	2	3	4	5
Totally Untrue	Mostly Untrue	Somewhat	Mostly True	Totally True

7. This teacher gives me assignments that help me better understand the subject.

1	2	3	4	5
Totally Untrue	Mostly Untrue	Somewhat	Mostly True	Totally True

8. This teacher asks questions to be sure we understand the lesson.

1	2	3	4	5
Totally Untrue	Mostly Untrue	Somewhat	Mostly True	Totally True

9. In this class, I learn a lot almost every day.

1	2	3	4	5
Totally Untrue	Mostly Untrue	Somewhat	Mostly True	Totally True

10. In this class, I learn a lot almost every day.

1	2	3	4	5
Totally Untrue	Mostly Untrue	Somewhat	Mostly True	Totally True

11. The work that I do for this class makes me really think.

1	2	3	4	5
Totally Untrue	Mostly Untrue	Somewhat	Mostly True	Totally True

12. This teacher encourages me to use my thinking skills, not just memorize things.

1	2	3	4	5
Totally Untrue	Mostly Untrue	Somewhat	Mostly True	Totally True

13. This teacher has high expectations for me.

1	2	3	4	5
Totally Untrue	Mostly Untrue	Somewhat	Mostly True	Totally True

14. In class, this teacher expects our full effort. 1 2 3 4 5 Totally Untrue Mostly Untrue Somewhat Mostly True Totally True
15. This teacher really cares about me. 1 2 3 4 5 Totally Untrue Mostly Untrue Somewhat Mostly True Totally True
16. This teacher tries to be fair. 1 2 3 4 5 Totally Untrue Mostly Untrue Somewhat Mostly True Totally True
17. This teacher accepts me for who I am. 1 2 3 4 5 Totally Untrue Mostly Untrue Somewhat Mostly True Totally True
18. This teacher makes class enjoyable most of the time. 1 2 3 4 5 Totally Untrue Mostly Untrue Somewhat Mostly True Totally True
19. This teacher connects what I'm learning in class with life outside this classroom. 1 2 3 4 5 Totally Untrue Mostly Untrue Somewhat Mostly True Totally True
20. This teacher makes me want to learn more. 1 2 3 4 5 Totally Untrue Mostly Untrue Somewhat Mostly True Totally True