

TO WHAT DEGREE WILL DIFFERENTIATED INSTRUCTION IMPACT STUDENT
GRADES IN A MIDDLE SCHOOL CLASSROOM?

by

Maureen K. Wilke

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 SCIENCE IN ELEMENTARY AND MIDDLE LEVEL
MATHEMATICS EDUCATION

BEMIDJI STATE UNIVERSITY
Bemidji, Minnesota USA

January 2009

STATEMENT BY THE AUTHOR

Brief quotations from this research paper are allowable without special permission, provided accurate acknowledgement of the source indicated. Requests for permission to use extended quotations or reproduce the manuscript in whole or in part may be granted by the Department of Mathematics and Computer Science or the Dean, School of Graduate Studies when the proposed purpose is in the interest of scholarship. In all other instances, however, permission must be obtained from the author.

Signed: _____

APPROVAL BY RESEARCH PAPER ADVISOR

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

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

Date

Dean, School of Graduate Studies

Date

TO WHAT DEGREE WILL DIFFERENTIATED INSTRUCTION IMPACT STUDENT
GRADES IN A MIDDLE SCHOOL CLASSROOM?

Maureen K. Wilke

The middle school student population encompasses one of the widest ranges of diversity in the educational system. Besides cultural, religious, educational, economical diversity, the middle school student copes with physical and psychological changes as well. It is important to understand that reaching students successfully is not teaching one way, but providing a learning experience based on students' needs. The five key differentiated strategies in the classroom are: knowing the student, the environment, meaningful lessons, tiered assignments, and assessment. Gather as much information on the students, such as data from past standardize tests, conversation with students, student journals about success and failure, and classroom observations. Equally important is for the student to feel successful in the classroom by providing a safe and caring environment. When students feel the environment is conducive to learning and success they will continue to work hard and be rewarded with positive results. Designing meaningful lessons will engage all students by incorporating activities and group work to enhance achievement. Tiered assignments are designed from the results of the pre-assessment test. The assignments are one level above the ability of the students in each group. It is important the teacher creates all assessments and when designing assessments, it is important that students obtain success and have mastered the concepts taught. A study was conducted in a middle school. Four groups were studied to see if student achievement would occur with the implementation of differentiation. Findings indicated that there was an increase in student achievement from mid-quarter to the end of the quarter. Successful classrooms need to incorporate differentiated strategies for students to be successful in the classroom.

Approved by:

Committee Chair

Date

Committee Member

Committee Member

Graduate Faculty Representative

ACKNOWLEDGEMENTS

I would like to thank my family for allowing me to take time away from them to pursue my masters in education. I would like to thank Laurel Barklow for her assistance in helping me create a professional paper. I would like to thank Nancy VanErp for her patience and guidance through the education research process. I would like to thank Joan Miller for making sure I was in the right masters program. I would like to thank Glen Richgels, Todd Frauentholtz, and Derek Webb for showing me that creating variety in the math classroom makes students successful. In memory of my dad I would like to thank him for encouraging me to pursue my dreams of being a teacher. His words and actions as a professional educator help me to continue to be the best teacher I can be for my students.

TABLE OF CONTENTS

LIST OF TABLES	vi
LIST OF FIGURES	vii
Chapter	Page
1. Introduction	
<i>Statement of the Problem</i>	1
<i>Research Questions</i>	2
<i>Significance of the Research Problem</i>	3
<i>Limitations and Assumptions</i>	3
<i>Definitions of Terms</i>	4
<i>Summary Statement</i>	4
2. Review of Literature	
<i>Summary of the Statement</i>	5
<i>Knowing the Student</i>	5
<i>The Environment</i>	6
<i>Meaningful Lessons</i>	8
<i>Assignments</i>	10
<i>Assessments</i>	11
<i>Differentiated Math Classroom</i>	13
3. Opinions of Research	16
4. Conclusion	25
Bibliography	27

LIST OF TABLES

Table	Page
3.1 <i>Average Classroom Size and Average Subgroups</i>	19
3.2 <i>Students below grade level and students receiving an F at 1st mid-quarter 2008</i>	20
3.3 <i>Group 3 and 4 Grade Comparisons</i>	24
3.4 <i>Group 5 and 6 Grade Comparisons</i>	25

LIST OF FIGURES

Figure	Page
3.1 <i>Ethnicity of the Middle School Mathematics Groups</i>	19

Chapter 1: Introduction

This researcher has spent the past six years teaching mathematics to middle school students. Every year frustration occurs because the needs of all students are not being met. Teaching became a job and not what it was intended to be, to make a difference in the lives of students. It was either leave the profession or change the way teaching and learning occur in the classroom. The motto of this researcher became “Put the needs of all students first.” Differentiation was a word used quite frequently in education. The meaning of the concept was vague, but it seemed to be the idea that would fit the new motto. Research and implementation of differentiation began in this middle school classroom.

Statement of the Problem

In recent years this researcher’s district has become more diverse, yielding a large range of students to educate. There are gifted and talented students, average students, special education students, English language learners, students of poverty, and struggling students who do not qualify for any services. Teacher training programs need to provide instructional procedures to equip educators with skills, knowledge, strategies, and training to address specific learning needs of each student. “In many classrooms, the approach to teaching and learning is more unitary than differentiated” (Tomlinson, 2001, p. 1). How can educators take the one size fits all instruction to a differentiated instruction where students will be successful? This research paper will define, explain, study, and analyze how a differentiated classroom addresses needs of diverse learners.

