IMPROVING MATHEMATICS SKILLS USING DIFFERENTIATED INSTRUCTION WITH PRIMARY AND HIGH SCHOOL STUDENTS

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TABLE OF CONTENTS

ABSTRACT

Varied academic ability is a problem across the country and is the focus of this action research project report. The four teacher researchers were searching for way to reach all learners with their mathematics instruction. The purpose of the research was to increase mathematical performance in a varied ability math classroom. To address varied ability levels in the classroom, the teacher researchers implemented differentiation instruction and modified three areas of instruction: curriculum, strategies, and student work. The research project was implemented on January 29, 2007 and concluded on May 11, 2007. The participants consisted of 79 math students: 26 grade 10-12 high school students, 53 kindergarten through second grade students, and 25 teachers, for a total of 104 participants.

Today's students enter the classroom with different learning experiences and prior knowledge. The teacher researchers encountered academic achievement that ranged from high, medium, and low. The students that performed at a high academic level were often finished with their work early and often left unchallenged. The students that performed below average academically needed constant support and redirection which took away from the teacher's instruction time. The only students that were benefiting were the average students. This research project used a student survey, teacher survey, observation checklist, and pre-test and post-tests to document the problem and found the above to be true.

The interventions consisted of cooperative learning lessons, multiple intelligence based lessons, student choice of assignments, and differentiated assignments. Cooperative learning is one way in which teachers can help students learn to work with one another. It allows students to work in groups to achieve a goal. Implementing lessons using Howard Gardner's Multiple Intelligences was another intervention used. Gardner suggests that each individual has the ability to learn in many different ways, yet we all have one preferred learning style. Student choice encourages students to be in charge of their own learning and help them to gain a better sense of personal and social responsibility (Betts, 2004; George, 2005). One way to accommodate for the many levels in today's classrooms is to differentiate assignments to suit individual needs.

After reviewing the results of the pre- and post-test data the four teacher researchers noticed a marked change in student performance. However, it was not possible to determine if student success was based on interventions or the fact that the teachers had covered the concepts with the class between testing. Since the pre-tests focused on concepts that had not been covered it is believed that presenting the material would inevitably lead to student progress. The positive change in student performance led us to believe that our interventions were effective in some way. It is believed cooperative learning positively impacted student progress and the teacher researchers plan to continue implementing this strategy. In conclusion, each teacher researcher would like to continue to implement differentiation. With the varied abilities in today's classroom it is necessary to adapt teaching methods to meet different needs. Differentiation is something that cannot be implemented immediately and needs to be well thought out, planned, and gradually implemented. Each teacher researcher felt the frustrations of planning time, time allotted for activities in the classroom, and changing teaching styles in the middle of the year. It is believed these frustrations can be alleviated through proper training and resources.

CHAPTER 1

PROBLEM STATEMENT AND CONTEXT

General Statement of the Problem

Reaching every student in an inclusion classroom was the problem identified by the four teacher researchers. Several behaviors were observed that could define multiple abilities in the classroom as a problem. The teacher researchers encountered academic achievement that ranged from high, medium, and low. The students that performed at a high academic level were often finished with their work early and often left unchallenged. The students that performed below average academically needed constant support and redirection which took away from the teacher's instruction time. The only students that were benefiting were the average students.

To identify that multiple abilities in the classroom exist, the teacher researchers developed four tools. The first tool that was created was a checklist to document on task and off task behavior. The second tool that was created was a student survey. The survey was developed to identify that students have different interest and that students might learn better if their interest were addressed in the learning process. The third tool that was created was a teacher survey. This was utilized to determine that multiple abilities is a common problem among teachers. The final tools that were developed were a pre- and post-test. These tools were created to assess the students' academic performances before and after interventions were implemented.

Immediate Context of the Problem

This action research was conducted by four teacher researchers at two different sites. Site A was a suburban primary school with one teacher researcher at the kindergarten level and two teacher researchers at the second grade level. One teacher researcher was at Site B teaching high school level mathematics.

Site A

Site A is a suburban primary school, and the teacher researchers teach kindergarten and second grades. Unless otherwise noted, the information in this section was retrieved from the Illinois School Report Card, 2005 and the 2005 Illinois School Profile.

Table 1 below identifies the ethnic backgrounds of the student body at Site A. As seen in this table, the majority of the student body at Site A consisted of Caucasian students.

Table 1

Racial/Ethnic Background by Percentage

	Caucasian	Hispanic	Asian	African American	Native American
School	72.2	14.6	5.7	5.5	2.0
District	80.3	12.3	4.2	2.6	0.5

Site A has a total enrollment of 508 students, with the district enrollment of 1,130. This enrollment included students from kindergarten through third grade. The low-income rates at Site A were 5.3% compared to 6.1% for the district. At Site A the students identified with Limited English Proficiency were 7.5 % and the district level was 4.6%. The mobility rate at Site A was 26.7% compared to 18.9% for the district. Site A had an attendance rate of 94.5% and while the district had 94.8%.

The number of full-time teachers at Site A was not reported on the 2005 school report card. However, according to the data from the staff information posted on the Site A website, (n.d., *Site A staff contact information*) teacher researchers calculated there were 21.5 full-time teachers during the 2005-2006 school year. Females make up 100% of the staff. The average teaching experience is 8.4 years for the district, with an average salary of $44,430. Teachers with

bachelor's degrees make up 55.8% (n = 12) of the district while those with a master's degree or above make up 44.2% (n = 10) (Site A Illinois School Report Card, 2005). The district student-teacher ratio is 17.7:1 and the student-administrator ratio is 255.3:1. Due to lack of information presented in the district report card, teacher researchers have calculated the average class size in kindergarten was 21, first grade was 27, second grade was 27, and third grade was 25 during the 2005-2006 school year.

Site A has one superintendent who overseas three schools. Serving under the superintendent were two principals. Site A was administered by one of the principals. Administrative support consists of two secretaries, one food service coordinator, and one custodian. Academic support includes one special education coordinator, one special education teacher, three Regular Education Initiative (REI) teachers, one reading specialist, one English Language Learner (ELL) teacher, two speech therapists, and one special service teacher. Special Education District of Lake County (SEDOL) employees includes one occupational therapist, one hearing itinerant, two social workers, and two psychologists. General education teachers include 3.5 kindergarten teachers, seven first grade teachers, six second grade teachers, and five third grade teachers. As the population grows, it is projected that for the 2006-2007 school year, kindergarten, second, and third grades will be adding one classroom per grade level. Site A employs one special teacher for the following subject areas: computers, physical education, art, music, and two librarians.

The core subjects taught in kindergarten through grade 3 consist of mathematics, science, English/language, and social science. According to the Illinois State School Report Card for grade 3, time devoted to teaching core subjects in the targeted school included 60 minutes of mathematics, 30 minutes of science, 170 of English/language arts, and 30 minutes of social

science in a day. Kindergarten is the exception with 300 contact minutes devoted for students per week (Building Principal, personal communication, June 27, 2006).

The students in the district take the Illinois Standards Achievement Test yearly. Reading, writing, and mathematics are tested in grades three and five while science is tested in grade four. The overall performance of third graders for the 2004-2005 school year reported that the targeted district had 68.3% of the students meeting or exceeding the Illinois Learning Standards in reading. This 68.3% is compared to 66.6% for the state. In mathematics, 79.7% of students in the district met or exceeded the Illinois Learning Standards. This 79.7% is compared to 79.2% for the state. In addition, students enrolled in a comprehensive ELL program take the Illinois Measure of Annual Growth in English (IMAGE) exam. The overall performance for the 2004-2005 school year reported that the targeted district had 75.0% of the students meeting or exceeding the Illinois Learning Standards. This 75.0% is compared to 49.3% for the state.

The targeted school also takes part in an annual grade level standardized test developed by the Scholastic Testing Service, Inc. Table 2 below shows the breakdown on performance scores by grade level. The benchmark score for each grade level is: the grade level plus .8 (which indicates the month, April, of the school year when the test was administered). Thus, the benchmark score for first grade would be 1.8; for second grade 2.8; and for third grade 3.8.

Table 2

Benchmark Scores: Grades 1-3

	Language	Math	Science	Social Science
Grade 1	2.2	2.4	1.9	2.1
Grade 2	3.1	3.1	3.0	3.1
Grade 3	3.9	4.2	3.9	4.1

Site A is located at the intersection of two rural streets on a large area of grassland purchased by the district many years ago. Construction has been in progress during the last two years and will culminate at the end of 2006 resulting in a beautiful, large campus that encompasses all three of the schools located in our district (one primary building, one elementary building, one middle school building). Our building is a single story brick structure (with the exception of the two-story middle school) that houses over 1,130 students (K-8). The targeted site welcomes students and families into a large spacious office which includes a principal's office, work room, and nurse's station. The building is broken up by grade level pods where all grade level classrooms are clustered together and share a large common area where classes are invited to work with one another. We have a well-stocked library, two computer labs, and cafeteria with kitchen, conference room, teacher's lounge, music room, and art room enclosed by a floor to ceiling glass wall.

Site A is unique due to a large nature center that is on school grounds. This nature center is an educational tool in that it is used to teach students about plant growth and animal habitats. Each classroom is assigned a garden area to observe and maintain throughout the school year.

We believe that there are many factors contributing to the varied abilities in the classroom. Site A is located in an area that has two different socioeconomic backgrounds. We feel that one particular area of the district may be less affluent which in turn leads to parents working more. The more affluent areas tend to have one parent at home who is able to partake in their child's education both at home and school. Along with socioeconomic status, each student's educational background is different. The district does not offer regular education preschool classes to prepare the students for kindergarten. When students enter kindergarten varied ability is already prevalent and the gaps are difficult to close throughout their years of education. The

state of Illinois has not mandated kindergarten. Thus, students can enter first grade with no prior school experience.

Site B

All of the following information is provided in the 2005 Illinois School Report Card, Site B, unless otherwise noted. The fourth teacher researcher teaches high school mathematics at Site B which is an upper middle class suburb of Chicago. The total enrollment at Site B is 2,124 students. The ethnic break down is noted in Table 3 below and demonstrates the school is overwhelming Caucasian with a much smaller percentage of Hispanic students compared to Site A.

Table 3

Racial/Ethnic Background by Percentage of Site B

Caucasian	Hispanic	Asian/Pacific Islander	African American	Multiracial/ Ethnic	Native American
92.3	4.1	2.3	.7	.5	.1

Of the 2,124 students at site B, less than 1% are categorized as ELL. Only 3% are considered as coming from a low-income family or qualify for free and reduced lunches compared to 40% state wide. Approximately .1% of the students at Site B are considered chronically truant. The mobility rate in this high school is only 5.4% compared to 16.1% statewide. The attendance rate at this site is very good with 96.1% of students attending school on a daily basis.

There are 417 teachers working within the entire district and a total of 141 teachers working at Site B. Although no further information was given on just the high school, the average salary of teachers in the entire school district is $58,881, with an average of 11.5 years of experience. Also, 41.3% (n = 172) of the district's teachers have bachelor's degrees and

58.7% (n = 245) have master's degrees or above. There is a student teacher ratio of 18.7 and an average class size of 19.8 at the high school. Lastly, there is a 98% parent contact rate at the high school which includes parent teacher conferences, visits to the school or school visiting the home, telephone conversations or written correspondence.

Regarding the academic program at Site B, the school prides itself on preparing students for college and that mission guides the curriculum to a great extent. The graduation requirements have recently changed. A committee was formed regarding increasing the requirements in 2005 and its recommendations were accepted and implemented just before the state of Illinois raised the requirements for high school graduation across the board. The changes are being phased in over the next four years but the current requirements for students, according to the high school's Student Handbook, is 22 credits. Of the 22 credits, students must earn three credits in English, two in math, two in science, two and one-half credits in social studies, one credit of humanities, and one-half credit in each consumer education and health. In addition to the above credits, graduates must be enrolled in a physical education course every single semester, complete the Prairie State Achievement Exam (PSAE), and also complete a driver's education course. Overall, the high school has a very high graduation rate of 97.8% compared to the state average of 87.4%. The average PSAE score is modest 71.2 compared to a 54.9 average statewide.

Site B has 199 staff members total, 141 teachers including 11 applied arts, 20 English, 11 fine arts, 12 foreign language, 18 mathematic, 16 physical education, 20 science, 15 social studies, and 18 special education. The administrative staff is broken down into one principal, three assistant principals, two deans of discipline, one athletic director, one registrar, and nine department chairs. The teacher support staff consists of one in-school suspension supervisor and 11 secretaries, including two for attendance, four for athletics, one for the dean's office, three for

the main office and administrators, and one for pupil personnel services. The student support staff consists of seven guidance counselors, two nurses, two social workers, one college counselor, three librarians, one SEDOL itinerant, one school psychologist, one speech pathologist, one occupational therapist, and one police liaison. The building support staff consists of four security, three technology support, and one head custodian in charge of maintenance.

The members of Site B's community recently passed a large referendum to remodel outdated science laboratories, add a larger auditorium, and add additional classroom space to the existing building which was under great pressure from increased student enrollment. The new auditorium was designed for the renowned theater and performing arts program and is used frequently throughout the year for some very impressive musicals and orchestra performances.

Depending on which one of the 20 entrances you walk through at the sprawling Site B, you may gain a very different impression. If you enter through the southeast part of the building the doors and airlocks are old and painted over many times. There are many murals painted on the walls and student artwork is abundant in an attempt to spruce up the building. If entering through the newer section that includes one finds the new field house is flush with trophies and plaques and pictures of alumni that have excelled in all sports. Although it is a new structure, anyone walking through the building would still feel a connection to past and the students that make up a part of Site B's history. If entering through the new auditorium's entrance, a visitor would be really be impressed with the exceptional artwork posted by the fine arts department in the display cases in the hallway and you will find it hard to believe you are in a high school when you walk in to the new auditorium itself. The architects claimed that this was by far the most sophisticated auditorium in any high school in Illinois and outside of a few newer auditoriums on

college campuses, it was probably the best in the state. The four-story auditorium's stage contains an elevator that descends into the orchestra pit, and a full-time lighting director has been hired to run the facility! The school is completely wireless in all but a few areas so teachers may take their laptops anywhere in the building and not lose any internet-based programs. There are numerous dedicated computer laboratories that may be reserved by teachers as well as wireless internet carts that may be taken into rooms for use. Walking in to the library a visitor will no doubt find many students surfing the web or doing research. Walking down the newest science wing visitors will find a fully equipped AutoCAD lab with computers, wind tunnel, and model electrical circuits.

As demonstrated from the large referendum that was passed to upgrade the facilities, I believe Site B has undergone some major changes in the makeup of the community in the last 20 years. A mostly blue-collar, working class community is becoming replaced by affluent, white-collar families. Today, many families are putting an emphasis on education and increasing their taxes to fund the education of their children. I believe this shift has led to a major increase in the number of college level classes, advanced placement courses, and honors tracks to better prepare students for college. While many students are on the fast track to college taking as many advanced courses as they can, some students are planning to attend trade schools or community college after high school and are taking remedial courses. I believe this growing disparity between student coursework, in combination with divergent plans after high school, has directly contributed to the varied ability that teachers see in the classroom.

