School of Graduate Studies
Bemidji State University
1500 Birchmont Dr NE, #27
Bemidji, MN 56601-2699
218-755-2027

# MATHEMATICS CLASSROOMS AT THE MIDDLE SCHOOL LEVEL: DOES GROUPING MAKE A DIFERENCE IN ACHIEVEMENT?

by

Adam Smieja

---

A Research Paper Submitted to the Faculty of the
DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SICNE IN ELEMENTARY AND MIDDLE LEVEL MATHEMATICS EDUCATION

BEMIDJI STATE UNIVERSITY
Bemidji, Minnesota, USA

May 2012

STATEMENT BY THE AUTHOR



Signed: _____

---

APPROVAL BY RESEARCH PAPER ADVISOR

THIS RESEARCH PAPER HAS BEEN APPROVED ON THE DATE SHOWN BELOW:

_____ _____

Dr. Glen Richgels, Date
Committee Chair
Professor of Mathematics and Computer Science

_____ _____

Dean, School of Graduate Studies Date

MATHEMATICS CLASSROOMS AT THE MIDDLE SCHOOL LEVEL: DOES GROUPING MAKE A DIFERENCE IN ACHIEVEMENT?

Adam Smieja

This paper reviewed related research on student achievement based on how students were grouped, homogeneously or heterogeneously. Questions examined were whether students performed better in heterogeneous or homogenous groupings and to what extent did high-, average-, and low-ability students perform better in a particular group. Results showed that high-ability students in homogeneous groupings had higher gains in achievement when compared to their counterparts in heterogeneous groupings. However, gains for these high-ability students were not statistically significant. On the contrary, average-, and low-ability students did show statistically significant gains in achievement in the heterogeneous groupings. Yet, despite their effectiveness, implementation of heterogeneous groupings was shown to be difficult. When successful heterogeneous groupings were implemented, they provided a high quality of instruction for all students and incorporated cooperative learning, differentiated instruction, flexible groupings, curriculum modification, and support for educators and students involved.

Approved by:

_____ _____

Committee Chair Date

_____

Committee Member

_____

Committee Member

_____

Graduate Faculty Representative

ACKNOWLEDGMENTS

I would like to thank Dr. Glen Richgels, Dr. Derek Webb, and Dr. Todd Frauenholtz for all their support during this stressful journey. I would like to thank them for serving on my committee, for being patient with all my questions, for their helpful and prompt feedback, as well as for their words of encouragement when times were tough. I would like to thank Joan Miller for guiding me though the paperwork required to complete my masters program. I would also like to send a special thank you to my wife, Katie. Without her, I would not have had the motivation to finish this process. She has been my rock throughout this entire ordeal.

TABLE OF CONTENTS

**Chapter** **Page**

**1. Introduction**

**Statement of the Problem** ..... 1
**Research Questions** ..... 2
**Significance of the Research Problem** ..... 2
**Limitations and Assumptions** ..... 2
**Definition of Terms** ..... 3
**Summary Statement** ..... 4

**2. Review of the Literature**

**Summary of the Statement** ..... 5
**Types of Groupings** ..... 5
**Homogeneous vs. Heterogeneous Groupings** ..... 7
**High-, Average-, and Low-Ability Students within Heterogeneous Groupings** ..... 9
**Components of Successful Heterogeneous Groups** ..... 11
**Cooperative learning** ..... 12
**Differentiation** ..... 12
**Flexibility** ..... 13
**Curriculum modification** ..... 13
**Support** ..... 13

**3. Results**

**Does Grouping Students Heterogeneously Affect Student Achievement in a Middle School Mathematics Class?** ..... 15
**To What Extend Do Students of High-, Average-, or Low-Ability Perform Better in Heterogeneous Grouping** ..... 16

**4. Conclusion**

**Challenges of Implementation** ..... 18
**Suggestions for Further Research** ..... 19

**References** ..... 22

# Chapter 1: Introduction

What is best for students in mathematics education at the middle school level in regard to how students are assigned to mathematics classes? Is it better for students to be mixed with a variety of ability levels, or is it better for students to be separated into ability groups and placed in classes with students only from that group? This is a highly debated question. Some educators believe that homogenous groups are easier to teach. Lessons can be tailored to the level at which the class, as a whole, is; therefore increasing achievement (Fulingi, Eccles, & Barber, 1995). Others believe homogeneous groups "label" students, creating low self-efficacy (Ability Grouping, 2002). These educators believe that by having mixed-ability classrooms, high-achieving students can influence and stimulate low-achieving students (Ability Grouping, 2002).

My goal is to identify whether or not middle school mathematics students achieve more in homogeneous versus heterogeneous classrooms. To do this, I will review available literature related to ability grouping to make my conclusions.

## Statement of the Problem

National and state standards are an essential part of what mathematics teachers teach to their students. These standards help define what a student needs to learn. Students, educators, and schools are held accountable for reaching these high standards (Burris, Heubert, & Levin, 2006). Having all students master mathematics concepts, when relating them to national and state standards, is my ultimate goal. But, what can be done to help increase achievement before teaching actually occurs? In other words, do middle school mathematics students achieve more in homogeneous classes or do they achieve more in heterogeneous classes?

**Research Questions**

Does grouping students heterogeneously affect student achievement in a middle school mathematics class?

- Do students perform better in heterogeneous or homogeneous groupings?
- If so, to what extent do students of high-, average-, or low-ability perform better in heterogeneous grouping?