Being a middle school teacher of six years, there has not been sufficient training to deliver differentiation in the classroom for student success. In college, teacher trainers

provided differentiation theory, but very little practice was provided to help teachers understand the application of differentiation. It is this researcher's experience that classrooms contain a wide variety of students, but teachers are not well educated in differentiation to help all middle school students in those varied classrooms. At one time this researcher taught at the board giving notes to the students, providing sample problems that would be checked, and then assigned students homework. "She explained the math one way and one way only. She taught each topic one way and one way only. She used one form of assessment and one form only. She knew math, but she didn't know me well at all" (Tomlinson, 2005, p. 12-13). The middle school student population encompasses one of the widest ranges of diversity in the educational system. Besides cultural, religious, educational, economical diversity, the middle school student copes with physical and psychological changes as well. "Not only do middle school students represent all forms of diversity that exists in general, but they represent a huge range of physical, social, emotional, and mental immaturities and maturities" (Tomlinson, 2005, p.13). It is important to understand that reaching students successfully is not teaching one way, but providing a learning experience based on students' needs. Using differentiated instruction helps the teacher understand students' individual needs and generates an atmosphere where students feel as though the teacher cares about their success. "We need to teach so that each student feels known, valued, and supported" (Tomlinson, 2005, p. 13).

Research Questions

To what degree will differentiated instruction impact students in a middle school classroom?

- What is differentiated instruction?
- How does one start differentiated instruction?
- What is the learning environment in a differentiated classroom?
- How are lessons and assignments planned based on differentiated instruction?

Significance of the Research Problem

Differentiation in the classroom needs to become an important element in teacher instruction. With the increasing amounts of diverse learners it is more important than ever to incorporate differentiated instruction for student success. With a changing work force that demands post high school education and training, it is important that students have a successful K-12 learning experience for the sake of the nation. “Three quarters (75.6 percent) of employer respondents say that K-12 schools should be responsible for providing the necessary basic knowledge and applied skills for their new entrants” (Casner-Lotto & Barrington, 2006, p. 54).

By training teachers to differentiate in the classroom it will give educators the opportunity to present a lesson that meets all learners’ needs, not just the students in the middle. Gifted-and-talented students should be challenged and struggling students should be provided access to knowledge and skills to further their learning. “In a differentiated classroom, the teacher assumes that different learners have different needs” (Tomlinson, 2001, p. 3).

Limitations and Assumptions

This paper discusses incorporating differentiation into a first inner-ring suburb middle school classroom. This paper will be limited to a middle school classroom. The focus of this research will be centered on knowing the students, the environment,

meaningful lessons, assignments, assessments, and differentiation in the mathematics classroom to meet all students' needs. The results of this paper will increase education on differentiation theory and practice for middle school teachers as they address the needs of all students.

Definitions of Terms

Differentiation: the adjustment of the teaching process according to the learning needs of the pupils. It can be aimed at:

- whole class
- groups within a class
- individuals

Mixed ability: groups of students, established by the teacher, who are at different stages of learning.

Heterogeneous: students who possess diverse abilities in a classroom.

Homogeneous: Students who possess similar abilities in a classroom.

Summary Statement

Educating twenty-five or more diverse students within one class period can be challenging. How should one approach this situation? Should one look at students as trees in a forest and care for the forest as a whole? Should one look at each student as an individual tree in the forest and tend to each trees' needs? Should one group students as the trees in a forest are grouped and tend to diverse needs within the context of small groups? Actually, all the groupings are needed: whole group, individuals, and small groups. The trees and students should be understood based on needs and cared for in a manner that meets those needs. Differentiation is a lot like the analogy of the trees in a

forest. Understanding who students are, one can group students based on individual strengths and challenges. This will allow one to design learning based on the needs of individual students. It will create an environment where all individuals can meet success.

Chapter 2: Review of Literature

Summary of the Statement

Gone are the days when teachers are at the board delivering notes, then students work on examples of the lesson, and finally students work independently on the assignment. “Mixed-ability classrooms that are ambiguous about learning goals, that evoke little passion, that cast the teacher as the centerpiece of learning, and that lack responsiveness to student variance show little understanding of these various learning realities” (Tomlinson, 2001, p. 9). With the increased competition in the world, it is important that we structure our classrooms so all students eventually will be prepared to compete globally. Today’s classroom brings many different students with many different needs. Classrooms have gifted students, average students, struggling students, special education students, and students who are English Language Learners (ELL) students. A teacher has to try to meet all of these students’ needs. Differentiated instruction is creating a lesson that meets the needs of mixed ability students. “In a differentiated classroom, the teacher assumes that different learners have differing needs. Therefore, the teacher proactively plans a variety of ways to ‘get at’ and express learning” (Tomlinson, 2001, p. 3).

Knowing the Student

In a differentiated classroom, a teacher gets to know all the students through data and assessments. When the teacher learns what the students know, lessons, assignments, and assessments are designed to fit the students’ needs. “We use strategies that adjust the content we teach, the process in which we teach it, and the products we ask students to give us so that we can determine their achievement in learning a concept or skill”

(Northey, 2005, p. xi). Teaching in this manner gives students the opportunity to successfully learn the content based on their ability. In order for all students to achieve their full potential, it is important that educators increase student access to learning concepts and skills through differentiation in the classroom. “Although not easy, there are at least two good reasons to learn how to implement differentiation in secondary schools. The most important is that is the only fair way to teach, and somewhat less important, but definitely a reality, is that most school districts and parents insist on it” (Northey, 2005, p. xi).