Local Context of the Problem

For the demographics of the region in which the teacher researchers are employed, statistics used throughout this paper will be from the common county in which Site A and B are located. The county is very diverse in economic terms and will mirror the diverse communities that the two sites serve. Site B is varied in economic terms but is much more affluent in general compared to Site A. Together, these sites provide a diverse spectrum which is very representative of the entire county ranging from low-income to extremely high-income families. Site A is located in the western region of the county and growing rapidly. The suburbs of Chicago are pushing outwards every year and Site A is on the cusp of new development. Site B, which is located in the southwest corner of the county, has already gone through rapid growth and suburbanization because it is closer to Chicago.

According to the 2004 United States Census Bureau, the total population of the county in which Sites A and B serve was 675,050 and is growing at a rate of 1.17% every year. The median household income was $70,347 and 5.2% of the population's families are below the poverty level. As can be seen from the age distributions found in Table 4, a majority (70.6%, n = 454,992) of residents are between the ages of 18 and 65.

Table 4

Age Distributions of County by percentage

Persons under five years	Persons between 5 and 18	Persons between 18 and 65	Persons 65 and older
7.7	12.8	62.3	8.6

Ethnicity distributions are found in Table 5 showing an overwhelming percentage of Caucasian residents with a sizeable Hispanic and Latino population.

Table 5

Ethnic Distributions of County by percentage

Caucasian	Hispanic or Latino	African American	Other	Asian	Two or more races	American Indian and Alaska Native	Native Hawaiian and other Pacific Islander
80.9	17.6	6.2%	5.9	5.3	1.4	.2	.1

High school graduates, age 25 or older make up 88% of the population, while 42.1% of the county's population hold a bachelor's degree or higher.

In the average household of this county, there are 2.99 people. The employment rate is 70.8%.Table 6 shows the diverse workforce of the county aged 16 years or older. This data shows that the majority (41.7%) of people in this age group have a management, professional, or related position.

Table 6

Types of Employment Within the County by percentage

Management, professional, and related occupations	Sales and office occupations	Service occupations	Production, transportation, and material moving occupations	Construction, extraction, maintenance and repair occupations
41.7	28.0	13.3	9.4	7.4

According to the Suburban Chicago Newspaper, the total crimes committed in 2004 within the county were 2,909 per 100,000 residents.

The county is located on the shore of Lake Michigan spanning north of Chicago to the Wisconsin border and west to the Chain-O-Lakes. The county is native to Potawatomie Indians

and was recognized as a settlement by Illinois State Legislature in 1839 (Encyclopedia of Chicago, 2005; Lake County Illinois Local Government, n.d., *History of Lake County*). The county began as a trading and farming community but was transformed with the installation of major roadways and railroads (Encyclopedia of Chicago, 2005). Today, the county is a mixture of progressing urban areas and scenic rural communities. The county has numerous places of interest. Recreational activities include numerous state parks, a super-regional shopping mall, and the theme park Six Flags Great America. Two professional sports teams have their practice facilities located in this county. Improvements in this county include preservation, expansion, and modernization projects of bike paths, roadways, and railroads (Lake County Illinois Local Government n.d., *Quick facts about Lake County: Five year highway improvement plan).* The largest employers of this county include the Great Lakes Naval Training Center, Abbott Laboratories, Hewitt Associates, Motorola, and Kemper Insurance Company (Encyclopedia of Chicago, 2005).

At Site A, the district's middle school, including three other middle schools in the area, feed into one high school. The district's mission statement at Site A is "…to foster excellence in education so that its students will be able to reach their full potential and enhance their quality of life in an ever-changing society" (Site A School District, n.d., paragraph 2). In the 2006-2007 school year, the district will have one primary building (kindergarten through second), one elementary building (third through fifth), and one middle school building (sixth through eighth). The district is overseen by one superintendent. The local property taxes are 70% of the schools revenue. The 2002 total school tax rate per $100 dollars was 2.31. The 2003-2004 instructional expenditure per pupil was $3,230. The operating expenditure per pupil was 6,419 (Illinois State Board of Education, n.d., *2005 Illinois school report card*). Between 2001-2003 the school

district attempted to pass three building referendums. During the fall of 2004 the school districts' building referendum passed (Illinois Association of School Administrators, n.d.). The district is currently building two new buildings on existing land next to the primary building. Each building is equipped with a computer laboratory. One computer is also provided for each classroom with Internet access.

Site B is considered a unit school district. It has six elementary schools that feed into two middle schools that in turn feed into one high school. The districts mission statement at Site B is "to inspire all students to be passionate, continuous learners and to prepare them with the skills to achieve their goals and flourish as responsible, caring citizens in a global community" (Community School District 95, n.d.). There is one superintendent for the district. The local property taxes are 80.5% of the schools revenue. The 2002 total school tax rate per $100 was 4.37. The 2003-2004 instructional expenditure per pupil was $5,134. The 2003-2004 operating expenditure per pupil was 8,723 (Illinois State Board of Education, n.d., *Illinois school report card*). There was a building referendum that was passed in fall 2000 (Illinois Association of School Administrators, n.d.). This referendum provided the school with a field house, auditorium, and equipment for the science department. Technology is a huge component of Site B. The district provides computer laboratories, a lap top for each teacher, and each classroom provides the students ample opportunities to use technologies.

We believe the various demographics of the county directly relate to the different values placed upon education. As the residents of Chicago continue to spread further into the suburbs, many households have parents working multiple jobs or two-income homes. With both parents working, there is little time available for parents to interact on an educational level with their children. This is one factor that we believe contributes to the varied abilities in our classrooms.

National Context of the Problem

Teachers are having difficulty accommodating disabilities, linguistic challenges, and other unique abilities in their classrooms. Special education teachers, along with other support staff, are concerned that the students they see on a daily basis are not receiving the proper support in the classroom (Ferguson, 1999). Teachers do not know how to appropriately implement lessons that will allow all students to reach their full potential (Holloway, 2000).

Varied ability is a problem across the country. Teachers are searching for way to reach all learners in their classrooms. To address varied ability levels in the classroom, the teacher researchers will implement differentiation instruction and modify three areas of instruction: curriculum (content), strategies (process), and student work (product). Additionally, research literature argues that teachers who want to reach all learners should also appeal to students' multiple intelligences, and engage students through their interests (Tomlinson, 1999). Thus, researchers will survey students to discover student interests and individual learning styles. Finally, the success of differentiated instruction hinges on continually assessing students to monitor their individual progress.

CHAPTER 2

PROBLEM DOCUMENTATION

Evidence of the Problem

The purpose of the research was to increase mathematical performance in a varied ability math classroom. Our pre-documentation data is looking to validate the fact that multiple abilities exist in the classroom and the challenge this presents for inclusion teachers. The problem of varied abilities appeared to be an issue among the four teacher researchers. The evidence was documented by a teacher survey, student survey, observation checklist, and pre-test and post-tests. These four tools were utilized from January 29, 2007 through May 11, 2007. The participants consisted of 79 math students: 26 grade 10-12 high school math students, 53 kindergarten through second grade math students and 25 teachers for a total of 104 participants.

Teacher Survey

The purpose of this instrument was for the teacher researchers to determine the extent to which teachers felt comfortable with differentiating instruction in mathematics. Teachers at Site A and Site B were asked by the teacher researches to complete a teacher survey regarding the use of differentiation strategies while teaching mathematics. Teachers were given two weeks to complete the survey. Completed surveys were anonymously returned to a teacher researcher's mailbox at the appropriate sites. Surveys were collected at the end of each day and kept in a central, confidential location. The researchers wanted to verify if teachers had the necessary tools, time, and materials for effective differentiation. Keeping one particular class in mind, teachers were asked to rate four questions using a Likert scale. The scale provided choices ranging from (1) strongly agree to (4) strongly disagree. In addition, teachers were asked one open ended question regarding the frustrations felt while teaching mathematics. Surveys were

distributed once on Monday, January 29, 2007 to15 primary teachers at Site A and 17 math teachers at Site B. Surveys were distributed through teacher mailboxes. At Site A, 10 out of the 15 surveys were returned, a 67% response rate. At Site B, 15 out of 17 surveys were returned for a response rate of 88%. Data was collapsed by combining strongly agree and agree into a single category of agree while responses of strongly disagree and disagree were combined into a disagree category. Teacher responses from Site A and B were combined using this method to show a clearer correlation between agree and disagree. Please refer to Appendix A to view the teacher survey.

The first question on the survey asked teachers if there was a wide range of math ability in the classroom. The majority of teachers (92%, n = 23) agree that there is a wide range of ability in their classroom.

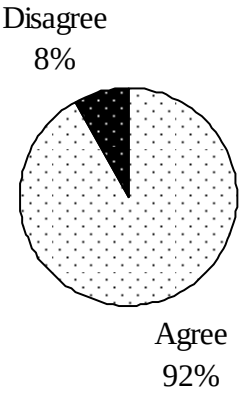

Figure 1: *Wide Range of Ability in Classroom* (n=25)

The second survey question asked if teachers felt like their instruction meets the needs of learners in their classroom. Forty percent (n = 10) of teachers feel that they are not reaching every student in their classroom with their mathematic instruction. The majority of teachers

(60%, n = 15) believe that they are reaching each student in their classroom during mathematic instruction.

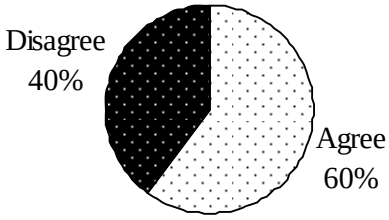

Figure 2: *Mathematics Instruction Meets Needs of Each Learner in Classroom* (n=25)

Question number three asked teachers about the importance of differentiation as a method for teaching. Eighty-four percent (n = 21) of teachers believe that differentiated instruction is necessary for student success in math.

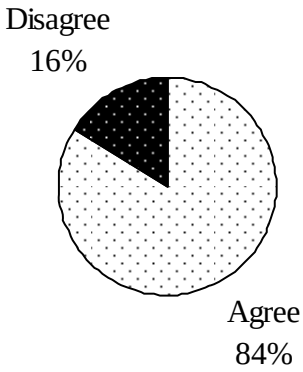

Figure 3: *Differentiated Instruction is Necessary for Student Success in Math* (n=25)

The fourth question on the teacher survey asked if teachers felt prepared to differentiate in the classroom. Thirty-two percent of teachers (n = 8) have the knowledge, tools, and support to effectively differentiate math instruction. A majority of teachers, 68% (n = 17) felt they lacked the knowledge, tools, and support to differentiate math instruction

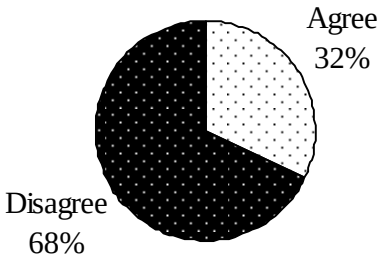

Figure 4: *Knowledge, Tools, and Support* (n=25)

The last question on the teacher survey was an open ended question asking teachers to share any additional frustrations they had with teaching mathematics. Out of the 25 surveys returned, 22 teachers responded to this question (88% response rate). Teachers at both Site A and B responded that one of their main concerns is time. They do not have enough time for planning differentiated math activities when they have a detailed curriculum to cover during the course of the school year. Several teachers at the high school level indicated they are unsatisfied with the idea of "teaching to the middle" because this leads to a lack of challenge for the advanced students, while it frustrates the lowest students who usually end up needing a re-teaching lesson anyway. Teachers at both sites were also unsure of what activities to give to accelerated students who finish early; it is difficult to define the difference between challenging activities versus busy work. A concern mentioned at the high school level was how to grade fairly; should grades be

based upon effort or performance? Several high school teachers expressed concern about whether or not their students truly have a low ability when it comes to math, or are they just being lazy and not putting in the proper amount of effort? Teachers at Site A commented that in the primary grades many students are unable to complete numerous tasks independently. When teachers are working with various small groups students need the skills to be able to work alone without constant teacher guidance.

Student Survey

The purpose of this instrument was for the teacher researchers to gain understanding of student interests and plan instruction based on these learning preferences. Students in each teacher researcher's classroom, who had parental consent to participate in this study, completed a student survey. Because there are a wide variety of ages taking part in this study, this survey was adjusted to be age appropriate for the students participating resulting in three different surveys being used in the research project. Below will describe the results of the three surveys beginning with Teacher Researcher A's high school survey, then Teacher Researcher B's kindergarten survey, and then conclude with the results of Teacher Researcher C and D's second grade survey.

High School Survey

Out of 48 high school students in Teacher Researcher A's two academic geometry classrooms, 26 (54%) students consented to the project and were surveyed. Surveys were completed in class once during pre-documentation on Monday, January 29, 2007. Students were asked to rate six Likert scale questions, choosing from one (strongly agree) to four (strongly disagree) and then were asked an open ended question asking about the students' interest outside of school. Please refer to Appendix B to view this survey.

Question one asked students if students learned better by working with other students. A noteworthy 85% (n = 22) of respondents agreed with the statement compared to 15% (n = 4) of respondents who disagreed. Please refer to Figure 5.

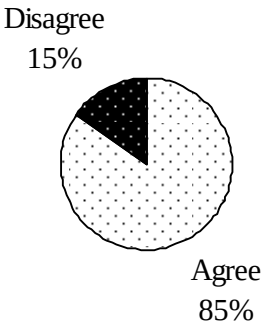

Figure 5: *Learn Better Working With Another Student or Groups* (n=26)

Question two addressed whether students would rather write about math problems instead of solving them problem by problem on a homework assignment was addressed by question two. As demonstrated by Figure 6, students markedly disagreed (96%, n = 25). Only one student would rather write about mathematical themes or problems than solve them.

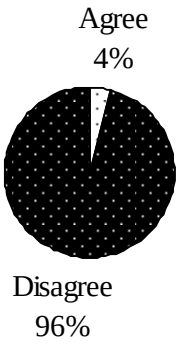

Figure 6: *Would Rather Write About Math* (n=26)

Question number three in the high school survey asked if students wished they could work with the teacher in a small group if they were struggling with concepts. Sixty-nine percent (n = 18) of the respondents agreed with the statement as illustrated in Figure 7.

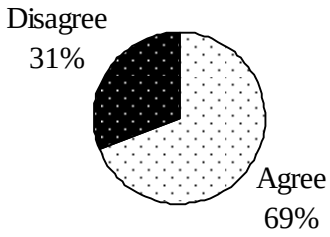

Figure 7: *Wished to Have the Opportunity to Work with the Teacher* (n=26)

The fourth question asked students if the material covered in the class was too easy. Twenty-three percent (n=6) of students agreed with that statement compared to the majority (77%, n = 20) who disagreed. Refer to Figure 8 below.

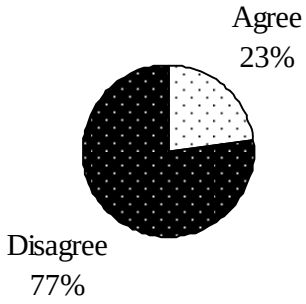

Figure 8: *Material Covered is Too Easy* (n=26)

Next students were asked if talking about math was preferred to solving math problems. A noteworthy majority disagreed with that statement at 81% (n = 21) and preferred to solve math problems as they normally do as shown in Figure 9.