**Significance of the Research Problem**

Imagine you are a parent of a middle school student. The school gives you a choice between two mathematics classes for your child. One class has students of all abilities mixed within: high, average, and low (a heterogeneous classroom). The other is grouped according to ability level (a homogeneous classroom). You have to choose one, but which one would you choose?

Parents, as well as educators, may not have complete control over the way students are grouped into classes, but does the way students are grouped into classes make a difference in student success? Would you want your student to be placed in the class that offers the best chance for success? Not all educators agree on which type of grouping serves students best, and according to Slavin (1990), ability grouping has been a controversial topic in education for more than seventy years.

**Limitations and Assumptions**

I am limiting my research to the middle school grades. I will not include research on students with severe disabilities, such as students with hearing impairments or sight impairments. I am also limiting my research to include data that have already been collected. I will not conduct my own research for this paper. I am also limiting my

research to between-class groupings of students. My research will not address within-class grouping.

I assume the teachers and researchers involved in the studies I collected are competent, regardless of their experience level. In addition, I assume each teacher is teaching with the student's best interest in mind. I assume that every teacher wants his or her students to be successful, regardless of the type of grouping used.

I also assume that what works for one school should work for students at similar schools, in terms of the success of grouping students homogeneously or heterogeneously. There is no possible way I could conduct research, let alone find research that already exists that involves every school there is.

Finally, I assume that, regardless of a student's ethnicity, race, gender, or socioeconomic background, all students have the capacity to learn. I do not assume all students have the same opportunity to learn. I only assume that every student involved in the research has the capability to learn.

**Definition of Terms**

Ability: a student's competence in mathematics as measured by quantitative results, such as standardized test scores and class grades.

Achievement: a student's performance based on quantitative results, pre- and post-test data.

Between-class grouping: a school's practice of separating students into different classes, courses, or sequences based on their achievement.

Detracking: grouping students together with mixed academic abilities.

Differentiated instruction: "is a student-centered approach to learning where the teacher, based on student needs, designs multiple pathways to content, process, and product" (Brimfield, Masci, & DeFiore, 2002, p. 14).

Heterogeneous classes: classes where students of mixed abilities are together.

Homogeneous classes: classes where students are grouped according to their ability with similar ability students put together in one class.

Middle School: grades 6th-8th

Tracking: grouping students according to their academic ability

**Summary Statement**

There is a long-standing debate among mathematics educators and school administrators as to which type of grouping benefits all students in a mathematics classroom. Some feel that students achieve more success when grouped based on ability (homogeneous grouping), while others feel that mixed-ability classrooms (heterogeneous grouping) better meets the needs of all mathematics students. My goal is to search for research related to the two types of groupings and identify which is the best approach in setting up mathematics courses that benefit all learners.

## Chapter 2: Review of the Literature

### Summary of the Statement

The debate between grouping students homogeneously versus heterogeneously has been controversial and on-going for many years (Slavin, 1990; Wiliam & Bartholomew, 2004). There are proponents of each type of grouping system. The advantages and disadvantages presented have been almost unchanged since the 1920's and 30's (Slavin, 1990). But which grouping dynamic allows for the highest achievement of all learners? Does one way of grouping produce higher achievement for high-, average-, and low-ability students in a middle school mathematics course, than the other? The following is a review of related literature to help answer these questions.

### Types of Groupings

One type of grouping is homogeneous class grouping, or tracked grouping. This type of grouping consists of students thought to have the same ability level in the same classroom (Daniel, 2007). For middle school age students, homogeneous groups are most often labeled advanced, basic, and low (Slavin, 1990). In this review of the literature, the terms high, average, and low will be used. Many middle schools group students according to their ability level. According to J.W. Valentine and his colleagues, in 2002, 85% of middle school grades used some type of ability grouping, which was up from 82% in 1993 (as cited in Daniel, 2007).

In order to homogeneously group students, educators and/or administration examine standardized test scores, IQ scores, and various other performance measures, along with using teacher recommendations and judgments (Daniel, 2007; Lynn &

Wheelock, 1997; Slavin, 1990). Students that perform similarly on those assessments are then placed in the same class or group.

Many parents and educators are proponents of grouping students homogeneously. These groupings are also known as tracked groupings (Daniel, 2007). Parents say they do not want their child's class to be slowed down or sped up by students with lower or higher ability. Educators argue that teaching students in a homogeneously grouped setting is easier. They also state that the lower ability students feel more comfortable with students at their same ability level, and high-achieving students excel when placed together (Ability Grouping, 2002; Daniel, 2007). Also, teachers support homogeneous groups because they find that type of classroom environment easier to manage, making their job easier (Daniel, 2007).

Heterogeneous class groupings, also known as detracked groupings, consist of a range of learners. All ability levels of learners are in the same classroom. Proponents of heterogeneous classes argue that homogeneous groupings do not benefit all students. Grouping methods used to separate advanced-, average, and low-ability students may not be data based. Teachers of homogeneous groupings tend to be less experienced, and instruction methods are generally different from low-ability classes to high-ability classes (Ability Grouping, 2002; Rees, Brewer, & Argys, 2000).

In an analysis done by Rees, Brewer, and Argys (2000) on tracking and resource allocation, using sample data from the National Educational Longitudinal Study of tenth graders, they found a 0.7 year gap in mean years of experience between high- and low-ability mathematics classes. They also note that "teachers of high-ability classes are much more likely to have undergraduate and graduate majors in mathematics and science

than those teachers assigned to low ability classes" (Rees et al., 2000, p. 19). In fact, they found that 77.8% of mathematics teachers assigned to high-ability groups had an undergraduate degree in mathematics, as opposed to only 67.0% of mathematics teachers assigned to low-ability groups (Rees et al., 2000).