The differentiated classroom allows students to gain as many skills as possible to apply in present and future settings. “The goal in education is for all students to learn as much as they can to be productive citizens and maintain personal success in today’s world” (Chapman & King, 2005, p. 28). In order to achieve this goal, it is important to gather as much information, on the students, as possible. Helpful information is data from past standardized tests, conversation with students, students journals about success and failure, and class observations to see how they do on the concepts being taught. “Effective teachers know it is worth their time to gather as much information as they can about each student and not to assume anything” (Chapman & King, 2005, p. 27). Once information has been gathered, it is important to take the time to interpret the results and make the right decision on how to deliver instruction to all students. “It takes time to think, assess, and analyze gathered information. Step back, interpret, and make the right instructional decisions” (Chapman & King, 2005, p. 27). Teachers who take the time to get to know students will increase their success across ability levels.

The Environment

Creating an environment where students of all abilities feel successful is the first step in creating a differentiated classroom. The teacher starts the year with a feeling of community and care in the classroom. “Remember, too, that a part of feeling genuinely welcomed in a place is that key people make an enduring and sustained effort to get to know and understand you” (Tomlinson, 2001, p. 22). Everyone in the classroom gives mutual respect to one another. Everyone feels welcomed and comfortable sharing ideas in class or admitting they cannot answer the question. “Students in a differentiated classroom should know it is a good thing to ask for help when it is needed, that it is fine to say you don’t know, that an earnest question will get an earnest response, that eyes will not roll when someone expresses something that seems unusual or evident, that fledging ideas will be given a chance to develop, and so on” (Tomlinson, 2001, p. 22). In order for a student to feel successful in the classroom it is important to provide a safe environment. When students experience failure in their past they will have little motivation to learn. It is important to convey to students that they can be successful. “Negative feelings create barriers to success, so it is imperative for the teacher to maintain a positive, comfortable, and inviting assessment environment. The teacher continually monitors the affective aspects of the environment to assure student success. The affective assessment climate is reflected in the student’s desire to grow in understanding.” (Chapman & King, 2005, p. 18) Constantly monitoring the student and rewarding them when they are working will help a student feel successful. “Emphasize and praise the quality, not the quantity or

amount of the student's work. BE THE BEST YOU CAN BE!" (Chapman & King, 2005, p. 7).

Another challenge a teacher faces is maintaining a student's motivation to learn. However, when students feel the environment is conducive to learning and success they will continue to work hard and be successful. After continued success in the classroom eventually students will be able to monitor and adjust their learning in any environment. "The recent brain research-specifically the 'emotional brain' basis of learning as discussed in Chapter 1 has emphasized that children require high levels of success in order to be motivated to continue their work in any curriculum area" (Bender, 2005, p. 59). All participants in the classroom celebrate successes and help those who need extra guidance. The teacher strives for individual student success with the academic expectation just above each student's comfort level. "In a good differentiated classroom, the teacher is constantly raising the stakes for success for any individual, then doing whatever is necessary to help the student succeed in taking the next step" (Tomlinson, 2001, p. 23).

Meaningful Lessons

Teachers need to create meaningful lessons in all classrooms. Each lesson should be designed and delivered where all students will be able to understand and learn the concepts that are being taught. When a teacher takes the time to design a lesson to meet all students' needs, in the end all students will be learning and taking away knowledge that will help them in their future education. "At this point in the planning process the teacher must outline the specific instructional actions that will be used to guide the students toward mastery of the objectives" (Moll, 2005, p. 124).

In designing a meaningful lesson, it is important to start each lesson with a launch. There are many different approaches to the launch in the lesson. The main objective in the launch is to grab the students' attention and motivate them to want to learn. This is a good time to bring in past concepts and explain the relationship to today's lesson. By bringing in past experiences, the brain makes the new information meaningful where it is stored it into the memory. "Refer to the student's past and current knowledge to make meaningful connections to the new skill or strategy. Create opportunities for the student to recall past experiences" (Chapman & King, 2005, p. 9). The launch is also a great time to tell a story, show a concrete demonstration, or have the students work on an activity that will relate to the day's lesson. In every lesson, within a short time students' attention will either be harnessed or lost. That is why it is important to grab them and motivate them in the launch. "This action is considered the 'hook'. It is the piece that pulls the students into the learning process. During this action the teacher attempts to connect the students' previous learning to what they are about to learn and indicates how the information will be used in real life" (Moll, 2005, p. 124).

The next step to a meaningful lesson is the explore section. This is where the main part of the lesson is given. After the launch the teacher begins the direct or explicit teaching of the lesson. During this part of the lesson the class is in a whole group instruction, where the new information or concept is taught. "This action is considered the actual teaching of new information. The teacher identifies how the specific content, skill, or process will be presented to the students" (Moll, 2005, p. 125). The teacher will decide whether to demonstrate or model the new concept. Whatever approach the teacher uses, it is important to walk the students through the steps of the lesson. When the

teacher is finished with whole group instruction, the students can practice the new information by working in groups or independently. It is important that the teacher observes and guides the students during this time. “Practice implies that the teacher will be systematically observing and guiding the student work, but not actively directing the new knowledge” (Moll, 2005, p. 126).