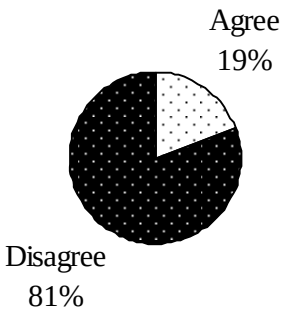

Figure 9: *Would Rather Talk About Math* (n=26)

The last Likert scaled question inquired if the high school survey respondents were curious how math is used in the world around them. Figure 10 demonstrates that the classes were somewhat split. Fifty-four percent (n=14) disagreed about being curious about math's application in real life while 46% (n=12) agreed that they were curious.

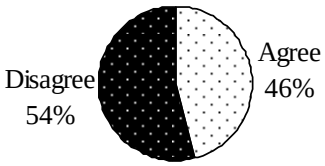

Figure 10: *Curious about How Math is Used in Real Life* (n=26)

Finally, the survey asked the students to briefly describe what kinds of activities the respondents participated in outside of school on an average day, and in particular, what internet sites they may visit or video games played. Figure 11 shows that the students' most frequent activity (n=12) was getting on the internet and communicating with other friends by email, instant messaging, or communicating through popular websites such as Myspace. The second most popular activity (n=8) for students after school is exercising by going to the YMCA, participating in a school sport such as track and field, or working out by lifting weights. Another popular pastime (n=7) for the high school students surveyed is playing all sorts of videogames from football to war simulation games.

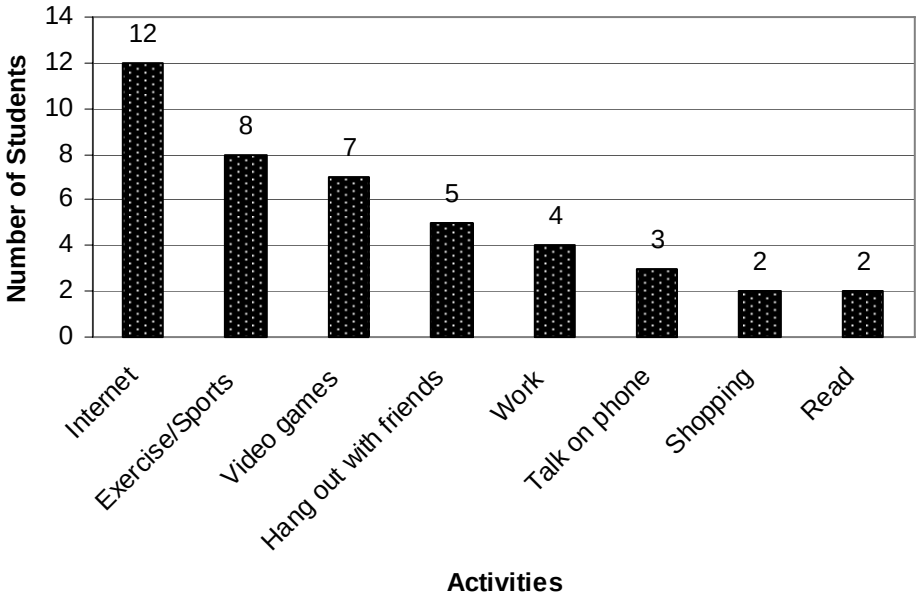

Figure 11: *What do you do after school?* (n=43)

Kindergarten Survey

Out of 21 kindergarten students, 17 students completed the survey (81%). Surveys were completed in class once during pre-documentation on Monday, January 29, 2007. Students in Teacher Researcher B's classrooms were asked to rate six questions, choosing a happy or sad

face (yes or no) to answer each one. Due to the age of the students, Teacher Researcher B dictated the questions to the class. Please refer to Appendix C to view this survey.

The first question on the kindergarten survey asked students if they enjoyed playing math games in class. One hundred percent (n = 17) of the students who filled out a survey indicated they like to play math games, as shown in Figure 12 below.

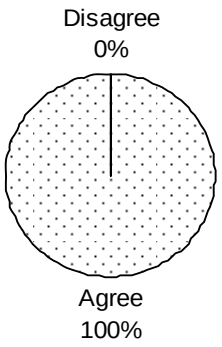

Figure12: *Like to Play Math Games* (n=17)

The second question on the kindergarten survey inquired whether the students prefer to work by themselves. The majority of kindergarten students (71%, n = 12) expressed that they enjoy working independently. Figure 13 below displays the results of this question.

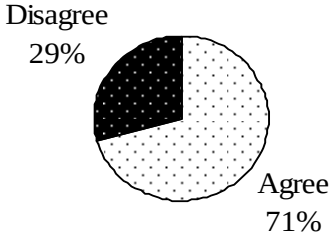

Figure 13: *Like to Work By Myself* (n=17)

The next question asked the kindergarten students if they enjoy using manipulatives such as cubes, squares, and counters to solve math problems. Figure 14 below shows the majority (82%, n = 14) of students stated they do like to work with manipulatives in math class.

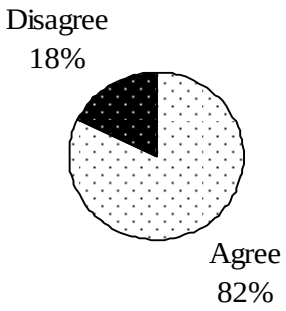

Figure 14: *Like Using Cubes, Squares, and Counters* (n=17)

The fourth question on the kindergarten survey asked the students if they like to complete math worksheets in class. A majority (59%, n = 10) of students indicated they do enjoy working on worksheets. A close minority (41%, n = 7) of students do not enjoy completing worksheets, as indicated in Figure 15 below.

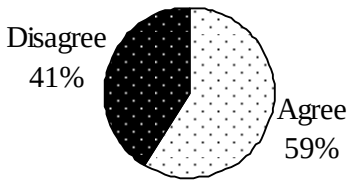

Figure 15: *Like Math Worksheets* (n=17)

The second to last question on the survey asked the kindergarten students if they feel that math is easy for them. As indicated in Figure 16 below, the majority (71%, n = 12) of students responded that they do feel math class is easy. Twenty-nine percent (n = 5) of the students feel that math is not an easy subject.

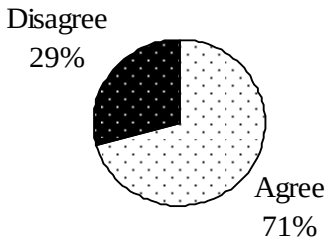

Figure 16: *Math is Easy* (n=17)

The final question on the survey asked the kindergarten students if they enjoy listening to music while working in class. One hundred percent (n = 17) of the students in Teacher Researcher B's classroom indicated they like listening to music while completing assignments. Please see Figure 17 below.

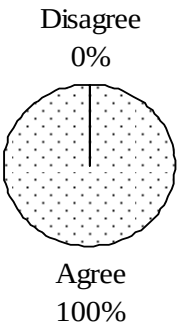

Figure 17: *Like Listening to Music* (n=17)

Second Grade Survey

Out of 48 second grade students, 36 students completed the survey (75%). Surveys were completed independently once during pre-documentation on Monday, January 29, 2007. Students in Teacher Researcher C and Ds' classrooms were asked to rate seven questions, choosing yes or no to answer each one. Please refer to Appendix D to view this survey.

The first question on the second grade survey asked if the students liked to work by themselves. Reflected in Figure 18, the majority of second grade students (69%, n = 36) expressed that they like to work alone.

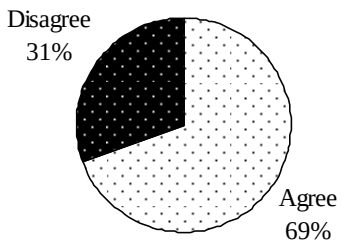

Figure 18: *Work by Myself* (n = 36)

The second question on the survey asked the students if they liked to work with a partner or a group of kids. Showing a close relationship, the majority of students (54%, n = 20) like to work alone, which correlates with the first question on this survey. Whereas, 44% (n = 16) of students like to work with a partner. Please see Figure 19 below.

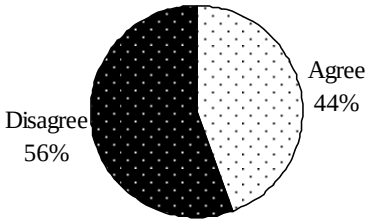

Figure 19: *Like to Work with a Partner* (n = 36)

The third question in the survey asked the students if they liked to use counters, cubes, and other math pieces. Students showed a preference to hands on learning. While completing math problems, the majority of students (69%, n = 25) like to use math manipulatives, such as counters and cubes. The minority (31%, n = 11) prefer to use other methods to problem solve. Please see Figure 20 below.

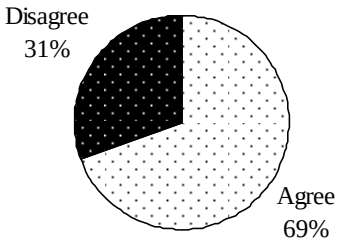

Figure 20: *Like Using Counters, Cubes, and Math Pieces* (n = 48)

On the fourth question, students were asked if they liked drawing pictures to help solve math problems. As shown in Figure 21, they students were evenly divided. Half the students preferred using pictures to solve math problems (50%, n = 18) and 50% (n = 18) of students do not like to draw pictures to solve math problems.

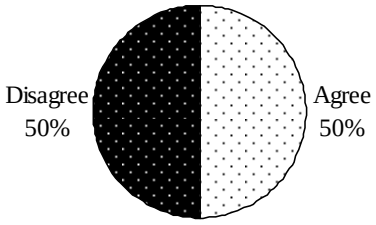

Figure 21: *Like Drawing Pictures to Help Problem Solve* (n = 36)

Question number five on the survey asked the students if they like to work on math worksheets. As indicated in Figure 22, the majority of students (69%, n = 25) like to do math worksheets. The minority (31%, n = 11) of students do not like to do math worksheets.

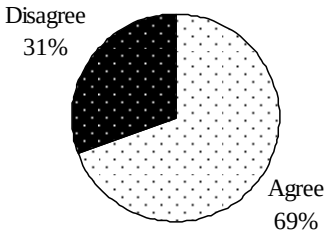

Figure 22: *Like Math Worksheets* (n = 36)

On the sixth question, students were asked if they like to listen to music while they work. Figure 23 shows that the majority of students (72%, n = 26) liked to listen to music while doing their work. The minority (28%, n = 10) do not like to listen to music while they work.

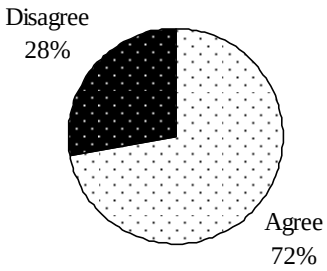

Figure 23: *Like Listening to Music* (n = 36)

The final question asked the students if they liked moving around while doing math. In Figure 24, the graph shows that the majority (58%, n = 21) of students like to move around, rather than the 42% of students (n = 15) who do not like to move around.

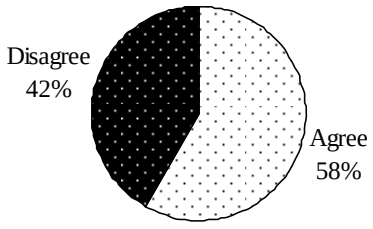

Figure 24: *Like to Move Around During Math* (n = 36)

Observation Checklist

The teacher researchers completed a daily observation checklist during 10 consecutive school days, beginning on Monday, January 29, 2007. The purpose of this tool is to record students' ability level by indicating if they were on task, finished with their work, or still needing support five minutes after an assignment was given. Teacher researchers walked around the room monitoring and recording the progress of each student. Once work was complete, teacher researchers graded the student products. Student products were recorded as satisfactory or unsatisfactory in the performance section of the observation checklist. Teacher researchers then compared the observation checklist to student performance on the given assignments looking for a correlation between student performance and application. A total of 773 observations took place during the two weeks. Please refer to Appendix H to view a copy of the observation checklist.

A majority (n = 427, 55%) of students were observed to be on task when an assignment was given. Twenty-six percent (n = 198) of students indicated that they needed help by asking questions or raising hands during the observation. When the assignments were graded, a majority (n = 631, 82%) of students were completing work in a satisfactory manner.

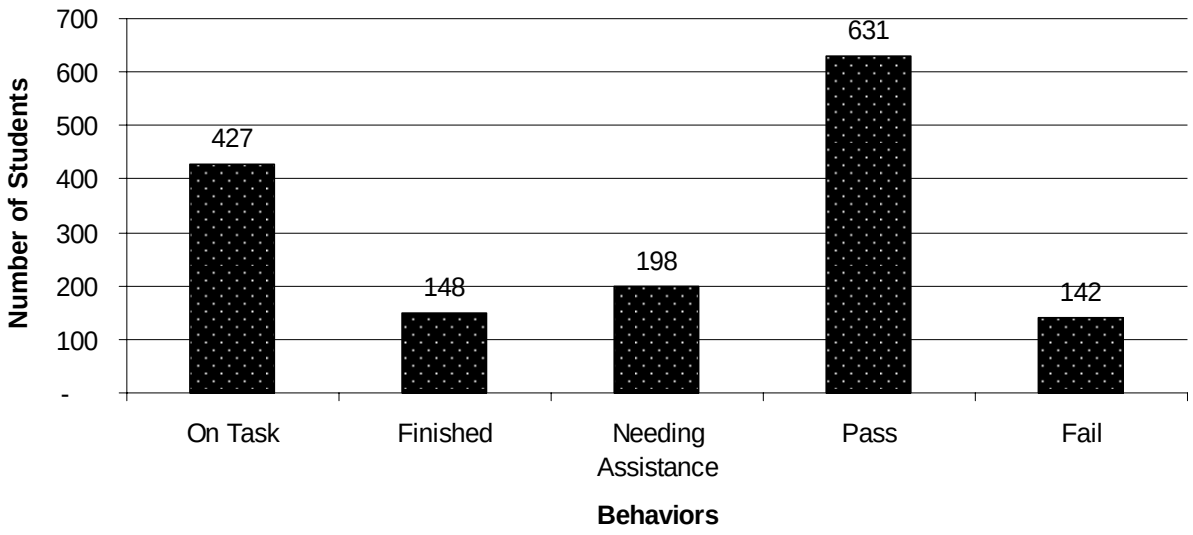

Figure 25: *Student Observations* (n=773)

Pre- and Post-Tests

Teacher researchers administered this instrument before the beginning of each new unit to assess prior knowledge of a topic. The identical test was then given again at the conclusion of a unit as a post-test. The purpose of this tool was two fold. First, this tool documents the varied ability of their students, in a very precise manner compared to the other tools, by focusing on particular topics in each unit. Recognizing the strengths and weaknesses of their students helped the teacher researchers guide instruction during the unit and differentiate instruction. Second and more importantly, since the pre- and post-tests were identical, the teacher researchers compared the results of each set of tests to see if student understanding increased due to differentiated instruction. Since the largest benefit of this tool was to try and document the effectiveness of the intervention, the teacher researchers decided to discuss all of the pre- and post-test data in the Presentation and Analysis of Results section of the action research paper (see page 76).