**Homogeneous vs. Heterogeneous Groupings**

Burris, Huebert, and Levin (2006) conducted a study on the effects of detracking students. The purpose of the study was to see if more students would take and pass advanced mathematics courses (trigonometry and beyond) if they took an accelerated algebra course in the eighth grade, and would high-achieving student performance suffer if all students were heterogeneously grouped in accelerated mathematics courses. The study was performed at a Long Island school consisting of approximately 3,500 students. The research included two different groups. The first group consisted of homogeneously tracked students. These students spanned three grade levels. The second group consisted of heterogeneously detracked students. These students also spanned three grade levels. Both groups were followed from 6th-grade through 12th-grade. The school involved in the study made a school-wide decision to gradually heterogeneously detrack all mathematics students, starting at the $6^{th}$ grade, and place them in accelerated mathematics courses. This decision was made by the district in response to the success of students taking advantage of the accelerated classes offered by the school (Burris et al., 2006). They found that if students were detracked and placed in an accelerated $8^{th}$-grade algebra course, more students would take and pass higher-level mathematics courses. Increased achievement was found in all student demographics. Also, there was no evidence to

support claims that high-achieving students suffered from heterogeneous grouping (Burris et al., 2006).

Slavin (1990) conducted a best-evidence review of related literature that spanned 29 different studies comparing students in homogeneous groups to students in heterogeneous groups. Through his research he found that there was no effect on student achievement through homogeneous grouping. "If [homogeneous] grouping is not found to be more effective than heterogeneous placement, none of the pro-grouping arguments apply" (Slavin, 1990, p. 3).

In Rockville Center School District, in Long Island, Superintendent William Johnson wanted to increase the percentage of graduates to earn a New York State Regents diploma from 58% to 75%. The plan he came up with was to detrack students, starting with the 8th grade. So, the 8th grade curriculum was revised and condensed, and all students were placed in heterogeneously grouped classes (Burris & Welner, 2005).

> The results were remarkable. Over 90% of incoming freshman entered the high school having passed the first Regents math examination. The achievement gap dramatically narrowed. Between the years of 1995 and 1997, only 23% of regular education African American and Hispanic students had passed this algebra-based Regents exam before entering high school. After universally accelerating all students in heterogeneously grouped classes, the percentage more than tripled -- up to 75%. The percentage of white or Asian American regular education students who passed the exam also greatly increased -- from 54% to 98%. (Burris & Welner, 2005, p. 596)

Many parents and educators assume that tracking benefits high-achieving students. In particular, parents of high-achieving students are afraid that detracking, or heterogeneous classes, would provide a watered down curriculum and lower learning standards (Burris & Welner, 2005). However, research has shown that homogeneously grouping students creates a negative impact on many students' achievement in a mathematics course, not only due to fostering negative attitudes within students, but also through the limiting of students' access to more advanced and challenging material (Lynn & Wheelock, 1997; National Association of School Psychologists [NASP], 2005). For students in homogeneous classes, the quality of instruction is usually greater for the high-ability classes and is lower for low-ability classes (Slavin, 1990). But despite what the research says, homogeneous class models are still widely used due, in part, to the difficult nature of creating a truly heterogeneous environment (Scholastic Inc, 2006).

Tracking students does not enhance student achievement. Tracking limits student achievement, and as a result, can be harmful to them (Scholastic Inc, 2006). It can be harmful for many reasons: grouping may not always be data based and can sometimes be based on subjective views of ability, tracking creates labels, (advanced student and low student), tracking fosters different expectations of each level of learner, once a student is tracked, it is difficult to move between groupings. The tracked groupings are inflexible (Scholastic Inc, 2006).

**High-, Average-, and Low-Ability Students within Heterogeneous Groups**

Research has shown that heterogeneously grouped middle school mathematics classes allow for higher achievement for student learners, overall, when compared to

homogeneously grouped middle school mathematics courses. But, which students benefit more?

According to the Long Island study conducted by Burris and Welner (2005), average- and low-ability grouped students made the most gains in achievement. Although this study involves race, it shows this particular schools increase in student achievement. In 1996, 32% of African American or Hispanic students and 88% of white or Asian American students who graduated earned a Regents diploma. By 1999, nearly all classes in the middle school and ninth grade were grouped heterogeneously, thus increasing the percentage of students graduating with a Regents diploma.
By 2003, the percentages increased to 82% and 97%, respectively (Burris & Welner, 2005).

Detracking also took place in other courses as well. For science, in just one year of placing all students in heterogeneous courses at the high school, passing rates for the science Regents test increases from 48% to 77% for African American and Hispanic students, and from 85% to 94% for white and Asian American students (Burris & Welner, 2005).

Linchevski and Kutscher (1998) completed research comparing two different grouping environments, same-ability and mixed-ability. Two tests were given to each group and were used to compare achievement gains between the groups. One test was a differential test. For this, each ability level received a test written in correspondence to their ability. The other test was a common test - a "one-size fits all" test. Unlike the differential test, which was ability level specific, the common test incorporated all ability levels. What they found was that average- and low-ability students performed better in

the heterogeneous, mixed-ability groups, when compared to similar students in the homogeneous, same-ability groups. They also noticed that average scores of high-ability students from the same-ability, homogeneous classes were greater than comparable student average scores from the mixed-ability, heterogeneous classes. However, average scores of the high-ability students in the homogeneous classes were not statistically significantly greater (Linchevski & Kutscher, 1998).