At the end of a meaningful lesson it is important to summarize what was taught. The teacher might want to ask some questions to enable the students to think about what they have learned. The teacher could also have the students write down what they have learned as a measure of learning. “The closure may be in the form of a simple transition from one content area activity to another or it might be a final piece that pulls together learning that has occurred over time” (Moll, 2005, p. 127).

After group instruction, students receive assignments based on mastery of the lesson. “In a differentiated classroom, a number of things are going on in any given class period. Over time, all students complete assignments individually and in small groups, and whole-group instruction occur as well” (Tomlinson, 2001, p. 15). At the end of a lesson it is important to provide some time for students to practice what they have learned. “Practice implies that the teacher will be systematically observing and guiding the student work, but not actively directing the new knowledge” (Moll, 2005, p. 126). This is a good time to help students who need extra practice. The teacher can work with those who need extra help and it is good practice to allow students to work in pairs to reinforce learning. In pairs they become both teacher and student. They can help each other when they are stuck and can compare answers when problems are finished. Allowing students to work in pairs frees the teacher to allow remediation of small groups

through a mini-lesson on the whole group lesson. “Perhaps more than any other strategy in this text, the class wide peer tutoring strategy should be mastered and used by every general education teacher in the elementary and middle grades. This tactic, in a very concrete sense, makes differentiated instruction possible, because it allows teachers to truly individualize their lessons for classes of 20 or even 30 kids” (Bender, 2005, p. 66).

Assignments

Differentiated assignments need to be carefully thought out. Differentiated assignments are not assignments where the gifted and talented students do challenging questions or the struggling students work on basic skills worksheets. Rather, differentiated assignments are tiered to stretch learning for all students. Students are brought to new levels of understanding through the work they do. “When everyone in the class has exactly the same homework assignment, some students will likely only be doing busy work because they have already mastered what they have been asked to practice, while some other students simply have no idea how to do the required work” (Tomlinson, 2005, p. 14). Differentiated assignments are designed on the ideas of the lesson taught. They are structured based on the results of the pre-assessment tests. The assignments are one level above the ability of the student in each group. “Plan to encourage your students to ‘work up’---that is, be ready to match students to tasks that will stretch them” (Tomlinson, 2001, p. 49). Assignments are designed around the part of the lesson needing emphasis. When designing differentiated assignments it is important to decide how many different assignments to create. Three different assignments will encompass struggling students, average ability students, and gifted and talented students. “Differentiated homework can provide a great opportunity for student to ‘work

backwards' to master missing skills, to extend content to challenge advanced learners, and to link applications of content to student interests" (Tomlinson, 2005, p. 14)

Assessments

A pre-assessment in the beginning of each chapter helps the teacher understand individual student needs. Results of the pre-assessment helps educators adjust and determine the progression of the lessons. "Pre-assess at the outset of each unit to determine what students know, understand, and can do related to the topic before the unit begins. Use what you learn to inform your sense of who has or lacks important background knowledge, understanding, and skills as well as the degree of knowledge, understanding, and skill individuals have about the content you will explore with them in the unit" (Tomlinson, 2005, p. 14). Lessons in the chapter are presented in different ways for students to demonstrate understanding. Pre-assessment should be based on the objectives on the upcoming unit. Pre-assessment helps the teacher prepare a unit based on all students' needs. "Use pre-assessment and post-assessment for evidence of mastery in order to differentiate product, process, and content for all students" (Northey, 2005, p. 182). The teacher can prepare lessons, collect materials needed, provide activities to enhance learning, and create assignments that correlate to the skills needed for the lesson and real world problems. This approach creates less stress on the teacher, by providing more time to work with students and allowing the opportunity to quickly adjust a lesson if needed. "This is the time to plan strategically to reteach, readjust, revamp, enhance, or enrich according to the diverse needs of the learners" (Chapman & King, 2005, p. 82).

Once the pre-assessment establishes what concepts the students understand and the concepts on which students need more work, it is important to continually assess

during the unit. It can be as easy as checking their work and solution to a problem they solved, it can be a quick quiz on the day's lesson, or it can be a quiz on many lessons in the unit. "Ongoing differentiated assessment assists students as their needs occur in daily activities. Individuals receive prompt interventions with specific, corrective feedback as they work. This avoids the pitfalls of failure as students learn to monitor their own work and take more personal control of learning" (Chapman & King, 2005, p. 11). Continuing assessment throughout the unit helps a teacher understand which students need extra help and which students need to be challenged. It may require the teacher to spend an extra day enhancing a lesson with hands-on activities for the students who struggle. While the teacher spends an extra day with the struggling learners, enrichment activities are provided to the students who understand the material. "Teachers should match instruction and assessment as closely as possible to students' readiness and abilities. Teachers should be prepared to reteach concepts and skills to students who simply did not 'get it' through the whole class instruction or the practice" (Northey, 2005, p. 143). Assessment during the lesson also helps the students see what concepts they are successful with and what concept requires assistance and extra work. "The results are used to strategically customize instructional plans, provide students with multiple ways to show their learning, keep them on the right track, and accelerate their learning journeys" (Chapman & King, 2005, p. xix).

At the end of a unit, it is important to give an assessment on the concepts learned during that time. The teacher should create the assessment for the unit. By creating an assessment, it can be differentiated based on all students' needs. "The most effective tests are made by the teacher for a specific individual or a particular group of students.