Summary

Based upon the tools described above, the data shows the teacher researchers that differentiation strategies may help to meet the multiple levels in today's classrooms. The surveyed teachers are feeling frustrated with varied abilities and they agree differentiation is necessary (Figure 3), but they often do not have the tools or time to accomplish this task (Figure 4). All teacher researchers completed an observation checklist and concluded that there are different levels of achievement in their classrooms (Figure 25). Along with the different levels of achievement, time to complete a task varies among students (Figure 25). The student surveys revealed that high school students like to work in groups (Figure 5) or if they are struggling they would prefer to work with the teacher in a small group setting (Figure 7). The primary students indicated they would like to work independently (Figure 13 and Figure 18). Students surveyed in the primary grade levels enjoy listening to music while completing math problems (Figure 17 and Figure 23). Primary students also indicated a preference for completing worksheets as a form of practice (Figure 15 and Figure 22). High school students indicated they prefer to spend time after school on the Internet (Figure 11).

Reflection

Figure 6 demonstrates that high school students markedly preferred to solve problems rather than write about problems. This data can lead to a problem, particularly in high school, because students are required to copy many assignments out of the book for homework. In addition, our data shows (Figure 9, Figure15, and Figure 22), and we concur, that worksheets are a preferable activity for students in math class. These two sets of data lead us to alter our differentiation strategies. First, we had originally planned to use all of the multiple intelligences

when implementing activities including writing. We may now disregard some of the writing assignments as options for the students.

We were all surprised that the primary students prefer to work on their own (Figure 13 and Figure 19), and the high school students enjoy working with those around them (Figure 5). We conclude that this is a representation of the social skills each age group. The younger students do not have the skills to work cooperatively in a group. On the other hand, the older students may prefer to work in groups to socialize rather than complete tasks. The surveys reinforced our belief that most students enjoy manipulatives and games (Figure 12, Figure 14, and Figure 20) as well as the internet (Figure 11). The student surveys are beneficial to the teacher researchers in regards to planning activities around student interests. Based on the survey results, all teacher researchers are planning to implement lessons using cooperative learning, allowing for student choice, and hands-on activities.

The observation checklists reinforced the idea that teacher researchers need to find alternative ways to reach all learners (Figure 25). Students are finishing work at different times and those that are advanced need to be given enrichment activities that are worthwhile, so time can be spent with struggling students. Teacher researchers believe that the numbers from the observation checklists validate the problem of varied ability in the classroom. Twenty-six percent (n = 198) of students need help while 19% (n = 148) were finished at the time the observations were recorded.

I, Teacher Researcher B, have a difficult time believing the validity of the kindergarten survey. I think my students preferred to color in the happy faces to just to satisfy me. Throughout the 10 weeks of intervention, I plan to ask my students for feedback regarding their likes and

dislikes for various activities and lessons. This will allow me to validate their opinions demonstrated on the survey.

All of the data collected demonstrates varied ability is prevalent in today's classrooms. We believe implementing differentiation strategies will help all students achieve their fullest potential.

Probable Causes

While examining the problems of varied ability in the classroom, we must first examine the issue through a wider lens and then we will work our way down to the actual classroom itself. Schools in general are in either of two camps: mix the ability of the students together into heterogeneous classrooms or separate students into different groups or tracks. The issue is far too complex to assume that all schools choose one method or the other. In fact, research on the topic provides no clear winner. A difficult choice must be eventually made by every school district as to how much ability will be mixed together to achieve an acceptable balance of learning.

Homogeneous instruction is the most efficient way to teach content (Brimijoin, 2005) and historically schools in the United States have been run on a factory model where all students learn the same way and should achieve the same goals (Baglieri & Knopf, 2004). In the past, teachers have seen their primary role in the classroom as the distributor of information. These views are outdated because in most of today's classrooms there is a wide range of abilities, which makes it necessary for teachers to reevaluate their role in the classroom (Scholz, 2004).

It is unspoken that, in general, schools favor certain behaviors, thinking, knowing, and interacting. Students who do not fit this protocol are identified for educational testing which confirms abnormality and segregates them (Baglieri & Knopf, 2004). Schools are continually identifying students with disabilities and qualifying them for special services. The schools need

to take responsibility to adjust the curriculum to the needs and levels of the students they serve so that fewer students are being pulled from the regular education classroom (Tomlinson, 2005). Especially if we think the larger purpose of any school is educate for a healthy democracy. Schools should not isolate groups of students since they will all eventually be members of a larger community when they graduate. Students should see other students' viewpoints and talents, good or bad, before going out into a democracy (George, 2005).

At the school wide level, there are many problems with both mixing all students together and separating students into tracks based upon ability. On the one hand, some argue that grouping all students into mixed ability classrooms does not challenge students enough (Cramond, Benson, and Martin, 2002). On the other hand, some will argue that tracking students does not necessarily guarantee all students' success either (Burris & Welner, 2005; DiMartino & Miles, 2005; Hallam, 2002; Lawrence-Brown, 2004). Either way, many studies have been conducted on ability grouping and the results have been inconsistent (Hallam, 2002); neither tracking nor heterogeneous grouping have shown to improve students' test scores (Reed, 2004).

Whether or not a teacher today agrees with tracking students to cope with mixed ability in the classroom, it is a reality in most classrooms and we should spend some time examining the problems with tracking. Beginning in kindergarten most schools separate special needs from the general population. By the time students reach high school, there may be five different ability levels for mathematics that students are already tracked into. Research suggests that tracking demonstrates no academic gain and even causes a wider gap between high and low students (Johnson, 1999). Students in higher ability groups are usually successful, but lower ability groups suffer (Hallam, 2002). Often the curriculum is watered down (Burris & Welner, 2005)

and teachers can begin to view the lower ability students as not being teachable or able to reach their full potential (Atkins & Elsesser, 2003).

In schools where tracking is taking place, many teachers do not know how to appropriately implement lessons that will reach all students and provide opportunities for each of them to reach their full potential. They are also not receiving the proper guidance to help them make these decisions. The reason one-size-fits-all classrooms continue is that teachers lack the exposure and the knowledge to incorporate differentiated instruction (Edgemon, Jablonski & Lloyd, 2006; Holloway, 2000; Tomlinson, 2005). Practicing teachers need training on how to address the varying learning styles, interests, and abilities of the students in their classrooms so they can implement differentiated instruction (Pettig, 2000; Wehrmann, 2000; Tieso, 2004). Besides the veteran teachers, many new teachers are entering their first year of teaching without the proper knowledge or tools of how to reach all learners. They are not adequately prepared by their university for the variety of abilities and skill levels that are found in today's classrooms (Holloway, 2000). Educators need to update their teaching methods to provide differentiated curriculum, instruction, and assessment (George, 2005). Many teachers find themselves teaching a class in a content area in which they are not well versed. In addition, they are having trouble finding appropriate resources, high level, and age appropriate material (VanTassel-Baska & Stambaugh, 2005). Teachers are expected to cover the curriculum and prepare students to pass standardized tests, but are often given little support (Tieso, 2004).

Now that we have touched on the problems that schools face with the varied ability of their students, let us examine the affects on the classroom itself. If teachers can agree on one thing it would be that, tracked or not tracked, there is still a large variety of ability in each classroom. This diversity will only continue to grow (Maheady, 1991). The students have

different learning abilities, and different learning styles (Bowerman, 2005; Johnson, 1999). Students arrive in the classroom with different levels of development, interests, and exposure to a multitude of environments and experiences (Ferguson, 1999; VanTassel-Baska & Stambaugh, 2005). In addition, each student enters the classroom with a different expectation for the year based upon past experiences. Some students need more time to work on things while others might need more instruction and re-explanation (Johnson, 1999). Teachers struggle to find a method of teaching to meet the diverse classroom needs because what works for some students will not work for others (Brimijoin, 2005; DiMartino & Miles, 2005; Johnson, 1999; Reed, 2004).

Regardless of the differences in student ability, teachers must hold themselves as well as their students responsible for learning in the classroom. Especially with the No Child Left Behind Law which is placing a great deal of pressure on teachers and school administrators to ensure that all students are successful learners (VanSciver, 2005). Consequently, educators are increasingly faced with the challenge of creating an environment where all the needs of the students can be met with a higher degree of accountability (Ferguson, 1999; Greenspan, 2005; Tomlinson, 2000; VanTassel-Baska & Stambaugh, 2005).

So to which level of ability does a teacher focus in the classroom? Teaching to the middle of the class means that the students at the extreme ends are not having their educational needs met (Tieso, 2004). If a teacher focuses on one particular ability level, then the other students' progress suffers. Let us examine some of the problems teachers face while teaching two distinct groups of students in the classroom: higher achieving students and lower ability students.

First and foremost, a typical general education curriculum does not challenge gifted students enough (Betts, 2004). Gifted learners are expected to repeat information that they

already know and wait for a chance to move ahead (Brimijoin, 2005). One major reason that gifted students are not challenged is that a school's curriculum is designed around school, district, state, and national standards that do not provide advanced standards and opportunities for gifted and talented students. The curriculum provides the basic guidelines that students should meet and teachers need to supplement enrichment activities on their own for accelerated learners.

Some educators misunderstand the entire idea of providing for gifted students; it does not necessarily mean higher expectations and more work (Van Tassel-Baska, & Stambaugh, 2005). Teachers must consider gifted students while designing lessons and activities or the ramifications can be severe. If gifted students continue to go without challenging activities, those who score high on standardized tests will regress to normal levels of achievement (Van Tassel-Baska & Stambaugh, 2005). With the current emphasis on standardized testing, schools cannot afford to neglect this group of students.

When considering lower ability or special education students in the classroom, teachers can encounter a totally different set of problems. Obviously lower ability students need to be challenged too, but often these groups of students need extra support as well. First, teachers need to consider a student's Individual Education Program (IEP) for accommodations when giving assignments or assessments. But teachers are frustrated when making individual adjustments because the existing research has failed to give teachers evidence-based advice about accommodations that are promising (Edgemon et al., 2006).

Special education teachers, along with other support staff, are concerned that the students they see on a daily basis are not receiving the proper support they need in the general education classroom (Ferguson, 1999). This is very possible because there are general education teachers

that lack the adaptive and general methods to work with students with special needs (Hughes & Kolstad, 1995). Even special educators may be unsure of the appropriate roles and tasks for successful collaboration between teacher, student and support staff.

Another challenging aspect that teachers face in the varied ability classroom is standardized testing. High-stakes testing is simply a way of life for many teachers and students across the nation (Brimijoin, 2005). Teachers are accountable for student success on high stakes testing while at the same time meeting the individual needs and strengths of the classroom students (McTighe & Brown, 2005). Teachers want students to succeed but are having trouble improving test scores when today's classes have a wide variety of ability levels (VanSciver, 2005). Take for instance the ELL student. Standardized assessment often underestimates an ELL student's academic potential and progress (Hoover & Patton, 2005).

With so much emphasis on high-stakes testing, the meaning, richness and enrichment of the curriculum is being squeezed out and swapped for test focused activities. Authentic learning and problem solving are seen as extras as testing is replacing what teachers consider best practice (Brimijoin, 2005).

Most educators would agree that methods that used to work in traditional classrooms are now considered ineffective; calling for a change in the way varied ability classrooms are run. One of the most well known best practices for dealing with varied ability in the classroom is differentiated instruction. Differentiation has become a popular idea among educators in recent years and many parents feel that schools should not expect children to adapt to a system that does not address their individual needs (Tomlinson, 2005). Of course, many educators are uncomfortable with the idea of change, making this transition to differentiate instruction more challenging (George, 2005).

There are no outlined or established steps for how differentiation looks in a mixed ability classroom (Brimijoin, 2005; Kettler & Curliss, 2003) but its main idea is to adapt to the varied ability within the classroom and use the differences in the students to the teachers advantage. Differentiation, just like any other best practice has its problems, too and we would like to address them here.

First, who is responsible for developing and implementing differentiation strategies? Many parents and educators believe it is the school's responsibility to develop a differentiation curriculum to meet the needs and levels of the students they serve (Betts, 2004; Tomlinson 2005). Differentiation should allow for all students to participate in all lessons (Harris, 2005). If today's teachers are expected to meet the needs of all learners in their classroom, advice and proper training of how to begin teaching differentiated instruction is needed (Pettig, 2000; VanSciver, 2005).

A second concern for teachers is where do they start and how does it work? Teachers are unsure of what a differentiated classroom looks like and how to develop appropriate lessons to accommodate a variety of abilities while still teaching the curriculum (Johnson, 1999; Kettler & Curliss, 2003; Pettig, 2000; Tomlinson, 1999; VanSciver, 2005; VanTassel-Baska & Stambaugh, 2005).

Also, asking teachers to differentiate instruction and modify the school curriculum to meet the needs of their learners takes them out of their comfort zone and questions regarding classroom management and fairness arise (VanTassel-Baska & Stambaugh, 2005). Again, if schools are expected to meet the needs of each and every student that walks through the door, proper training on differentiation will be crucial for all teachers.

The idea of fairness and grading when using differentiation strategies in the classroom is yet another concern for today's teachers. The idea of differentiation is to make education appropriate for each individual student, making accommodations when necessary to ensure success. It is a teacher's responsibility to explain the need for differentiation within the classroom to students. Students should understand why accommodations are being made and what is expected of them (Tomlinson, 2000). If a teacher is adjusting the curriculum or assignments to meet the needs of the students in the classroom, the grading system must also be adjusted. Due to the lack of teacher training when it comes to differentiation, many teachers wonder how to fairly grade assignments in a differentiated classroom (Powell & Napoliello, 2005; Tomlinson, 2005). Implementing differentiation strategies in the classroom sounds like a wonderful way to reach all learners, however guidance for teachers on how to be fair and grade appropriately is needed.

Another problem with differentiation (or any teaching method) is keeping students actively engaged and interested in what they are learning, which is a challenge (Tomlinson, 2000). Developing intriguing and exciting lessons that peak the interests of a variety of students in one class can be a time consuming and difficult task for teachers. Some students simply may not be interested in the topic at hand and others may not be able to keep up with or comprehend what is being taught. If students' interests are not kept and there is too much repetition throughout multiple lessons, their talent may not be fully developed (Johnson, 2000). Another concern that teachers face when trying to keep students motivated, is how to adapt lessons to meet the needs of various learners. Special education students may not work as hard because they know that their teacher will do modifications (Barnes, 2006). Also, when teachers are expected to assign grades to student work, does it help or hinder student motivation (Tomlinson,

2005)? It is difficult for teachers to predict what lessons will reach all learners and keep them motivated to work up to their full potential.

Finally, the biggest problem that teachers face when they implement differentiated instruction: planning time. Many teachers become overwhelmed and frustrated when thinking about the time and effort to plan differentiation (Powell & Napoliello, 2005; VanTassel-Baska & Stambaugh, 2005). Often there is a lack of planning time for teachers to make differentiation feasible (VanTassel-Baska & Stambaugh, 2005). There is no way around it, structuring differentiation in the classroom takes planning and it needs to be reflected upon to be sure that quality work is being produced (Tomlinson, 2000). Many teachers see this as a major turn off to implementing differentiation because time is a major component and something they have very little of. Educators must find ways to provide excellence and challenge to all students (George, 2005) because research has shown that there are discrepancies between what teachers feel are appropriate instructional activities for their students and what the students think about their own academic ability (Hallam, 2002).