On the other hand, Linchevski and Kutscher (1998) found that average scores of average- and low-ability students were significantly higher for mixed-ability, heterogeneous class students than average scores for average- and low-ability students in same-ability, homogeneous classes. Post-test scores for low-ability students belonging to the homogeneous classes turned in tests that were mostly blank, for the common assessment. The equivalent students from the heterogeneous classes had an average score of 54%. Also, the average- and low-ability heterogeneous students found the tests written for their respective levels to be easier than they were used to in their heterogeneous classes (Linchevski & Kutscher, 1998).

Heterogeneously grouping students may not result in a statistically significant difference in achievement for high-ability students. However, there are statistically significant results indicating increases in academic achievement of average- and lower-achieving students (Linchevski & Kutscher, 1998; Slavin, 1990).

**Components of Successful Heterogeneous Groups**

"Detracking remains one of the most complex challenges that public schools face" (Lynn & Wheelock, 1997, p. 3). Despite the complexity and politics involved, schools can be successful in creating heterogeneous groupings. Research has shown that

in order for heterogeneous, mixed ability groupings to be successful, multiple components need to be present (NASP, 2005). Similarities found among successful heterogeneous mathematics classes involve: student engagement in cooperative learning environments, incorporation of differentiated instructional strategies, flexible groupings, and commitments to staff development throughout each district.

**Cooperative learning.** Through cooperative learning, students work together to achieve an outcome (NASP, 2005). Each cooperative learning environment should embrace learners of all levels (NASP, 2005). According to John A. Huss (2006), learning environments can promote academic achievement, increase retention, and vastly improve student self-esteem and communication. Cooperative learning, however, is not just group work. Students in cooperative learning environments have a specific goal to achieve. "Cooperative learning is one of many strategies, but it can't stand alone. It needs to be a linchpin of a high-content, activity-oriented, inquiry-based curriculum that provides access to all ability levels" (Scholastic Inc, 2006, para. 9).

**Differentiation.** In classroom settings in which there are a variety of ability levels, differentiated instruction has to be used (NASP, 2005). According to Tomlinson (2003), differentiated instruction is responsive. As teachers become increasingly aware of the students they teach and are comfortable with their discipline to be flexible in their teaching, they can then match instruction to meet the needs of all learners in order to maximize student potential (Tomlinson, 2003). If students are to make gains in achievement in a heterogeneous mathematics classroom, differentiated instruction is a key element. It allows for students of all levels to receive challenging instruction.

**Flexibility.** Flexibility of groups is also a best practice to help multiple levels of learning (NASP, 2005). All too often, by the time students are in middle school, they have already been placed in a track with little to no flexibility to move to other tracks (Brimfield et al., 2002). Groupings within a class need to be routinely rearranged based on student needs. Homogeneous groupings can be helpful if the groupings are temporary (NASP, 2005; Scholastic Inc, 1997). Students can get extra help if needed to grasp a concept (Scholastic Inc, 1997). This may be done by creating smaller groups within a heterogeneous class, or by supporting students by having them placed in an additional mathematics class (Lynn & Wheelock, 1997).

**Curriculum modification.** Unchallenging, unnecessary, and repetitive topics must be removed (Burris & Welner, 2005; NASP, 2005). For example, instead of teaching all thirteen chapters of an algebra book, a teacher must align curriculum according to their respective standards. Engaging questioning strategies must be used. Curriculum must be challenging but not too challenging. If the curriculum is too easy for students they lose the motivation to learn. Conversely, if the curriculum is too challenging for students and the students consistently fail, they, too, will lose the motivation to learn (Tomlinson, 1999).

**Support.** Tomlinson also notes that another key element for making mixed ability classes successful is the commitment and training of the staff involved (as cited in Brimfield et al., 2002). If a school is going to eliminate tracking, the school also has to put an emphasis on quality instruction and should provide professional development to work effectively with the different levels of students involved in the heterogeneous

classroom (Daniel, 2007). In order for teachers to be comfortable teaching a variety of learners all at once, they need to be trained on how to successfully work in such an environment.

## Chapter 3: Results

### Does Grouping Students Heterogeneously Affect Student Achievement in a Middle School Mathematics Class?

Is student achievement affected based on how students are grouped, homogeneously or heterogeneously? All of the research found indicates the answer to be yes. Grouping students heterogeneously, in mixed-ability mathematics classes, can positively affect student achievement, as well as increase student self-esteem, mainly in low-ability students. Research has also shown the increase in student achievement is due to many possible factors. One of the factors found is that students involved in heterogeneous classes generally receive a higher quality of instruction due to having more experienced and qualified teachers, when compared to their homogeneous counterparts. Students of heterogeneous groups take part in instruction that involves cooperative learning environments and differentiated instruction tailored to meet their individual needs. Successful heterogeneous class environments also include support systems for struggling learners. Students who need extra support get it through pull out programs or through an extra mathematics class.

However, research also has shown that despite the effectiveness of heterogeneously grouped classes, school districts find them challenging to implement. School politics seems to be one of the main obstacles schools face when trying to implement heterogeneous classes in mathematics. Parents, school boards, and administrators need to be better educated in the effectiveness of heterogeneous courses before a solution to effective implementation of heterogeneous courses can occur.

**To What Extent Do Students of High-, Average-, or Low-Ability Perform Better in Heterogeneous Grouping?**

Research has shown that overall student achievement increases when students are placed in a heterogeneously grouped classroom environment. But, which students receive the most benefit from being in a mixed-ability grouping? Some researchers have found that high-ability students have a greater increase in achievement in homogenous groups as opposed to high-ability students in heterogeneous groups. However, the research has also shown that the difference in achievement is not significantly different.