Quality, effective tests are developed by the teacher who provides instruction for the skill or unit. Teacher-made tests provide opportunities to differentiate assessment with tools and strategies that are thoughtfully tailored for the learners.” (Chapman & King, 2005, p. 126). The final assessment should be based on the objectives that the students learned throughout the unit. “Assessing after the learning has traditionally been viewed as a way to analyze the student’s mastery of the standards. Post assessments are a crucial step because the results are analyzed to see if the learner has reached the initial goals. If the goals have not been reached, specific plans are customized for this individual” (Chapman & King, 2005, p. 91). It is important that the assessment be designed with the intent that all students obtain success and that they have mastered the concepts taught. “Persistence is an individual’s desire to continue his efforts to complete a task. Create assessments that provide opportunities for success WINNERS NEVER QUIT” (Chapman & King, 2005, p. 7).

Differentiated Math Classroom

Mathematics is a subject some people fear and that fear can be passed on to their children. In order to have student success in mathematics, differentiation in the math class is critical. “Of course, research has frequently shown that many students perceive math quite negatively or even fear math. In fact, such fears often provide a significant emotional barrier to mathematics achievement” (Bender, 2005, p. 5). New concepts in mathematics should be presented using the concrete, semi-concrete, abstract model (CSA). “Clearly, teachers who wish to move into differentiated instruction should implement instruction using the CSA tactic” (Bender, 2005, p. 30). In the concrete stage students are given manipulatives to help learn the concepts that are being taught. In this

stage, manipulatives are used to help students understand what they are learning. It helps to form pictures in the brain of what is learned. “The first level, representing the lowest level of comprehension, is the concrete level. This involves the use of manipulative objects during instruction, such as tally marks for numerals, circles divided into fractional parts, or even edibles such as an orange divided into its segments” (Bender, 2005, p. 54).

The next stage is the semi-concrete stage. In this stage the students draw pictures of the concept. Drawing pictures helps to reinforce concepts as students create mental images of the concepts in their brains. “In the differentiated classroom math class, teachers must make certain that they do not skip this stage simply because the curriculum materials may do so. Rather, teachers should develop and provide examples of all types of math problems in semi-concrete fashion” (Bender, 2005, p. 55).

The last stage is the abstract stage. Taking the time to use a hands-on activity, then drawing pictures of the concepts, helps students in the abstract stage. Most students do not understand the abstract stage of learning. They are taught how to do a problem without the meaning behind it; they will be able to recite the problem back without meaning. However, if learning begins with manipulatives, then pictures, students are guided toward meaningful understanding of the concept. When they get to the abstract stage, they are able to do it because they have mental images of the concept. “Again, all math curricula include abstract problems as the final assessment of skill mastery, and such abstract thinking should be the teachers overall goal” (Bender, 2005, p. 56). Using the CSA method helps differentiate a lesson. The needs of all students can be met from this way of teaching. “In differentiated classrooms, teachers need access to a wide variety

of math strategies; the use of concrete or semi-concrete instructions can assist many students who are currently struggling in math” (Bender, 2005, p. 58).

Chapter 3: Interpretation of Research

On Monday, December 15, 2008 this researcher proceeded to teach a differentiated lesson. The lesson being taught was adding and subtracting fractions with unlike denominators. This can be a difficult lesson for some students to understand. When the students entered the room, they went to their desks, and began a warm up that had adding and subtracting fractions with like denominators. This was considered a launch of prior knowledge. The launch allows students to bring in prior knowledge to help them with the upcoming lesson.

After the launch this researcher introduced unifix cubes to help model adding and subtracting fractions with unlike denominators. An example of the demonstration would be adding $\frac{1}{2}$, and $\frac{1}{4}$. The fractions are represented with unifix cubes. To represent $\frac{1}{2}$, one cube is placed on the top of two cubes. To represent $\frac{1}{4}$, one cube is put on the top of four cubes. Students are instructed that they cannot add the two because the denominators are different sizes. The students are shown how you would add groups of each fraction until the same amount of cubes were in the denominator of each fraction. A hint was given to start with the smaller number of cubes in the denominator. The students realized that adding one group to the fraction $\frac{1}{2}$ made the denominators the same. The students were then instructed to add the cubes in the numerators and put over one set of denominators. This would give the answer to the problem. Two demonstrations occurred using the unifix cubes. After the demonstration with the unifix cubes, this researcher proceeded to create pictures of unifix cubes on the whiteboard. While this researcher proceeded on the white board, drawing unifix cubes and writing the abstract method of adding and subtracting fractions were simultaneously happening. After the whole class

demonstration, this researcher gave the students two problems and had them draw the unifix cubes and complete the abstract method at the same time. This researcher canvassed the room and facilitated the individual group work. After the individual work was completed, a discussion of the work and answers occurred in a whole class discussion.

Once this researcher felt confident that the students understood the lesson, an assignment was given. At that time all students were allowed to work with a partner. The students who struggle in class were invited to go to the table at the back of the room. This researcher was at the table giving additional help to those who did not understand the lesson. For each problem the students were given the unifix cubes with which to work. As they worked the unifix cubes together, the students were also writing the abstract process on their paper. It was a slow process. However, by the end of the class period the students were beginning to understand why they had to find a common denominator before they could add or subtract. They completed only four problems, but they walked away with a wealth of knowledge. When this researcher sat with them to study for the test, if they were struggling with adding and subtracting fractions this researcher brought back the discussion of the unifix cubes. The students quickly remembered what they had to do and they were able to successfully complete the problems.