Today's schools face a tremendous challenge. Providing the opportunity for every student to reach his/her full potential is a difficult task. Whether a school believes in tracking or not, teachers will always have a classroom of mixed ability students. Each student brings a unique situation to the classroom and it is the teacher's responsibility to find some way to reach as many students as possible. Even though the research has not shown a sure-fire approach to address the varied ability in the classroom, differentiation has gained popularity in recent years.

CHAPTER 3

THE SOLUTION STRATEGY

Review of the Literature

Before reviewing the research for possible solutions to varied ability in the classroom, tracking versus heterogeneous groups must be discussed. Since teachers cannot control the school's policy, tracking will not be included as a possible solution to the problem of a varied ability classroom. Tracking students into a particular academic level can allow for a more appropriate curriculum for the students. For instance, teachers can spend three days on a topic with a lower ability group of students instead of just one day because the students are all on the same page academically. Lower level students may receive more one-on-one time while higher level students are being pushed to their fullest potential (Atkins & Elsesser, 2003).

There are many schools that implement tracking with great success and there are always instances where the elimination of tracking has increased graduation rates. Instead of tracking, one may argue that teachers can still teach to a student's ability level within of a mixed ability class by grouping students together into ability groups. That way, students are together and the teacher can focus on instruction that is more suited to the capabilities and level of understanding of students (Scholz, 2004). At the same time, students will also have the models and interactions with other students outside of their ability group that will help prepare them for life after school (Atkins & Elsesser, 2003). Overall, the best recipe for success may be a mixture of tracking and heterogeneous groups (Atkins & Elsesser, 2003).

In a varied ability classroom a teacher needs to find ways to reach all learners. Many researchers believe that the best practice for accomplishing this task is differentiation. Differentiation is designing lesson plans, projects, assessments, and learning environments to

accommodate the individual readiness, interests and learning profile of each student (George, 2005; Powell & Napoliello, 2005; Tomlinson, 1999; Tomlinson 2000; Tomlinson 2005). This does not mean that one group of students receives one curriculum and another group does not receive that curriculum. Rather, everyone should be encouraged to think at a high level and be actively engaged in learning tasks, albeit slightly modified tasks (VanSciver, 2005). Teachers must also continue to assess students' needs, ability level and analyze their learning goals and then use these differences to plan upcoming curriculum and activities for the week (Dover, 2005; McTighe & Brown, 2005; Tomlinson, 1999; VanSciver, 2005). Teachers need to take into account individual interests and preferred learning styles and allow for students to make choices regarding their instruction. For instance, a math student that excels in writing should be given an assignment option that allows him/her to write about a math concept instead of doing 20 math problems out of the book.

Teachers need to move from the way things have always been done to an attitude of searching for the best practices to improve schools, education, and teaching (Tomlinson, 2005). Differentiating instruction is a difficult task that is embraced by teachers who are unwilling to accept a classroom where growing numbers of students are less successful (George, 2005). Teachers who differentiate require knowledge of content, a broad range of assessment tools, flexibility in matching tasks to students, creativity to find various resources, continuous reflection, collaboration, and support (Brimijoin, 2005). In order for differentiation to be successful, teachers need to make sure their work is engaging, accessible but challenging, and identify the obstacles (Harris, 2005). Teachers should differentiate content focus, process requirements, and end products based on student ability (McTighe & Brown, 2005).

Differentiated curriculum, instruction, and assessment should be implemented in the classroom to challenge, support and provide success for all levels of students (George, 2005).

Regardless of ability level in a classroom, effective classrooms have some common characteristics when it comes to the overall classroom environment. Obviously smaller class size is preferable because behavior issues are reduced; student participation increases, and students have an easier time focusing. However, teachers cannot control class size for the most part. What teachers can control is that all students are exposed to a complex, enriched curriculum along with energetic instruction in an effective classroom (George, 2005). Classrooms should always support the importance of effort and persistence when working (George, 2005). The classroom is based on trust, shared management, self-governance, high expectations, and a balance of teacher-directed and student-centered learning (Brimijoin, 2005). The learning environment needs to make the student feel safe (Easton, 2002). Each member of the class is able to make a contribution and is respected for their opinion (Scholz, 2004).

When it comes to the learning environment of the differentiated classroom, success depends on the flexibility in teaching and learning arrangements (Brimijoin, 2005). Teachers in a differentiated classroom must recognize the right of every student to have access to all experiences and benefits available. When teachers are making decisions about which accommodation to use, it is important to examine each student's individual needs, paying special attention to each student's functional skill level (Edgemon et al., 2006). Each student is unique, requires special attention, and adaptation of learning experiences to fit those unique needs, interests, attitudes, and abilities (George, 2005). Emphasis is placed on the development of the total learner; both emotional and social development (Betts, 2004).

Another crucial characteristic of a successful varied ability classroom is that students should have the opportunity to work and learn together. An effective classroom environment should allow students to work in many settings such as groups, pairs or by themselves (Johnson, 2000). When it comes to grouping varied ability students in a classroom there are many different options. Teachers must continuously assess and monitor the groups and allow for students to migrate from one to the other (Cramond et al., 2002; Hallam, 2002). Whole group instruction can be replaced by group activities that rely on collaboration (Hughes & Kolstad, 1995; Baglieri & Knopf, 2004). A small group setting will allow for important concepts to be taught and assessed more effectively (Scholz, 2004). These work groups are formed based on student readiness for a given topic and allows teachers to target a particular ability level, thus individualizing instruction for students (Bowerman, 2005). Some activities will require the whole class to participate while other lessons will work better pairing students to work together to accomplish an objective. Different situations and activities will require the teacher to determine how to group students but the key is to remain flexible and to diverge the groups to vary instruction and keep students interested (Pettig, 2000).

Through a larger lens, working together enables students learn life skills such as leadership, communication, conflict resolution habits, and problem-solving strategies. This social interaction also improves peer-to-peer learning, self-esteem, and can facilitate education for future citizenship (George, 2005; VanTassel-Baska, 2005). Teachers must integrate a variety of students' lives into classrooms so that students see other view points and cultures as a benefit and they are prepared for the real world in which they will live one day (George, 2005).

When teachers model positive language and an attitude that embraces differences, students verify the development of their peer relationships, and gain a greater appreciation of

differences (Baglieri & Knopf, 2004). Their peer acceptance, social skills, and interpersonal tolerance grow; each student's voice is heard and valued (Baglieri & Knopf, 2004; Barnes, 2006; George, 2005). There is a lower risk of labeling or stigmatizing high and low achievers and students start to see their differences as strengths (George, 2005). When students support and interact with one another in continuous, meaningful ways, teachers are promoting relationships that lead to mutual caring (Baglieri & Knopf, 2004).

Not only does working together provide life skills for the students, but the effects on learning are evident as well. Students who are seeing success in their school work have an increased self-esteem and take pride in their work. This confidence and self-esteem is carried over into various aspects of their lives. Students do not see themselves as failures and are more comfortable contributing to whole class discussions (Easton, 2002; Scholz, 2004).

It is imperative that students interact with each other *and* the curriculum during the day and throughout the entire school year (Brimijoin, 2005). Discussion and questioning between like-minded peers creates a community of learners by supporting each other and, most importantly, helps increase understanding (Johnson, 1999; Scholz, 2004). Students that instruct their peers by class-wide peer tutoring or class-wide student tutoring teams perform better on tests (Maheady, 1991). Cooperative learning goups can also benefit students by reducing competition between peers, allowing students to work at their own pace, and enhancing student/teacher interactions (Baglieri & Knopf, 2004; Hallam, 2002; Hoover & Patton, 2005).

The benefits of taking the time to create genuine teacher-student relationships are immeasurable. Never underestimate the importance of human relationships in learning (Baglieri & Knopf, 2004). Research has shown that student performance can increase when a little bit of extra attention is given to students by their teachers (Parker, 2002). Teachers need to demonstrate

that they care about their students and their progress (Easton, 2002). Creating a teacher-student relationship is important and takes time to grow into an intimate and trusting rapport (Baglieri & Knopf, 2004; Greenspan, 2005). Meeting one-on-one, making casual conversation, recognizing birthdays, assigning an important task, and giving students special status in class can have a marked improvement in academic scores (Parker, 2002). These ideas do not take much time and are easy for teachers to implement on a daily basis.

In a differentiated classroom the teacher assumes the role of classroom manager and facilitator (George, 2005). Teachers guide students to develop organizational skills, learning plans, the pursuit of knowledge, involvement with mentors, appropriate assignments, presentations, and assessments (Betts, 2004). The teacher is not the keeper of all knowledge and learning should be facilitated by providing opportunities for students to pursue their own interests (George, 2005; VanTassel-Baska & Stambaugh, 2005). One important aspect of differentiation is acquiring and maintaining student involvement in learning. It is believed that student directed learning allows individuals to determine their goals, take it upon themselves to meet those goals, and be held accountable for what is learned (Easton, 2002; Johnson, 1999). Although individual accommodations are made when using differentiated instruction, teachers should have high expectations for all of the students in the class (Johnson, 2000; Wehrman, 2000). Teachers are responsible for creating different levels of expectations for their students (Easton, 2002; Lawrence-Brown, 2004; McTighe, & Brown, 2005). Students will have a genuine feeling of achievement that comes from the teacher providing problems that are challenging to each level (Scholz, 2004). To ensure that goals and high expectations are set, teachers can ask students to create a plan for activities (Powell & Napoliello, 2005). By continually asking students to asses their work and review their plan, teachers can be aware of what progress is

being made and if a student needs assistance. The more students are the center of their own learning process and take responsibility for their learning, the more they will understand and master desired skills (Dansinger, 2000; McTighe & Brown, 2005). Holding students accountable for their learning will better prepare them for a successful future.

One strategy teachers can use to keep students motivated is to survey the interests and abilities of the class though observations or conferences (Hughes & Kolstad, 1995; Tieso, 2004). Once student interests are discovered, teachers should use the information to develop inquiry based/discovery learning activities (Johnson, 2000; Tomlinson, 1999; Tomlinson, 2000). While taking their interests into account, teachers should also pre-assess students to discover ability levels within the classroom. Pre-assessing student knowledge allows the teacher to have a clear understanding of what material needs to be covered and to what extent. It will also minimize repetitive activities that may not be needed and allow time for extension activities (Johnson, 2000; Pettig, 2000). Students need to be exposed to an education that offers challenging curriculum while addressing the difference in learners' prior knowledge, interests, and preferred learning styles (Brimijoin, 2005; McTighe & Brown, 2005). Student progress needs to be evaluated on a regular basis to ensure the individual needs are being addressed (Dover, 2005). The educator should aim their lessons to the various abilities and interests in the classroom (Scholz, 2004). Individualized planning addresses each student's needs. Although it is more preparation for the teacher, it might alleviate issues in the long run (Cramond et al., 2002). When a student begins to struggle, teachers need to increase support for testing and classroom assignments (Dover, 2005). By surveying students to discover interest and ability levels teachers can make individualized accommodations in an effort to reach all learners.

Once a teacher has discovered the hobbies of the class, lessons should be adapted to allow students to learn about their own interests (Easton, 2002). It is the teacher's job to motivate each student's desire to learn and time should be spent deciding on how to deliberately arouse student curiosity (Harris, 2005; Tomlinson, 2005). Teachers should pay special attention to the preferred learning styles found within the classroom. When planning lessons and assignments, teachers should keep Gardner's Multiple Intelligences in mind to keep students engaged in the topic at hand (Lawrence-Brown, 2004; Tomlinson, 1999; Tomlinson 2000). One way to involve students in the learning process is to allow for individual choices (Betts, 2004; Easton, 2002). Multi-option assignments and a choice of final products should be given to the students (Hughes & Kolstad, 1995; Pettig, 2000; Powell, & Napoliello, 2005; Reed, 2004; Tomlinson 1999). Giving students the opportunity to choose which particular activity or final project they would like to complete allows them to be in charge of their own learning and help them to gain a better sense of personal and social responsibility (Betts, 2004; George, 2005). Students should be given many different opportunities to relay their knowledge and the activities that are chosen should require multiple ways of interacting and accessing the curriculum (Baglieri & Knopf, 2004; Brimijoin, 2005). Allow students a chance to be creative and demonstrate how much knowledge they have gained. When students are given appropriate options, choices, and guidance, they are more likely to demonstrate and express learning (McTighe & Brown, 2005).

When using differentiation teachers need to consistently check the progress of each student. This is necessary to make proper adjustments with assignments, projects, and assessments to maximize student performance (Brimijoin, 2005; Tomlinson, 1999). If a teacher is using differentiation strategies in the classroom, he or she is taking each individual student's strengths, weaknesses, past experiences, and interests into account when developing lessons. The

same is true when it comes to assessing students of varied ability. Teachers should stray away from having a one size fits all point of view when it comes to assessing student understanding (Bowerman, 2005). A variety of assessments should be available and each student shall select how he/she would like to demonstrate the knowledge that has been gained (McTighe & Brown, 2005; Tomlinson, 2000; Tomlinson, 2005). Assessment should include respectful tasks allowing students to engage in independent decision making, problem solving, investigation, experimental inquiry, creative expression, and related higher order thinking (Lawrence-Brown, 2004; McTighe & Brown, 2005). Experts in grading believe that grading takes the motivation out of students at all levels of achievement. Teachers should allow students a second chance, if needed, to demonstrate what they have learned, and not be hung up on assigning grades (Tomlinson, 2005).

To start differentiation in a classroom, first a teacher must begin with a unit that they enjoy teaching and with which he or she feels most comfortable. Then, modify the content for one small group of students before attempting to differentiate for the entire class (Pettig, 2000; Wehrmann, 2000). Take small steps toward a differentiated classroom; do not attempt to do a full change in one day. Also, talk with your students about the differentiation process and your expectations of them. Remember to get feedback along the way and ask students what they think could work better (Tomlinson, 2000).

In a differentiated classroom teachers need to create lessons based on where the students are rather than where a graded or standard assumes students should be (Baglieri & Knopf, 2004). They should select appropriate instructional objectives to plan what they want students to get out of the lessons (Hughes & Kolstad, 1995; McTighe & Brown, 2005). Teachers must be clear about their goals and standards in their curriculum before, during, and after a unit and continue to

ask if their students have achieved those goals (McTighe & Brown, 2005; Pettig, 2000; Tomlinson, 2005). Students need to understand the learning goals and see them as meaningful and personally relevant (McTighe & Brown, 2005). Teachers need to select methods that encourage each student to learn as much as possible (Baglieri & Knopf, 2004). When selecting an accommodation, ask the question, "Does this accommodation help the student show how much he or she knows or can do (Edgemon et al., 2006)?" Teachers should use ongoing assessment data to guide instruction (Brimijoin, 2005).