Now, every educator knows that not all students are high-achieving students. So, what does research say about the average- and low-ability students? Research indicates that average-and low-ability students receive the most benefit from heterogeneous groups. Scores are significantly higher for these students, when compared to their homogeneously grouped counterparts. As mentioned in the study conducted by Linchevski and Kutscher (1998), differential test mean scores for average- and low-ability students in homogeneous groups were 64% and 55%. Common test mean scores for these same students were 41% for average-ability students, and no mean percentage could be calculated for low-ability students due to students not able to complete the test. As for the heterogeneous counterparts, average- and low-ability students had mean scores of 80% and 78% on the differential test. Mean scores for the common test were 65% for average-ability students and 54% for low-ability students (Linchevski & Kutscher, 1998).

Of average- and low-ability students, the low-ability students reap the most benefit from heterogeneous groups. When put into an environment that demands high

standards for all, low-ability students rise to meet the level of expectations set for them. The high- and average-ability students serve as examples to the level expected of them.

In homogeneous groupings, low-ability grouped students generally do not receive the same quality of instruction as their high-ability grouped counterparts (Linchevski & Kutscher, 1998; Rees et al., 2000; Slavin, 1990,). These classes tend to move more slowly, give lower level material, and have lower expectations of the students. Students in these courses tend to have lower perceptions of themselves because they know they are a part of the lower track. When these students are placed in a mixed-ability group, they receive the same quality of instruction as the high-ability students, are introduced to higher-level material, and have an increased self-perception due to being a part of a mixed-ability class (Daniel, 2007). Research has also shown that in order for low-ability students to be successful there needs to be support for those learners that are struggling. How these supports should be implemented and the extent of these supports requires further research.

Since the difference in achievement for high-ability students is not significantly greater for homogeneous groups when compared to heterogeneous groups, heterogeneous groupings must be the obvious choice for school districts looking for ways to improve overall student achievement in mathematics. Heterogeneously grouped mathematics courses do not negatively affect high-ability student achievement and are a positive influence for average- and low-ability student achievement.

# Chapter 4: Conclusion

## Challenges of Implementation

Research has shown that heterogeneous grouping environments in middle school mathematics increase student achievement for average- and low-ability students, all the while not being detrimental to high-ability students. So why is homogenous ability grouping so widely used amongst educational systems?

A reason I believe that heterogeneous groupings are difficult to implement is perception. Some educational professionals, as well as community members, are under the perception that separating students into strictly homogeneous learning environments in mathematics is better for the students. Teachers may feel it is easier to teach to an ability rather than learning and implementing new and more demanding ways of reaching multiple ability levels all at once. Some community members may be under the impression that their student falls into one of the ability groups and wants to advocate for their student to be placed into that ability level. However, if research has shown that, no matter what a student's ability level, all students can be successful in a heterogeneous environment without decreasing achievement, why wouldn't every school district be on board for the change? This question may be too extensive for the research I collected.

Another reason heterogeneous environments may be difficult to implement is teacher buy-in. I believe that in order for a completely heterogeneous environment to be successful, teachers need to believe in it, be properly trained, and be willing to put in the effort into making it successful. If there is no teacher buy-in to heterogeneous grouping, and as a result teachers are not incorporating differentiation, cooperative learning groups, and other best practice teaching strategies needed, they may come to their own

conclusion that heterogeneous grouping for mathematics does not increase achievement and that homogeneous grouping is better for students.

**Suggestions for Further Research**

Educators may not have the authority to make district wide decisions on whether students are grouped heterogeneously. So, the question remains, what can teachers do to help students be successful if a district does not buy in to heterogeneous grouping for mathematics, for whatever reason? How else can we, as educators, make these low and middle tracks more successful if heterogeneous grouping is not an option? What do we have control of in our classroom to better help students of all levels increase in achievement?

If research states a reason low-ability students do not have significant gains in achievement due to low expectations and low quality of instruction, would it be enough to raise expectations and the quality of instruction for that particular group? Also, if student achievement is heavily influenced by the instruction of the teacher, what kinds of professional development are needed for teachers to begin to provide the higher quality of instruction needed to maximize student achievement? These questions would be a topic for future research.

Research also has documented that in order for low-ability students to be successful in heterogeneous classes there needs to be some form of extra support. There were a few references to the types of support incorporated, such as pull-out groups and extra mathematics classes for these students, but what else could be implemented and how could these supports be implemented? Would a co-teaching environment involving a mathematics teacher and a special education teacher help these students? I did not

come across any research that specifically stated how supports were implemented into the school day for schools that went from homogeneous mathematics classes to heterogeneous mathematic classes. I conclude that more research on this topic is needed.

Also, are student gains in a heterogeneous mathematics class because of the classroom environment or are gains due to the specific teacher in control of the environment? Research shows that low-ability homogeneous mathematics classes tend to have a lower quality of instruction. What if a teacher of a heterogeneous classroom does not provide the high quality of instruction needed? And as stated previously, what happens if that teacher does not buy in to the notion of having a mixed-ability classroom environment? Would there still be significant student gains? I did not come across any research encompassing this topic, however, I feel that it is an important extension to heterogeneous and homogeneous classroom environments.