Based on the research read, the author incorporated a differentiated model into the classrooms. These classrooms are based in a first inner-ring suburb middle school. Figure 3.1 shows the average ethnicity of the groups and Table 3.1 shows average classroom size and average subgroups. Finding the data to help understand who your students are will help create a trusting environment, meaningful lessons, and be able to design

assignments to meet the needs of all students, and assessments based on the objectives learned in class.

Figure 3.1. Ethnicity of the middle school mathematics groups

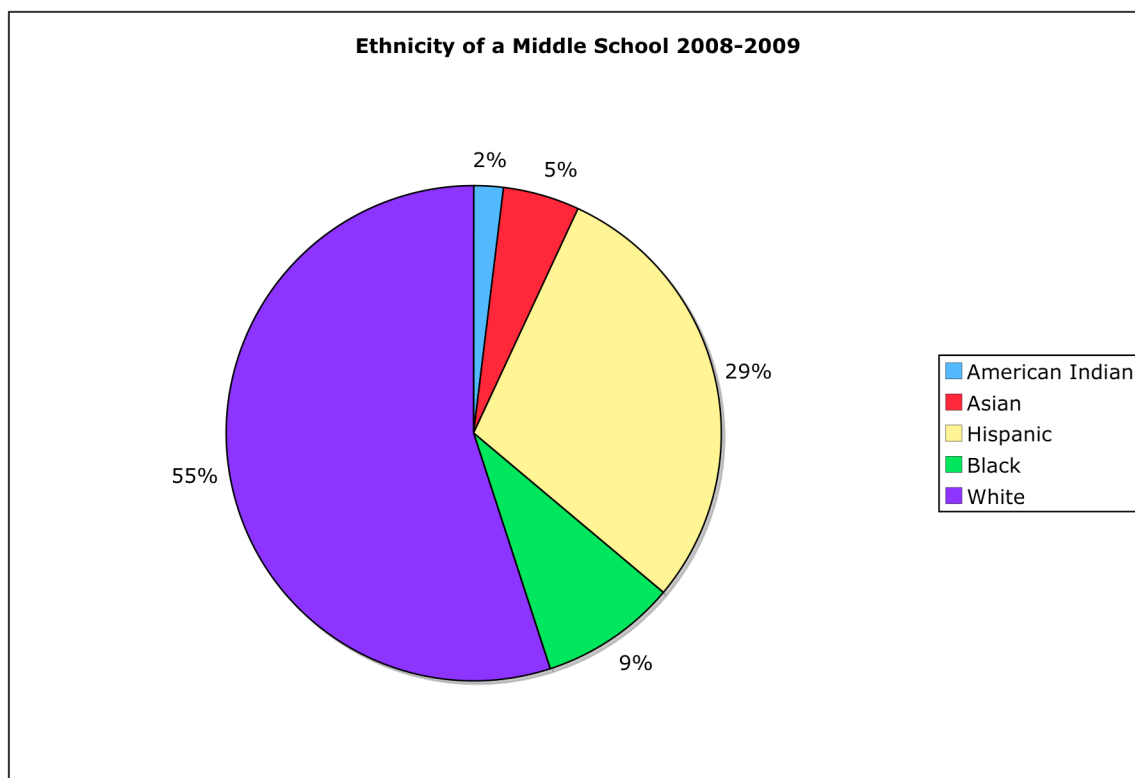


Table 3.1. Average classroom size and average subgroups

2008-2009 Average Classroom Size	24
English Language Learner Students	13%
Special Education Students	15%
Free and Reduced Lunch Students	63%

Northey (2005) states that getting to know the students teachers must review the data on all students, make observation in classroom, and take time to interpret the results. This will allow teachers to base instruction on the needs of all students in the classroom.

Getting to know the students was the first step in creating a differentiated classroom. Researching past transcripts, Minnesota Comprehensive Assessments (MCA) scores, and the Northwest Evaluation Association (NWEA) scores, and checking which students were in ELL and Special Education services was the first step. After reviewing the information, students were put into categories based on past performances. The next four weeks were spent watching and getting to know the students by how they worked in class and outside of class. By mid-quarter there was enough information and observation of who needed extra help and who worked well on their own. On average 60% of the students were below grade level in all the testing areas. By mid-quarter, 22 students were receiving an F. Table 3.2 shows the average of students below grade level and the number of students receiving an F at mid-quarter. It was time to fully implement differentiation into the classroom.

Table 3.2. Students below grade level and students receiving an F at 1st mid-quarter 2008

Class	Students below grade level	Students receiving an F at 1st mid-quarter 2008
Group 3 7th grade	55%	4%
Group 4 7th grade	54%	4%
Group 5 8th grade	69%	48%
Group 6 8th grade	63%	26%

Based on Tomlinson, it is important to create an environment that makes all students feel safe, respected, and successful. It is important to make the classroom a community where every student feels care. Monitoring and rewarding students helps reinforce these concepts. The first challenge was to create a trusting environment. Many

of these students have experienced failure in the classroom. It was important to create an environment that would make the students want to succeed. After the main instruction, students were allowed to work together on solving problems. At the same time a group of students were invited to work at the table at the back of the classroom. Many students were reluctant to come and others refused to come. They were not pushed, but encouraged to come for help. The seventh grade classes understood the importance of receiving extra help and started coming to the back table. The eighth grade classes were not convinced and time was spent running from one-eighth grade student to another. However, by the end of first quarter trust had been established. Students are now comfortable coming to the back table for help.