Teachers should incorporate multilevel instruction. This is very time efficient because the teacher implements one lesson and includes variations for individual students at their level (Johnson, 1999). Teachers need to be comfortable allowing students to work on different assignments, tasks, and levels of content through various lessons (VanTassel-Baska & Stambaugh, 2005). Have students practice and demonstrate knowledge through learning centers, small group activities, independent studies, tiered activities, compacting, learning contracts, personalized agendas, and choice boards (McTighe & Brown, 2005). Teachers can compact curriculum by telescoping or using tiered objectives in their classrooms to allow for acceleration. Tiered objectives involves using an aligned objective across the curriculum so that the teacher can give the student work that focuses on the higher grade level (Kettler & Curliss, 2003). This can be done by curriculum modifications that include accelerating units, substituting more difficult texts, adjusting the complexity, adjusting the pace, and including various independent activities. These modifications challenge students to higher levels of thought and gives them the opportunity to learn more instead of the status quo (VanTassel-Baska & Stambaugh, 2005).

Modifications are pertinent in today's schools because there will always be students who require an alternative form of instruction in order to reach their education potential and succeed

(Scholz, 2004). When making decisions about which modification to use, it is important to examine each student's individual needs, paying attention to the student's functional skills (Edgemon et al., 2006). Teachers need to make necessary modifications based on district, state, and government standards. Content, process, and product can be modified for the learning experience with an emphasis on pre-testing, integrated units, flexible grouping, tiered assignments, and enrichment activities. Students should be given choices and they should be involved in their learning process. When making a modification the main emphasis should be placed on the total learner including both emotional and social aspects (Betts, 2004).

Due to the prevalence of special education students in today's classrooms, we should address the preferred learning environment for these students. Most importantly, special education teachers should be giving consultation and support to the teacher and, if possible, schools should have a half-way class between full inclusion and self-contained classes (Carney et al., 2003). Special education students should go to a "learning lab" to get one-on-one help from special education teachers throughout the day. In class, special education students should be given personal assistance from a peer, a parent volunteer, or a teacher. In other words, give struggling students the support they need.

When addressing students with special needs, there are five basic accommodation categories. The categories include presentation, time, setting, response, and aides. Presentation accommodation is how the teacher presents information to the students (Edgemon et al., 2006). This can include a variety of instructional materials, educational media, technology, and hands-on activities (Hughes & Kolstad, 1995; Johnson, 2000). Teachers can also use role play, demonstration, visual images, and other methods that incorporate the multiple intelligences (Harris, 2005). Regardless of ability, it is helpful when teachers demonstrate what is expected

from the students or display a work sample (Lawrence-Brown, 2004). Time accommodations include extended time or breaking down assignments into sessions. Setting accommodations adapt the environment to make it suitable for all learners. It can include small group, special lighting, centers or the presence of a familiar teacher. Response accommodations relate to how the student records the answers. This can include dictating answers, using a word processor, brailler, or a test booklet. Aid accommodations include using a device during testing. This could include overlays, allowing the student to see only one question at a time, calculators, and voice-activated computers (Edgemon et al., 2006). Students may also be pulled to a resource room for testing. (Dover, 2005). At all grade levels, small-group, read-aloud, extended time, paraphrasing, and dictation are the most commonly used accommodations (Edgemon et al., 2006). As students with modifications show academic improvement, slowly reduce the modifications that are being made (Barnes, 2006; Dover, 2005).

Modifications must be made in order to challenge talented and gifted students (Betts, 2004). Some of these modifications can consist of extension assignments. These assignments allow the students that have mastered the skills to continue to be challenged (Reed, 2004; Hughes & Kolstad, 1995). Presenting open-ended questions to advanced learners is one modification. Open-ended questions are very challenging for gifted students. These kinds of questions not only challenge students but they also promote a higher level of thinking (Johnson, 2000; Reed, 2004). Along with extension of assignments and asking open-ended questions, teachers can accelerate gifted students so there is less repetition. Teachers can compact curriculum by telescoping or using tiered objectives in the classrooms to allow for acceleration. Tiered objectives can involve teachers using aligned objectives across the curriculum of different grades. An example of this would be if a sixth grader needs to be working at the seventh grade

level, the teacher can give the student work that focuses on the higher grade level (Kettler & Kurtis, 2003). Overall, a classroom that makes effective modifications for gifted students, offers consistent opportunities for the gifted students to extend their knowledge, thought, and skill in the same way the classroom offers other students to advance everyday (George, 2005).

Teachers need adequate training and support in order to benefit all of their students. There will always be various levels of achievement; there should also be a variety of teaching methods (Scholz, 2004; Tieso, 2004). To support differentiation, teachers should attend conferences to learn helpful and innovative techniques, collaborate with other teachers, and take into account the needs of students as they plan their units of study (Powell & Napoliello, 2005). Staff development can play an important role in meeting the needs of students. Professional development programs and school districts need to provide support and mentoring for teachers. School districts should also provide teachers with models for differentiated curriculum and activities that can be used (Carney et al., 2003; Holloway, 2000). One way to assist teachers is to bring professionals into the building. It is not just up to the schools to provide staff development. It should be a teacher's responsibility to implement best practices in their classrooms. Continuing professional development and specialty endorsements have been highly encouraged to update classroom practices (Ferguson, 1999).

One of the best support tools for implementing differentiation is a teacher's colleagues. Teachers can enhance curriculum by working together with colleagues, asking for suggestions, and sharing ideas. Colleagues can also make suggestions for additional support, instruction, accommodations, and learning strategies (Betts, 2004; Dover, 2005; Pettig, 2000; Tomlinson, 2000). Block teams have been implemented into some schools. This allows grade level teachers to work together and share resources, curriculum planning, and teaching tasks (Ferguson, 1999).

Specialty teachers have also been included into these groups to help create curriculum that includes strategies to help every student become successful. The regular education and special education teachers are able to be resources for each other and to merge their talents (Carney et al., 2003; Ferguson, 1999; Sacacore, 1997). Another option is to consider sharing the load of differentiation by grouping students and trading groups for content area with another teacher. This strategy is effective, it involves pre-assessing students, grouping them based on need, and providing effective curriculum adjustments (VanTassel-Baska & Stambaugh, 2005). This strategy allows groups of teachers to be collectively responsible for a class. Instead of having one teacher per group of kids there are several. The teachers can pull together to help meet every students' needs (Ferguson, 1999). Volunteers and paraprofessionals can give teachers additional support in the classroom (Ferguson, 1999; Sacacore, 1997). Administrators can provide instructional support and suggestions for the teacher and paraprofessional on how to best utilize and work with one another and the children (Dover, 2005).

Project Objective and Processing Statements

As a result of cooperative learning lessons, multiple intelligence based lessons, student choice of assignments, and differentiated assignments during the period of January 29, 2007 through May 11, 2007, the students of Teacher Researchers A, B, C, and D, were to improve mathematic skills in a varied ability classroom.

To implement the intervention for this research project, the teacher researchers focused on four areas of differentiation. First, teacher researchers developed cooperative learning lessons at each grade level. For example, teachers paired up high and low level students and introduced a math game to review money concepts. Secondly, multiple intelligence lessons were implemented in each classroom. For instance, second grade students used manipulative "cake slices" to

demonstrate fraction values while kindergarten students practiced counting by fives using a clapping song with a partner. Teacher researchers also developed lessons utilizing student choice. At the high school level, the teacher developed three different projects for students to choose from to demonstrate proportion and scale change. Finally, differentiated assignments were produced to reach each student at their particular level of mathematical ability. At the high school level the teacher created three versions of a worksheet each with varying difficulty.

Project Action Plan

The following timeline outlines the implementation of the research project. Of the 14 weeks allowed for this project, 10 weeks of intervention took place from February 13th, 2007 through April 27th, 2007. The remaining four weeks, January 29th, 2007 through February 9th, 2007 and April 30th, 2007 through May 11th, 2007, were used for pre- and post-documentation, and compiling information.

Week of January 22nd, 2007 – January 26th, 2007

Principal needs to approve parent permission forms.
Xerox parent permission forms, teacher surveys and observation checklists.

Pre-documentation Weeks: January 29th, 2007 – February 9th, 2007

Send parent permission and student assent forms home.
Parent permission and student assent forms due back by February 6th.
Make calls to obtain parent permission forms February 9th.
Survey students for personal interests.
Prepare activities for upcoming units using multiple intelligences.
Distribute teacher surveys.
Teacher surveys due back by February 5th.
Begin pre-documentation daily student observation checklist.

Week of February 13th, 2007 – February 16th, 2007

Compile data from student observation checklist.
Administer pre-test of first unit.
Review teacher surveys and collect data.

Teachers will reflect daily to assess the effectiveness of chosen interventions and plan accordingly.
Each researcher will differentiate math instruction using modified assignments, incorporating multiple intelligences, and cooperative learning.

Week of February 19th, 2007 – April 27th, 2007

Teachers will reflect daily to assess the effectiveness of chosen interventions and plan accordingly.
Each researcher will differentiate math instruction using modified assignments, incorporating multiple intelligences, and cooperative learning.
Each researcher will administer pre- and post-unit test when appropriate.

Post-documentation Weeks: April 30th, 2007 – May 11th, 2007

Teachers will complete post-documentation daily student observation checklists.
Each researcher will compare data from pre- and post-documentation checklists and interpret results.
Each researcher will compare data from pre- and post-tests and interpret results.

Methods of Assessment

The teacher researchers at Sites A and B used several pre- and post-tests as a part of post-documentation. The purpose of this tool was to compare the pre- and post-test to see if student understanding had increased due to differentiated instruction. The pre- and post-tests were given by the teacher researchers as needed from February 13, 2007 through April 27, 2007 according to their individual classes. The teacher researchers used the tool by giving each of the 104 students in the intervention a pre-test. See Appendix E through G for sample pre-tests. The students were then given the same test after the teachers had taught and implemented differentiated instruction in their class. The pre- and post-tests were then compared to see if student achievement increased.

The teacher researchers at site A and B completed two observation checklists that included each consenting student in their classroom. One checklist was completed during pre-documentation and the other one was completed during post-documentation. The purpose of the

first observation checklist was to record students' ability level by indicating if they were on task, finished with their work, or still needed support. This indicated that different abilities were relevant in our classrooms. The purpose of the second observation checklist was to see if differentiated instruction helped to bridge the gap of varied abilities. The first observation checklist was completed during the weeks of January 29, 2007 through February 9, 2007. The second observation checklist was completed during the weeks of April 30, 2007 through May 11, 2007. Post-data was compared to pre-data to document any change. Please refer to Appendix H for the student observation checklist.

CHAPTER 4

PROJECT RESULTS

Reaching every student in an inclusion classroom was the problem identified by the four teacher researchers. The teacher researchers encountered academic achievement that ranged from high, medium, and low. The students that performed at a high academic level were often finished with their work early and left unchallenged. The students that performed below average academically needed constant support and redirection which took away from the teacher's instruction time. It appeared that the only students that were benefiting were the average students.

Over the course of 10 weeks, the teacher researchers implemented four main interventions into their classroom. The interventions consisted of cooperative learning lessons, student choice of assignments, multiple intelligence based lessons, and differentiated assignments. The participants in this study consisted of 79 students: 26 grade 10-12 high school students, 53 kindergarten through second grade students, and 25 teachers for a total of 104 participants. This research project ran from January 22, 2007 through May 11, 2007.

Historical Description of the Intervention

At any given time throughout the school year, teachers are faced with students that have a wide range of abilities. Instructing students using a one-size-fits-all approach is no longer appropriate for today's classrooms (VanSciver, 2005). In an effort to reach all learners, differentiation strategies have become popular in recent years. The basic idea behind differentiation is designing lesson plans, projects, assessments, and learning environments to accommodate the individual readiness, interests, and learning profile of each student (George, 2005; Powell & Napoliello, 2005; Tomlinson, 1999; Tomlinson 2000; Tomlinson 2005).

However, teachers need to be careful not to lower the learning standards, but rather find different ways to teach the content (DiMartino & Miles, 2005). Examples of differentiation strategies include using cooperative learning, allowing for student choice of assignments and projects, implementing lessons that utilize Gardner's Multiple Intelligences to engage learners, and modifying the difficulty of assignments or projects.

Cooperative learning is one way in which teachers can help students learn to work with one another. It allows students to work in groups to achieve a goal. Teachers can group the students according to abilities or learning styles. The students are then given ample time to work together to complete a task as the teacher monitors the progress of each group. Research has shown that discussion and questioning between like-minded peers creates a community of learners by supporting each other and, most importantly, helps increase understanding (Johnson, 1999; Scholz, 2004). Cooperative learning groups can also benefit students by reducing competition between peers, allowing students to work at their own pace, and enhancing student/teacher interactions (Baglieri & Knopf, 2004; Hallam, 2002; Hoover & Patton, 2005).

During the two weeks of cooperative learning each teacher researcher implemented various activities in the classroom. Teacher Researcher A used playing cards to pair up students to work on a chapter review sheet before a chapter test. This was an effective technique because it allowed the students to pair up with someone new, rather than constantly working with a friend. Teacher Researcher A also noticed that the students were more comfortable asking questions to each other rather than asking direct questions to the teacher. Teacher Researcher B paired up high and low achieving students to play a game "Race to the Bank." This game reviewed the concept of coin identification and value. This was a positive learning experience because the higher students were eager to help the struggling students identify or recall the

values of the coins. Teacher Researcher D also paired up her students using mixed ability. Students were asked to work together to practice re-grouping with a dry erase board. This was an effective teaching strategy because the students understood the concept and enjoyed using the dry erase boards. Teacher Researcher C paired students differently depending on the activity being completed. Students were either grouped by mixed ability or similar ability; by forming these groups the students were introduced to working with new partners of various levels. This also proved to be an effective strategy because it was observed that students were positively interacting with one another and occasionally children were able to explain concepts to one another using simpler terms.

All teacher researchers enjoyed the two weeks of cooperative learning. It was felt that using cooperative groups alleviated some of the demands on the teacher. It allowed for the teachers to monitor the progress and give additional support when needed. However, it was also observed that sometimes the higher achieving students were forced to do extra work to make up for the struggling students.

Designing multiple assignments, projects, and assessments to allow students to select which item to complete is another way a teacher can differentiate in the classroom (Betts, 2004; Easton, 2002). It is the responsibility of the teacher to get students interested and actively involved in the concepts being taught. Allowing choices encourages students to be in charge of their own learning and help them to gain a better sense of personal and social responsibility (Betts, 2004; George, 2005).

During the two weeks in which teacher researchers focused on student choice a common theme became apparent. Planning and preparing the various activities was tedious and time consuming. Teacher Researcher A enjoyed challenging the students to their fullest ability. The

project choices that were selected surprised Teacher Researcher A. Allowing for student choice motivated the students to work on the project. Teacher Researcher B found that giving the students a choice of what to do was difficult due to their lack of independence. When two choices were given and each student selected one, they quickly forgot the directions and needed additional support from the teacher. This took away valuable one-on-one teaching time with the struggling students. Teacher Researcher C felt frustrated with the lack of time available for students to complete enrichment projects. Students were excited about the activities but the demands of the curriculum did not allow for extra activities to be completed. Teacher Researcher D created math centers for her students. The students were able to select a center that appealed to them. However, it was frustrating for Teacher Researcher D to create multiple centers and have the students not utilize all of them. It was disappointing to see that many students stayed within their comfort zone when choosing a center.

The teacher researchers felt that developing activities for student choice may have taken longer than necessary. Rather than developing three complicated projects, the teacher researchers could have done something as simple as allowing students to choose a certain number of problems to complete. On the positive side, student participation increased because students felt they were able to choose their work and have more direction over their own curriculum.