An area of research I did not fully incorporate in the topic of homogeneous grouping versus heterogeneous grouping in mathematics classrooms is the closing of achievement gap between high-ability and low-ability students. In doing my research I did come across an article that incorporated this notion. Results from the study conducted by Linchevski and Kutscher (1998) showed that the achievement gap may be closed with heterogeneous grouping, mainly due to gains made by average- and low-ability students (Linchevski & Kutscher, 1998). However, the topic of closing the achievement gap was beyond the scope of my research. Questions about the achievement gap between high-ability and low-ability students does interest me. Closing the achievement gap between these abilities should be an important topic of discussion for all educators.

This paper shows the importance of grouping students heterogeneously over homogeneously to increase student achievement, especially for the population of students that tend to struggle with mathematics. I am hopeful that despite the challenges school districts face, administration and educators see that grouping students by ability is not the best way to make all students successful. There are other and more effective ways available.

## References

Ability Grouping. (2002, July). *The Balanced View*. Retrieved from http://www.sharingsuccess.org/code/bv.html

Brimfield, R., Masci, F., & DeFiore, D. (2002). Differentiating instruction to teach all learners. *Middle School Journal, 33*(3), 14-18.

Burris, C. C., Heubert, J. P., & Levin, H. M. (2006). Accelerating mathematics achievement using heterogeneous grouping. *American Educational Research Journal, 43*(1), 105-136.

Burris, C. C., & Welner, K. G. (2005). Closing the achievement gap by detracking. *Phi Delta Kappan, 86,* 594-598.

Daniel, L. (2007). *Research summary: Heterogeneous grouping. National Middle School Association.* Retrieved from http://www.nmsa.org/Research/ResearchSummaries/HeterogeneousGrouping/tabid/1264/Default.aspx

Fulingi, A. J., Eccles, J. S., & Barber, B. L. (1995). The long-term effects of seventh-grade ability grouping in mathematics. *The Journal of early adolescence*, *15*(1), 58-89.

Huss, J. A. (2006). Gifted education and cooperative learning: A miss or a match? *Gifted Child Today, 29*(4), 19-23.

Linchevski, L., & Kutscher, B. (1998). Tell me with whom you're learning, and I'll tell you how much you've learned: Mixed-ability grouping in mathematics. *Journal for Research in Mathematics Education, 29*(5), 533-554.

Lynn, L., & Wheelock, A. (1997). Making detracking work. *The Harvard Education Letter, 13*(1), 1-5.

National Association of School Psychologists (NASP). (2005). *Position statement on ability grouping and tracking.* Retrieved from http://www.nasponline.org /information/pospaper_ag.html

Rees, D. I., Brewer, D. J., & Argys, L. M. (2000). How should we measure the effect of ability grouping on student performance? *Economics of Education Review, 19,* 17-20.

Scholastic Inc. (2006). *Hot topic: Does ability grouping help or hurt? A talk with Anne Wheelock*. Retrieved from http://teacher.scholastic.com/professional/classmgmt/ abilitygroup.htm

Slavin, R. E. (1990). Achievement effects of ability grouping in secondary schools: A best-evidence synthesis. *Review of Educational Research, 60*(3), 471-499.

Tomlinson, C. A. (1999). *The differentiated classroom: Responding to the needs of all learners.* Alexandria, VA: Association for Supervision and Curriculum Development.

Tomlinson, C. A. (2003). *Fulfilling the promise of the differentiated classroom: Strategies and tools for responsive teaching.* Alexandria, VA: Association for Supervision and Curriculum Development.

Wiliam, D., & Bartholomew, H. (2004). It's not which school but which set you're in that matters: The influence of ability-grouping practices on student progress in mathematics. *British Educational Research Journal, 30*(2), 279-293.

**Annotated Bibliography**

Ability grouping. (2002, July). *The Balanced View*. Retrieved from http://www.sharingsuccess.org/code/bv.html

The author of this article answers some questions regarding ability grouping. What is ability grouping? How prevalent is ability grouping? What do people say about ability grouping? What does the research say about ability grouping? All of these questions are answered using researched based evidence.

What is ability grouping? Definitions of ability grouping are given, as well as definitions for other terms related to ability grouping. Two types of ability grouping are also identified. These are within-class grouping and between-class grouping.

How prevalent is ability grouping? Within-class grouping is common in elementary grades. Between-class grouping can be found in elementary grades, mainly in math and reading. For other subjects, students are mixed. It is most common in secondary schools. What do people say about ability grouping? Defenders say it is easier to teach grouped students. The lower ability students feel more comfortable with students at their same ability level, and high-achieving students thrive when placed together. Opponents say ability grouping does not benefit all students. Grouping methods may not be data based. Teachers usually are less experienced, and instruction methods are different from low classes to high classes ("Ability Grouping", 2002).

What does research say? Results of research based on achievement depend on the type of ability grouping studied. For within-class ability grouping, larger gains are made in mathematics than mixed groupings (for upper elementary grades). For cross-grade grouping, larger gains are made in mathematics than mixed ability classes. For between-class ability grouping, no benefits in achievement are made. The ability grouped students learn the same as mixed group students. There tends to be an increase in achievement gap with this type of grouping. The high-ability students keep gaining; the low-ability students maintain.

This article is going to be a great reference for definition of terms. It also helped identify the different types of ability grouping. The only hang-up I have with this article is that I don't know the author of it. I do have the journals contact information. All I need to do is contact them and ask for the information.

Burris, Carol C., Heubert, Jay P., & Levin, Henry M. (2006). Accelerating mathematics achievement using heterogeneous grouping. *American Educational Research Journal, 43*(1), 105-136.