Having 60% of the students below grade level, it was important to incorporate the CSA approach. Bender (2005) states the CSA method is teaching with concrete activities, moving to semi-concrete activities, and eventually learning the abstract method. It was important to incorporate as many concrete activities as possible. Instead of spending one day on a lesson, two to three days were spent on a lesson. Counters and an integer card game were used to understand the rules of adding and subtracting integers. Counters and Dixie cups were used to understand solving equations. Finally Unifix cubes were used to understand adding and subtracting fractions with unlike denominators. Eventually students were able to draw pictures from the concrete activities. When abstract concepts were taught, it was easier to understand, because students had pictures in their minds on how the process worked. Students gained confidence and were able to solve problems that they were unable to do in the past. One female student had never been successful in mathematics. The first quarter was spent gaining her trust. She was continually reminded

that she could be successful if she keeps trying. Two weeks ago, she was finally able to solve equations. Her hard work and continued effort gave her the confidence that she was able to do math even though she had been unable to do it in the past. She is trying and working harder than she did in the beginning of the year.

Tomlinson (2005) affirms that assignments need to be designed around the main point of the lesson. It is also important to design lessons that stretch the learning of all students in the classroom. This researcher felt it was important to design assignments that met the needs of all students. Before each lesson problems were viewed to see what problems each group of students could handle. The majority of the time a basic assignment was given to everyone. However, the below average students received fewer problems so they could focus on learning the concept instead of focusing on how many problems they had to finish. As the year progressed students who were grasping the lesson were given an assignment that offered challenging problems. This helped them think more in depth about the concept they were learning. During the first quarter of 2008, the students who were below grade level were given a few problems that covered the material in class. The struggling students were asked to complete problems during class time. They are now given some problems to do at home. Students need to start learning to work on their own. In the seventh grade classes, this researcher has become a facilitator and the students are now working the problems with one another. Eighth grade students still need assistance and are slowly starting to ask the questions they need to solve the problems. Homework completion is going from a 60% turn in rate in September, to 90% turn in rate in November.

Based on the Northey (2005) data from a pre-assessment can help differentiate lessons in the upcoming unit. In a summer classroom in 2008, an instructor stressed to continue assessment through out the unit and give an assessment at the end of the unit. It helps to see if learning occurred during that time. Assessments are very important in the differentiated classroom. Creating your own assessments based on the objectives can generate success for all students. Different assessments were created based on the needs students. The second half of the first quarter, the class worked hard to incorporate differentiation into the classroom. Only one student out of 104 failed the chapter one test. The students received no assistance on the test; the answers and work were their own. The excitement in the room was amazing. The students were high fiving each other and screams of happiness filled the air. Immediately after, they were told if all students pass first quarter they would be rewarded with a bingo day. The work that started occurring was wonderful. Students ask if they can help each other. At the end of first quarter, not one student failed. Table 3.3 and 3.4 shows the data on each group's mid-quarter grade and end of quarter grade. This researcher did a Paired t-test on each group. Based on the one-tail data, Group 5 showed the most improvement followed by Group 4, Group 6, and Group 3. Differentiation does work; proof came from the experience of first quarter of 2008.

Table 3.3. Group 3 and 4 grade comparisons

Student	Group 3		Group 4	
	Mid-quarter grade	End of quarter grade	Mid-quarter grade	End of quarter grade
1	82%	88%	63%	83%
2	56%	71%	79%	91%
3	72%	86%	96%	98%
4	82%	92%	83%	91%
5	96%	87%	65%	81%
6	80%	87%	91%	93%
7	61%	75%	89%	93%
8	85%	95%	66%	81%
9	69%	79%	91%	88%
10	79%	87%	63%	86%
11	96%	99%	41%	70%
12	86%	93%	77%	93%
13	67%	87%	94%	94%
14	90%	86%	99%	96%
15	80%	77%	71%	86%
16	90%	89%	74%	87%
17	64%	91%	63%	75%
18	71%	90%	96%	98%
19	70%	86%	96%	99%
20	83%	88%	84%	92%
21	90%	93%	84%	85%
22	117%	101%	93%	92%
23	60%	79%	69%	93%
Class average	79%	87%	79%	89%

Table 3.4. Group 5 and 6 group comparisons

Student	Group 5		Group 6	
	Mid-quarter grade	End of quarter grade	Mid-quarter grade	End of quarter grade
1	90%	96%	78%	89%
2	89%	88%	90%	92%
3	71%	90%	79%	81%
4	50%	76%	70%	78%
5	51%	85%	79%	82%
6	49%	74%	85%	82%
7	55%	80%	55%	72%
8	91%	86%	37%	61%
9	36%	74%	35%	65%
10	38%	70%	63%	72%
11	52%	78%	93%	89%
12	73%	85%	83%	94%
13	16%	65%	85%	93%
14	29%	65%	97%	99%
15	46%	72%	47%	79%
16	76%	91%	76%	88%
17	85%	92%	43%	72%
18	89%	96%	79%	92%
19	85%	93%	91%	86%
20	30%	70%	81%	84%
21	96%	93%	71%	77%
22	95%	88%	68%	82%
23	83%	86%	42%	61%
24	65%	79%	33%	66%
25	38%	80%	84%	92%
26	83%	83%	91%	95%
Class average	64%	82%	70%	81%