Two weeks of the research project were dedicated to implementing lessons using Howard Gardner's Multiple Intelligences. Gardner suggests that each individual has the ability to learn in many different ways, yet we all have one preferred learning style. For example, some students are able to visualize ideas and concepts while others students have an easier time understanding concepts when manipulatives are used. Gardner lists eight different forms of intelligences:

linguistic, logical-mathematical, visual-spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, and naturalist.

Each teacher researcher developed lessons and activities using multiple intelligences. Teacher Researcher A used the visual-spatial intelligence when students explored parallel and skew lines by drawing in perspective. This was an engaging lesson because it brought up topics from art class and became cross-curricular. The students who were very interested in art were given the opportunity to shine and share their knowledge with the class by defining such words as horizon line and vanishing point. Teacher Researcher B used many of the multiple intelligences during the entire research process. One example was when students were asked to solve simple addition problems. Popped popcorn was set on the tables for the students to demonstrate each addend. This was a very effective way to teach addition to kindergarten students because the popcorn enticed each student into trying addition. When the students were done with their addition worksheet, they were able to eat their popcorn. This particular activity asked the students to use their hands to move the popcorn (bodily-kinesthetic) into place and also allowed student to see (visual-spatial) the math problem in front of them. Teacher Researcher C used bodily-kinesthetic through the use of manipulatives to teach various math concepts. During one lesson students were asked to demonstrate their knowledge of place value by using connecting cubes. This was a positive learning experience because the teacher could identify which students understood the concepts and who needed additional help. Teacher Researcher D used multiple intelligences when teaching students how to regroup. The activity began by Teacher Researcher D writing a double digit addition problem on the board. Students were used as the addends and Teacher Researcher D demonstrated how to regroup by moving the smaller

group to the larger group to make the next ten. This was a successful lesson for the students because it allowed them to visualize the regrouping taking place.

The teacher researchers felt that the lessons using Gardner's Multiple Intelligences were very easy to implement in the classroom. Students were motivated by the various activities and it was discovered that many students excelled in more than one multiple intelligence.

The idea of one teaching strategy or lesson fitting all students is not appropriate for today's classrooms. To actively engage and push each student to reach their fullest potential, some accommodations must be made. One way to accommodate for the many levels in today's classrooms is to differentiate assignments to suit individual needs. This can be done as easily as making a three-tiered practice worksheet. The lowest students would be responsible for demonstrating a basic understanding of the concept while the higher achieving students would be asked to synthesize the ideas. By making simple modifications to the application, the content is still being taught and the student is being challenged at their individual level.

The final intervention of this research project was implementing differentiated assignments. This intervention was aimed at reaching each student at his/her ability level with the hope of increasing student performance. Teacher Researcher A differentiated a chapter review assignment. A worksheet for lower level students was designed with a word bank with only the words necessary to complete the assignment. Another worksheet had a word bank with extra words; this was developed for the average ability students. The highest achieving students received a worksheet that did not have a word bank. This proved to be a positive learning experience for the students. When it came time to review the assignment with the class, Teacher Researcher A was pleased that some of the low level students were able to answer the questions that the higher students could not because they had the help of the word bank. This seemed to

increase student participation and confidence. When completing a chapter on money identification and value, Teacher Researcher B designed a shopping activity for her kindergarten students. Each student was able to select a classroom item he/she wanted to purchase and the students were given pretend coins to buy their selected item. The higher level students were given a combination of pennies, nickels, and dimes to shop with. The lower level students were only given pennies to shop with so that they would not be overwhelmed. This activity was successful because it allowed the students to move around the room and each student was within his/her comfort zone when making a purchase. Teacher Researcher C used a challenge sheet for students who were excelling at the math concepts. Students were asked to complete enrichment activities based on the concepts covered. Students enjoyed the activities but became frustrated because they did not have sufficient time to complete the activities. Teacher Researcher D differentiated an assignment on regrouping. The low to medium students were given regrouping problems as a practice activity. The above average students were given addition problems that had one addend and the sum. The challenge was to calculate the missing addend. This was a positive experience for all students because it demonstrated their individual strengths and everyone was successful.

I, Teacher Researcher A, used the normal review day before a test to develop a worksheet that implemented differentiated instruction. Normally I would use the same worksheet for the entire class but I made three different versions of the same worksheet, each focusing on low, middle, and higher achieving students. I then distributed them to the respective levels of students in my class based on quiz scores from the chapter. Please see Appendix I for the three versions of the worksheet. I differentiated the worksheet by adding or removing two things: a word bank, and a similarity statement. The lower version included a word bank with the vocabulary words

that students would need to fill in the blanks of definition statements. The middle version also included a word bank with words used to complete the statements, but it also had extra words as distracters that made it more challenging. The higher level version had no word bank at all. I think the lower ability students that would normally just skip the “fill in the blank questions” took the time to look through the word bank and truly try and answer the questions rather than just give up and leave them blank. Also, when it came time to go over the answers to the vocabulary statements, the lower achieving students got the opportunity to say the answer and feel proud of themselves because the highest achieving students were completely stumped and could not blurt out the answer first. The second way I made the worksheet more challenging was that I left off the similarity statements for the similar figures for the practice problems on the second page. The higher achieving students had to write their own statement or deal without it while the lower achieving students could refer to the statement to help them set up proportions and solve for missing sides. By including the similarity statements, it effectively removed one step to the problem but still asked students to demonstrate they knew how to use proportions to solve for sides of similar objects. This helps avoid discouraging students that are more likely to make a small mistake with the set up and get an entire problem wrong even if they understand and can correctly do most of the problem.

One specific lesson I, Teacher Researcher B, implemented in my kindergarten classroom focused on simple addition. I designed this particular activity to incorporate student interests by using multiple intelligences. I also differentiated the problems my students were given to accommodate the variety of ability levels. Prior to introducing this lesson, I wrote a math problem on a sentence strip for each student in my class. The problems varied in difficulty from 0 + 0 up to 10 + 10. Each problem was labeled with a student name which easily allowed me to

distribute the assignment. After I briefly reviewed the concept and vocabulary of addition, the students were asked to color and cut out a picture of a ladybug. Then, they were given a piece of construction paper that already had their addition problem attached to it. After gluing down the ladybug, each student was given black paint and asked to paint the correct number of spots on each wing of the ladybug using the addends in their problem. When they were done painting, they were asked to count the number of spots and write the answer to their addition problem on sentence strip. We covered each answer with a leaf and proudly displayed the ladybugs in the hallway for other students to practice their addition.

I believe each student enjoyed this lesson. The students who usually struggle with addition were able to easily complete this assignment with little assistance. The students who were given the problems with higher numbers enjoyed the challenge. Each student successfully solved their math problem by counting up the number of spots on their ladybug. I feel this lesson was beneficial because it allowed my students to move around and be creative while they worked. Also, by designing the problems to meet the students at their at their particular ability level, it allowed each student to comfortably and confidently finish the assignment. Please refer to Appendix J to view a student example of this assignment.

I, Teacher Researcher C, incorporated multiple intelligences, student choice, and adapted the lesson using the Challenge Sheet found in Appendix K. The Challenge Sheet was given to students who excelled at the material being covered. These sheets were given out on a weekly basis. Students were first asked to complete a certain number of questions from the material covered. Once the required work was finished, students were given six choices of enrichment activities. These six choices related to different intelligences and gave the students an opportunity to apply the math concept.

While we were working on place value, one student chose the card game option. This student made up a game similar to ‘War’ with a twist. Two cards were flipped over and students were to add the numbers together. Once the numbers were added, students had to identify how many tens and how many ones were in their answer. For example, 5 + 7 = 12 this would be one ten and two ones. As a challenge, they made the ace cards worth 100. I thought this was a great game and implementation of using the math concepts.

I liked using the Challenge Sheet because I could give my attention to the struggling students while the excelling students had something meaningful to keep them occupied. The Challenge Sheet did not require additional planning or preparation on my part and was easy to implement. I also think there were drawbacks to using the Challenge Sheet. My first concern was that students did not have enough time to finish the challenge activities during the allotted time. Finding time for students to work on finishing the activities proved to be difficult. I would have liked to give every student an opportunity to try the Challenge Sheet. Unfortunately, with the varied abilities, struggling students were unable to complete the activities because they needed additional help with the basic concepts.

The Challenge Sheet did leave me with a few questions to ponder. The Challenge Sheet would give struggling students an opportunity to use the math concepts in a new way, which I believe would help them to understand the ideas better. This could be used as a collaborative learning activity, pairing high and low students, to help one another. I think that I would like to try using the Challenge Sheet again next year, but I will not use it for only excelling students. I would like to use the Challenge Sheet as a morning activity that students can work on each day. This will give each student the opportunity to be creative with the math concepts and build understanding.

I, Teacher Researcher D, used ability folders, found in Appendix L as one way to implement differentiated instruction in my math class. At the beginning of the week each student was given a folder that included re-teaching or enrichment activities. There was an activity for each lesson that was going to be taught that week. The re-teaching activities were given to students that needed more support and the enrichment activities were given to the students that were on level or needed a challenge. The students would keep these folders in their desk and complete them when the lesson had been taught. Each week new activities would be placed in the student's folders. This activity seemed to work well for the students. It gave them confidence because they were able to complete the activities in the folder independently and successfully. Along with the activity folders being successful for the students, it was also successful for me. It allowed me to pull students that needed more one-on-one support. I look forward to using this in the future.

I, Teacher Researcher A, found that implementing semi-regular lessons involving differentiated instruction can be an effective best practice in some classrooms. During my first five years teaching, I struggled to get a firm grasp of the curriculum and hone my classroom management skills. I thought that an effective teacher had students in rows, in their seats, taking notes off the board and that automatically equated to learning. It was only recently that I have tried to improve my classroom instruction and alter my dependence on teacher-centered delivery of curriculum. Lecturing bores many students and taking notes off the board does not necessarily mean students are paying attention and, most importantly, learning. I assumed that "that is the way I learned best so this is the best way to teach." Rather, some students learn best from peers, from hands-on activities, discovery activities, or even just doing the homework problems. Differentiated instruction addresses this difference in student learning and adds variety to the

classroom to keep students interested. With that being said, I do not believe that it can be effective in every situation and it is not the ultimate teaching technique. The reality of trying to differentiate the entire curriculum is very difficult though and I agree with Wehrmann when she advocates taking baby steps toward differentiation and slowly building up your resources (2000). During the intervention, I differentiated just two classrooms of lower level students and the difference between the two classes when I tried to do particular differentiated lessons was enormous. One class could not handle the computer lab because of maturity issues while the other class preferred to learn through lecture and wanted me to tell them the relationships with given quadrilaterals. Sometimes it depended on the day of the week, not just the class. For instance, on a Monday when the students are quiet and focused, I would rather do a lecture. On a Friday when the students are rambunctious, I would love to do a multiple intelligence based discovery activity. Implementing this intervention has given me more practice evaluating different classrooms as well as individual student needs and strengths. Being flexible is something that I have always counted as a strength of mine and I believe that this challenging project made me get out of my comfort zone and challenged me to experience another method of delivering content to my students.

Throughout the 14 weeks of this project I, Teacher Researcher B, feel I have learned a great deal in regards to what my students enjoy about math. Prior to implementing this research project in my classroom, I would feel guilty if an administrator walked into my room and I was not formally teaching my students. I now know it does not take a worksheet to validate that I am teaching a concept to my students. I discovered that even though a game is being played, learning is taking place. My five and six year old students enjoy playing math games. It does not matter what topic the game is about or who they are paired up with, they love it. They enjoyed

the games so much that I was asked several times throughout this research project if they could play them again. I also found that my students were eager to participate in math knowing that they were not going to be sitting and completing a worksheet each day. The activities I introduced that allowed for movement and used manipulatives were typically the most successful. Five and six year old students need the opportunity to move, and giving them the choice of manipulatives allowed my students to comfortably complete activities on their own. Throughout this research project, I was teaching what I consider to be difficult concepts for kindergarten students to comprehend: telling time and money. By developing as many hands-on activities as possible, I believe my current students performed better than my students in previous years.

When I began to research the solutions to varied ability, I was excited to learn about the many aspects of differentiation and the opportunity to implement ideas with my students. I quickly discovered that it would not be as easy as I initially thought. Finding appropriate planning time to differentiate my math lessons was difficult. Also, I wanted to allow my students freedom to select which math activities interested them. I did this by developing several math centers and allowed my students to decide what activity they preferred. Allowing for several choices of activities led to a problem; my students constantly needed reminders to stay on task. Many students also had trouble remembering the directions of the different activities and unfortunately at this age they are not able to read directions independently. This led to many interruptions during the time I had hoped to work with lower level students. After two weeks of trying many activities with student choice, I began to focus my attention on differentiated assignments, multiple intelligences, and cooperative learning activities. That decision positively

impacted the remaining eight weeks of the research project. I felt more relaxed and the students were able to complete activities with less confusion.

As I spent time reflecting on my weeks of research, I do feel that differentiation can be a very positive, and at times frustrating, way to instruct students at their individual levels. However, when implementing differentiation strategies, it is important that teachers do not take on more than they can actually handle. I have learned to begin small, with one unit of study, and as you become more comfortable, expand the amount of differentiation strategies you use with students. The knowledge and ideas I have gained throughout this research process will give me the opportunity to be a better educator for my future students.

As a result of implementing this project and these interventions I, Teacher Researcher C, feel that there are some aspects of my teaching that have been affected. For me this has been a very challenging and sometimes frustrating process. Lack of planning time, resources, support, and classroom management knowledge left me feeling inadequate to successfully differentiate at various levels. These were some of the same problem areas that were found by other researchers. My first struggle was planning time. I was only differentiating for one subject and found myself needing more time to plan. Being a primary teacher, and teaching all subjects, I cannot imagine the amount of time it would take to differentiate for each subject. There has to be an easier way to plan and make differentiation successful and possible. Classroom management was another struggle. Planning activities to successfully engage all students in meaningful activities was extremely difficult. It was hard for me to be working with a small group while other students would be done and asking what they should do next. Another aspect was timing; trying to find activities that would be able to be completed by different students in an allotted amount of time. Some of the challenge activities required more than one class period; while the regular classroom

work could be completed quickly. I felt success and failure with using differentiation in my classroom. My students and I loved using cooperative learning. Working together is a lifelong skill that I feel needs to be introduced and used in education. When students work together they learn how to problem solve and compromise. They can help each other learn and sometimes explain the concept in ways I did not think of. I plan on continuing using cooperative learning strategies throughout my classroom. Hands-on learning was another area I felt was successful. This brought some excitement and motivation into our classroom and gave us a break from the norm of the traditional classroom environment. Students loved the hands-on approach. I felt that using manipulatives helped students to grasp abstract ideas and make them more concrete. In my opinion, the idea of differentiation in a classroom is just an idea for now. It sounds good on paper, but the practicality of it is so challenging! I would love to meet a teacher who has successfully differentiated and would be able to mentor and help me to make this a reality in my classroom. I do believe that differentiation is necessary. With the wide range of abilities and inclusive classrooms, whole-group instruction will not help all students to be successful.