The purpose of this study was to see if more students would take and pass advanced mathematics courses (trigonometry and beyond) if they took an accelerated algebra course in the eighth grade, and would high achieving student performance suffer if all students were heterogeneously grouped in accelerated mathematics courses. The study was performed using a Long Island school which included approximately 3,500 students. Demographics of the school were mostly White, with some African-American, Latino,

and Asian students. The research included two different groups. The first group consisted of homogeneously tracked students. These students spanned three grade levels. The second group consisted of heterogeneously detracked students. These students also spanned three grade levels. The first group was followed from 6th-grade through 12th grade. The same was done for the second group. The school involved in the study made a school wide decision to heterogeneously detrack all mathematics students and place them in accelerated mathematics courses.

The results showed that if students were detracked and placed in an accelerated 8th-grade algebra course, more students would take and pass higher level mathematics courses. Increased achievement was found in all student demographics. Also, there was no evidence to support claims that high achieving students suffered from heterogeneous grouping.

This study is very useful to my research. There is a lot of data to support the research. Other than the data, I find it interesting how the school set up support for students and teachers when it decided to place all students in accelerated mathematics courses. Extra help was given to those students who needed it or wanted it. There was a conscience effort made by the school district to support instruction. I feel that if detracking students is a model that other schools would like to follow, similar steps as the ones described in the article are a necessity for success. Just placing students in accelerated courses is not enough. There needs to be supports in place to prevent students from “falling through the cracks”.

Duflo, Esther, Dupas, Pascaline, and Kremer, Michael (2009). Can tracking improve learning? *Education Next*, *9*(3), 64-70. Retrieved from http://vnweb.hwwilsonweb.com.bsuproxy.mnpals.net/hww/jumpstart.jhtml?recid=0bc05f7a67b1790ee280c5d551d3257c361eea9af8e5ec1d74db1df413a889f7e776bd544975a74a&fmt=HDuflo

The authors of this article use data from Kenya to determine whether or not tracking can improve student learning. A study was conducted in western Kenya where 140 primary schools received extra funding to hire another teacher to reduce class size. Of the 140 schools that received the funding, 121 of those schools used the extra teacher to add another 1st-grade class. Of the 121 schools, 61 schools were randomly selected to assign students to classes based on test scores. The lower fifty percent were in one class and the upper fifty percent were in the other. The other 60 schools just randomly assigned students to classes. The students were followed for 18 months, from the middle of their 1st-grade year to the end of the next year.

The results showed that students in tracking schools scored 0.14 standard deviations higher than nontracking schools. Students were also tested again one year later to see if there was retention. The students who were a part of the tracking schools still performed better than the nontracking school students, by 0.16 standard deviations.

This article is very interesting. The authors present the data in an unbiased way. However, I feel that the authors should have paid more attention to a few details in regard

to the teachers involved in the study. It was mentioned that teacher attendance is a problem in Kenya. When unannounced visits were made to the sites, the teachers of the tracking school were 9.6% more likely to be there and to be teaching when compared to the nontracking schools. The authors did put this into perspective stating that this resulted in a 25% increase in teaching time. The only conclusion made from these results was that teachers must be more motivated to teach tracked students than nontracked students. No consideration was made to the possibility that students may do better when teachers are there teaching.

Huss, John A. (2006). Gifted education and cooperative learning: A miss or a Match? *Gifted Child Today*, *29*(4), 19-23. Retrieved from http://vnweb.hwwilsonweb.com.bsuproxy.mnpals.net/hww/jumpstart.jhtml?recid=0bc05f7a67b1790ee280c5d551d3257ceaa18014faa64a8b73cf1e3d7bb35325853e470ed5e4d5f5&fmt=PHuss

Not all teachers like the idea of cooperative learning, nor do all teachers who use cooperative learning implement it in an effective way. Cooperative learning is generally perceived to benefit low- and middle- ability groups (20). They are not generally thought of as good practice for gifted students. However, Ross and Smyth (1995) make the point that cooperative learning must actually be demanding for gifted learners. The author, John A. Huss, describes the five essential elements of cooperative learning and believes that each element must be present in order to have a productive and useful cooperative environment. The elements are: 1) positive interdependence, 2) face-to-face interaction, 3) individual and group accountability, 4) interpersonal skills, and 5) group processing.

The author, John A. Huss, looked at different studies about whether or not cooperative learning is beneficial for gifted students, or is it only for low- to middle-ability students. By synthesizing different studies and gathering data, he came to the conclusion that cooperative learning environments can promote academic achievement, increase retention, and vastly improve student self-esteem and communication (20). However, the author also states that not all what teachers believe to be cooperative learning environments are cooperative. Therefore, Huss put together a list of elements that must be used in order for the environment to be successful. The elements are: 1) positive interdependence, 2) face-to-face interaction, 3) individual and group accountability, 4) interpersonal skills, and 5) group processing. If each element is a part of the cooperative learning environment and the activity in which the students are working with is intellectually demanding, then gifted students, as well as lower ability students, will benefit.

I feel that this article will be useful to me in a number of ways. One, there are a lot of sources I may want to take a closer look at that are cited in the article. There are references to studies that I may want to read more about so I can make up my own conclusions about them. There are also parallel ideas in this article when comparing to my ideas for my paper. Heterogeneous and homogeneous grouping is mentioned and gives statistics on the percentage of principals at different age levels who use mixed ability grouping in their schools.