Chapter 4: Conclusion

Five years into teaching and this researcher was debating whether to continue in this career. The K-8 math master's program and the research on differentiation have convinced this researcher teaching is the right career. Differentiation has allowed changes in the way teaching is approached. Differentiation has made students successful by meeting their individual needs. It is not an easy concept to embrace in part because it takes a great deal of work to make differentiation successful. In the first year, there have been times when it felt too difficult to continue this way of teaching. Remembering the goal, "Put the needs of all students first," helped this researcher to continue to use differentiation. The second year of differentiation is easier than the first. However, at the end of the day, exhaustion hits; however, knowing the students learned something keeps this researcher going.

During the past 17 months this researcher discovered getting to know the students and gaining their trust is a significant aspect of differentiation. It is essential to be in the locker bay greeting students as they come to school and making them feel successful in the classroom. A trusting environment is a prerequisite for differentiation. The students will feel safe working in groups, working with the teacher, and they are willing to try the problems even if they have failed the concept in the past.

The concrete, semi-concrete, and abstract approach is a procedure this researcher wants to continue to implement into the classroom. The many times this approach was used in the classroom, the students had a better understanding of the lesson introduced. This approach gives the students prior knowledge for future lessons. If they forget how to

do a concept this researcher can have them visualize the concrete activity that was taught to help them remember how to do the concept.

This researcher has realized that modifying assignments and tests for students who struggle helps them be successful in the classroom. The students can take their time and work fewer problems to understand the concept. Modifying tests also help the struggling students take their time, think about how to solve the problem, and do a better job on the test. This researcher has found a weakness working with the top students in the classroom. They need to be provided with more challenging problems on assignments and tests.

During the past year, this researcher has discovered that pre-assessments do not work well in the classroom. This studied district has accelerated mathematics classes for the top students. It was quickly discovered that the students did poorly on the pre-assessment. The pre-assessment was supposed to help a teacher understand what concepts students need reinforcement and what concept they already know. The students had little prior knowledge on the concepts in the pre-assessments. The pre-assessments did not give any extra information for planning the future chapter. As a result, this researcher has decided not to use pre-assessment in the classroom.

This researcher plans to share the finding of this research with colleagues. To make a presentation on differentiation successful, it is important to plan and organize the research. A presentation to the staff development committee will be the second part of the process. Staff development days provide an excellent opportunity to give a presentation on differentiation. Colleagues will be presented with information on the meaning of differentiation and what can be easily incorporated into the classroom. If colleagues show

an interest, future presentations will teach colleagues how to slowly implement the five concepts of differentiation which are know the students, the environment, meaningful lessons, assignments, and assessments. Continuing to research differentiation and how it can improve the classroom is integral to mathematics instruction. Currently, concrete activities are a weakness in this researcher's classroom. This researcher plans to use the websites and professional organizations that were given in the program, to find concrete activities that will enhance the learning of all students. Focus on finding activities that will connect with the concepts taught in class is another component in continuing differentiation. The past 18 months, this researcher discovered teaching is more than teaching concepts right out of the book; it is about finding ways to present the concepts the way students learn. Reviewing past notes, this researcher came across Bemidji's principles of teaching, which relate to differentiation. It is important to teach how students learn, encourage group work, communication between teacher and student and student to student. This principle also encourages multiple ways to solve a problem, problem solving, and assessment. The research on differentiation encourages these principles. Differentiation was the perfect research for this master program. Continuing with this concept is exciting. It can help the students be successful on a daily basis.

This paper is the in the beginning stages of implementing differentiation in the mathematics classroom. There is much more research to be discovered and shared on this topic and it is important for this researcher and others to find and utilize. The purpose of the paper is to get educators to start thinking of how they can improve their student's performance in an era where the classroom is diverse. However, there may be educators who would like to take this research and take it down a path that is different from this

researcher's study. This paper serves as a starting point for educators to improve their instruction in the classroom.

Bibliography

- Bender, W. N. (2005). *Differentiating math instruction*. Thousand Oaks, C.A.: Corwin Press Inc.
- Cassner-Lotto, J., & Barrington, L. (2006). *Are they really ready to work?* Retrieved November 29, 2007, from http://www.infoedge.com/product_type.asp?product=CB-BED6
- Chapman, C., & King, R. S. (2005). *Differentiated assessment strategies: One tool doesn't fit all*. Thousand Oaks, C.A.: Corwin Press Inc.
- Moll, A. (2005). *Differentiated instruction guide for inclusive teaching*. Port Chester, N.Y.: Dude Publishing.
- Northey, S. S. (2005). *Handbook on differentiated instruction for middle and high schools*. Larchmont, NY: Eye On Education.
- Pierce, R. L., & Adams, C. M. (2004). *Tiered lessons: One way to differentiate mathematics instruction*. *Gifted Child Today*, 27(2), 58-66.
- Tomlinson, C. A. (2001). *How to differentiate instruction in mixed ability classrooms*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Tomlinson, C. A. (2005). *Differentiating instruction: Why bother?* *National Middle School Association: Middle Ground*, 9(1), 12-14.