Kahveci, Murat and Imamoglu, Yesim (2007). Interactive learning in mathematics education: Review of recent literature. *The Journal of Computers in Mathematics and Science Teaching, 26*(2). 137-153. Retrieved from http://vnweb.hwwilsonweb.com.bsuproxy.mnpals.net/hww/jumpstart.jhtml?recid=0bc05f7a67b1790ee280c5d551d3257c3f08e03de9093bc7ef54dca2fc153a21284da8210d004a15&fmt=HKahveci

The authors of this article review literature related to the use of different types of interaction in mathematics education. Interactions investigated include student-student interactions, teacher-student interactions, and student-technology interactions. Of the types of interactions reviewed, the interactions related to cooperative groups were the most beneficial to me. Factors that effects interactions in cooperative groups are group composition, type of interaction, effect of teaching, interdependence of students, and the nature of the task. In regard to group composition, groups that were most likely to have active participation were ones that were "homogeneous medium ability groups, heterogeneous groups with moderate range of ability (high-medium or medium-low), and groups that contain equal number of boys and girls."

The teacher also plays a role in influencing group interactions. It was found that students seemed to imitate the kind of help they received from the teacher. If the teacher did not give a high-level of help to the students, the helpers in the groups also did not give that level of help to their peers.

Basically, what I found to be useful in this article is that a teacher has a huge influence on the success of cooperative group environments in a mathematics education classroom.

The teacher needs to set up an environment that promotes positive participation from all members and the tasks involved need to be high-level.

Rees, D.I., Brewer, D.J. & Argys, L.M. (2000). How should we measure the effect of ability grouping on student performance? *Economics of Education Review, 19*(1), 17-20. Retrieved from http://csaweb113v.csa.com.bsuproxy.mnpals.net/ids70/results.php?SID=di4dkfmgh793dus4dm 0h64n1t0&id=2

The authors of this article critically review the results of another article, *The effects of ability grouping on student math achievement and resource allocation in secondary schools,* by Betts and Shkolnik. The results Betts and Shkolnik produced stated that when comparing tracked and untracked schools, achievement levels of students were similar. However, Argys, Rees, & Brewer claim that the schools Betts and Shkolnik used were actually all tracked schools. Some of the schools tracked formally, while others tracked informally. They concluded that the claims by Betts and Shkolnik were not accurate, and that there was little difference in student performance between the two types of tracked schools.

This article was interesting to read. I have yet to read an article that critiqued the results of another, until now. The points the authors of this article do make sense. Tracking can be done formally and informally. It is the job of the researcher to identify which type of tracking is taking place and to identify when no tracking is happening.

Rock, Marcia L., Gregg, Madeleine, Ellis, Edwin, & Gable, Robert A. (2008). REACH: A framework for differentiating classroom instruction. *Preventing School Failure, 52*(2), 31-47. Retrieved from http://vnweb.hwwilsonweb.com.bsuproxy.mnpals.net/hww/jumpstart.jhtml?recid=0bc05f7a67b1790ee280c5d551d3257c03c94964b713328f5e30178565fd0b837318ccd7f0f8b3da&fmt=HRock

The authors of this article discuss three categories of differentiated instruction in which they say the majority of their research articles on differentiated instruction belong to. The categories are model, myths, and evidence. The authors discuss each to help the reader better understand what differentiated instruction is. Differentiated instruction is the process of "ensuring that what a student learns, how he/she learns it, and how the student demonstrates what he/she has learned is a match for that student's readiness level, interests, and preferred mode of learning" as defined by Thomlinson. The authors also mention that differentiating instruction is a daunting task; however, the effort is worth it. To help educators better differentiate instruction they put together a framework for implementing differentiated instruction into a classroom. REACH is the acronym used to describe the steps of the framework. It stands for: reflect on will and skill; evaluate the curriculum; analyze the learners; craft research-based lessons; and hone in on the data.

What I got out of this article is that no matter how a class is put together, homogenous or heterogeneous, differentiating instruction can help all students. No matter the dynamic of a classroom, all students are at different levels. Identifying where they are and creating lessons and assessments that attend to all learners needs would be useful in any classroom

situation. This article may not be directly helpful to my needs. However, it may be useful if I want to extend my paper to classroom strategies that can reach all learners. But, I feel that this task may be too much.

Schweiker-Marra, K., & Pula, J.J. (2005). Effects of a homogeneous low-tracked program on academic performance of at-risk students. *The Delta Kappa Gamma Bulletin, 71*(2), 34-42, 58.

In this article, the researchers try to determine if students who are at-risk will improve their academic performance due to being a part of a low-tracked homogeneous program. They conduct their study over three years using 40-50 7$^{th}$-grade grade at-risk students from a middle school located in a mid-Atlantic state. The students were placed into a homogeneous group where the treatment program was implemented. In each of the three years, two teachers were considered the lead teachers. Each year, the combination of teachers changed. Different treatments on the students were implemented throughout each year. The first year emphasized drilling basic computation, using the teach/re-teach method, and offering monthly student rewards. The second year emphasized hands-on experiences, study skills and test-taking strategies, and an incentive program. Finally, the third year emphasized much of the same as the second year but implemented more cooperative learning environments, such as group projects and teamwork.

I did find this article useful in the fact that the results did surprise me. I didn't expect significant increase in test scores. I also didn't expect that the most relevant results in increasing test scores were: 1) drill and hands-on teaching methods; 2) disciplinary

programs to manage behavior; and 3) strategies to improve attitudes and increase self-esteem. How can drill and hands-on teaching methods result in equal emphasis on increasing scores when the practices are so different? I also find it questionable when the results of the study state that "experienced" teachers are essential to any low-tracked program. Most of the teachers used had at least 15 years of experience. They didn't try the study with teachers that had less than 15 years experience. Could they have had the same results?