I, Teacher Researcher D, have always been challenged with meeting the specific needs of every student in the classroom. It was not until I implemented this project, that I truly saw some light at the end of the tunnel. From the beginning, the literature gave me encouragement. I was relieved to see other people out there that were struggling with the same problem. It was also reassuring that there were many solutions that I could implement in my classroom. Suddenly, differentiating instruction became a little bump in the road as opposed to a mountain.

There were several encouraging things that I observed while implementing differentiated instruction in my math class. The first thing that stood out was that the students were excited when it was time for math. I saw my unmotivated students become motivated. It seemed as

though they were almost assured that they would understand the lesson that was going to be taught to them. Next, test scores improved, especially with the students that tend to struggle academically. I think that they were really able to benefit from the small grouping with mixed abilities. Finally, I was able to get a chance to challenge the high students. Without differentiating instruction it is really hard to make sure that they stay motivated. In the future, I look forward to differentiating other subject areas.

On the flip side, differentiating instruction does not come easy. It was very time consuming and I often found myself overwhelmed. I found that my weekly planning took me twice as long just to differentiate instruction in math; I could not imagine differentiating instruction for all subject areas. In theory this is a good idea but it is certainly not realistic for one teacher to do by themselves in a classroom with 27 kids. I will continue to use differentiated instruction in my classroom in hopes that the practice and experience will make it less of a challenge.

Presentation and Analysis of Results

The purpose of the research was to increase mathematical performance in a varied ability math classroom. Our post-documentation data was looking to validate the fact that multiple abilities existed in the classroom and the challenges this presented for inclusion teachers. The problem of varied abilities appeared to be an issue among the four teacher researchers. During the two weeks of pre-documentation between January 22, 2007 through February 9, 2007 the teacher researchers at both sites copied and distributed the teacher surveys. Fifteen primary teachers at Site A and 17 high school teachers at Site B were given the survey. Please refer to Appendix A for a copy of the teacher survey. Each teacher had two weeks to anomalously complete the survey. The results of the surveys were compiled at the end of the second week.

Parent permission forms were sent out during the two weeks of pre-documentation. Each teacher researcher began a 10 day observation checklist. Please refer to Appendix H to view a copy of the observation checklist. This checklist noted how many students were finished, on task, or still needing assistance five minutes after a math assignment was given. The children who did not receive permission to participate were eliminated from the observation checklist. Each teacher researcher found the observation checklist to be time consuming. Teacher researcher C felt that the students were showing the same ability levels daily and there was better overall performance when students understood the concepts covered.

Each teacher researcher developed an age appropriate student survey. The purpose of the survey was to find out the interests of the students. Please refer to Appendix B, Appendix C, and Appendix D to view a copy of each survey. Twenty-six high school, 36 second grade, and 17 kindergarten students participated in the surveys. The teacher researchers enjoyed reading the results of the student surveys. It was interesting to learn about the preferred activities of each grade level. Teacher Researcher B felt that her students were selecting the happy faces on each question just to please her. This raised questions regarding the validity of the kindergarten survey.

It was noted by all teacher researchers that the students who did not turn in a consent form were primarily the students who struggle academically and perhaps do not have parental support.

Observation Checklist

The teacher researchers completed a daily post-observation checklist during 10 consecutive school days, beginning on Monday, April 30, 2007, which was identical to the observation checklist done during pre-documentation. Teacher researchers recorded students'

behavior by indicating if they were on task, finished with their work, or still needing support five minutes after an assignment was given. Once work was complete, teacher researchers graded the student products they were recorded as satisfactory or unsatisfactory. A total of 718 observations took place during the two weeks. Please refer to Appendix H to view a copy of the observation checklist. A majority (64%, n = 463) of students were observed to be on task when an assignment was given. Twenty percent (n = 142) of students indicated that they needed help by asking questions or raising hands during the observation. When the assignments were graded, a majority (88%, n = 629) of students were completing work in a satisfactory manner.

As demonstrated in Figure 26 below, when comparing the pre-observations to the post-observations, the number of students that were on task increased after the intervention took place. Conversely, the number of students needing assistance decreased as did the amount of unsatisfactory work being turned in.

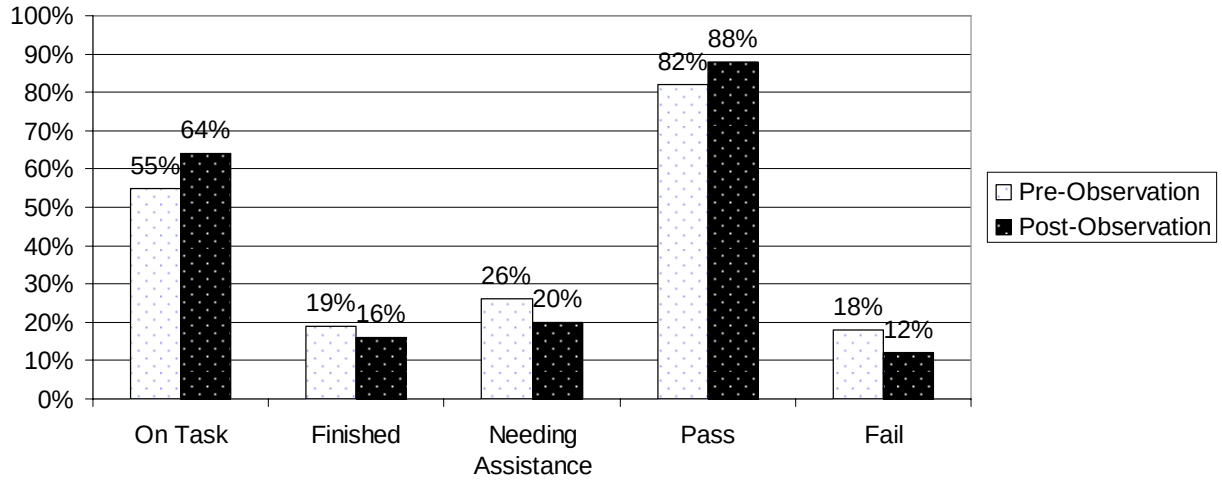

Figure 26: *Observations Before and After Intervention* (n=1491)

Pre- and Post-Tests

Teacher researchers administered this instrument before the beginning of each new unit to assess prior knowledge of a topic. This instrument was given again at the conclusion of a unit

as a post-test. Pre- and post-tests were identical and compared to see if student understanding increased due to differentiated instruction. Teacher researchers used this tool to guide instruction, look for areas of weakness and strength. Pre-test questions differed for each researcher depending on the curriculum to be covered. Please refer to Appendix E through G for Teacher Researcher A through Ds' pre/post-tests, respectively.

When compiling all pre- and post-test data as Figure 27 illustrates, there is a marked increase from pre- to post-test scores. The average score increase for all teacher researchers from the first test to the second is 35%.

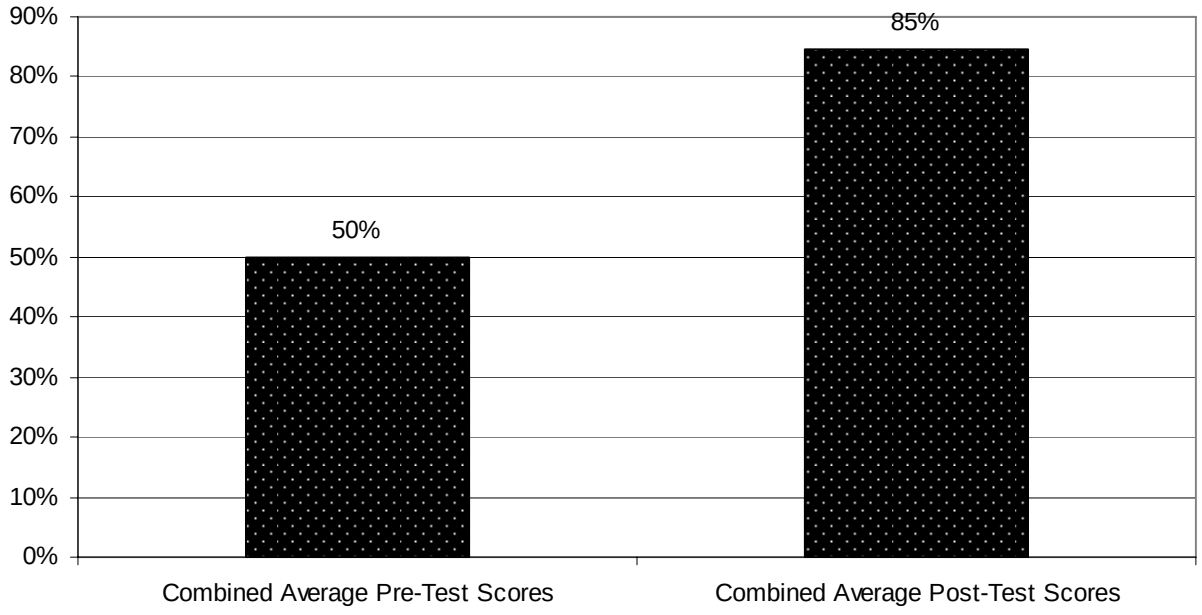

Figure 27: *Pre- Versus Post-Test Scores* (n=461)

Conclusions and Recommendations

After reviewing the results of our pre- and post-test data we noticed a noteworthy change in student performance. Looking at scores across the grade levels, during pre-testing the average score was 50% while post-test scores averaged 85%. However, we are unable to determine if

student success was based on interventions or the fact that the teachers had covered the concepts with the class between testing. Since the pre-tests focused on concepts that had not been covered it is believed that presenting the material will inevitably lead to student progress.

It was noted that students were very uncomfortable during pre-testing. This was demonstrated in their behaviors of relying on students around them, complaining, and second guessing their abilities. During pre-testing, some students thought they knew how to solve a problem and made-up their own steps. This caused a conflict when teachers were presenting the correct way to problem solve because some students reverted back to their own “made-up” steps. Pre-testing also led higher students to thinking they did not have to participate during class because they thought they passed the pre-test and understood the material. Due to a concern regarding a possible lack of participation, pre-tests were never handed back to students.

Looking at the observation checklist there was a 9% increase in on task behavior (Figure 26) and a 3% decrease in off task behavior. This change is attributed to the fact that students were engaged through cooperative learning during many activities. It is believed that when students are engaged in learning they are more likely to participate and stay focused. There was a 6 % decrease in students needing assistance; we credit this change to students working in groups and assisting one another. There was a 6% increase in satisfactory work; we believe this is due to the fact that some students are more comfortable asking questions to peers rather than a teacher. It is also believed that students can relate better to one another, often using more simplistic terms to explain concepts. We believe cooperative learning positively impacted student progress and we plan to continue implementing this strategy.

Overall, student performance increased. This leads us to believe that our interventions were effective in some way. We cannot credit this solely to differentiation because there is no

way to evaluate or compare it to another teaching strategy, unless we were to undertake another research project. As previously noted, students come into our class with different learning experiences and prior knowledge. Students may have performed better on pre- and post-testing because of a previous exposure to material rather than the differentiated interventions that were implemented. The results of the interventions can also be related to the time of the year and the curriculum covered. Curriculum concepts build on one another and later in the year students are usually asked to recall previously learned material and apply it to new concepts. Students are more familiar with the material which may lead to an increase in achievement. Also, our pre-observations were started before spring break when students are less focused on academic. This may have led to the increase in student performance we saw in our post-observations.

Having this experience has given us more knowledge and a starting point for implementing differentiated instruction in our classrooms. We have decided to eliminate pre- and post-testing in the future in an effort to eliminate unnecessary stress and/or confusion. Teachers can use informal anecdotal records to monitor student progress rather than administering a pre-test. A post-test should still be used to formally assess student progress.

In conclusion, we would like to continue to implement differentiation in our classrooms. With the varied abilities in today's classroom it is necessary to adapt teaching methods to meet different needs. This is something that cannot be implemented immediately and needs to be well thought out, planned, and gradually implemented. We felt the frustrations of planning time, time allotted for activities in the classroom, and changing teaching styles in the middle of the year. We feel these frustrations can be alleviated through proper training and resources.

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APPENDICES

Appendix A

Teacher Survey

Please answer the following questions based upon how you feel when teaching mathematics to your students. Your completed survey can be turned into _____'s mailbox.

Grade Level Taught: ____

1. There is a wide range of mathematic ability in my classroom.

1 2 3 4 5

Strongly Agree Agree No Opinion Disagree Strongly Disagree

2. My mathematic instruction meets the needs of each learner in my classroom.

1 2 3 4 5

Strongly Agree Agree No Opinion Disagree Strongly Disagree

3. Differentiated instruction is necessary for student success in math.

1 2 3 4 5

Strongly Agree Agree No Opinion Disagree Strongly Disagree

4. I have the knowledge, tools, and support to effectively differentiate my math instruction.

1 2 3 4 5

Strongly Agree Agree No Opinion Disagree Strongly Disagree

5. What frustrations do you have when teaching math to the various abilities in your class?

Please use the back for any additional comments
Thank you!

Appendix B

Student Survey **Name_____**
Period_____

I learn better by working with another student or groups of students

Strongly Agree	Agree	Disagree	Strongly Disagree
1	2	3	4

I would rather write about math than solve math problems

Strongly Agree	Agree	Disagree	Strongly Disagree
1	2	3	4

I wish I had the opportunity to work more with the teacher in a small group when I don't get it

Strongly Agree	Agree	Disagree	Strongly Disagree
1	2	3	4

The material covered in this class is too easy and I can do everything by myself

Strongly Agree	Agree	Disagree	Strongly Disagree
1	2	3	4

I would rather talk about math than solve math problems

Strongly Agree	Agree	Disagree	Strongly Disagree
1	2	3	4

I'm curious how math is used in real life

Strongly Agree	Agree	Disagree	Strongly Disagree
1	2	3	4

Briefly describe what you usually do after school. Include the type of video games you might play, or internet sites you might visit, etc…

Appendix C

Kindergarten Student Survey

Name_____

1) I like to play math games. ☺ ☹

2) I like to work all by myself. ☺ ☹

3) I like using cubes, squares, and counters during math class. ☺ ☹

4) I like to do math worksheets. ☺ ☹

5) I think math is easy. ☺ ☹

6) I like to listen to music when I work. ☺ ☹

Appendix D

Second Grade Student Survey

Name: _____

1.	I like to work by myself.	YES	NO
2.	I like to work with a partner or a group of kids.	YES	NO
3.	I like to use counters, cubes, and other Math pieces.	YES	NO
4.	I like to draw pictures to help me solve a Math problem.	YES	NO
5.	I like to do Math worksheets.	YES	NO
6.	I like to listen to music while I work.	YES	NO
7.	I like to do Math that involves me moving around.	YES	NO

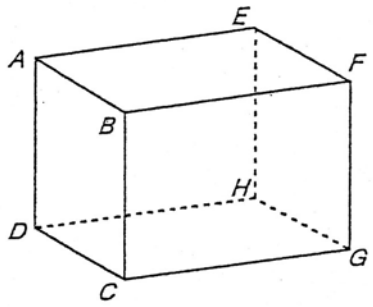
Appendix E

Name _____ Date _____

Chapter 7 Test

Name the segments in the prism that are parallel to the given segment.

1. $\overline{CG}$ 1. _____
2. $\overline{EH}$ 2. _____
3. $\overline{AB}$ 3. _____

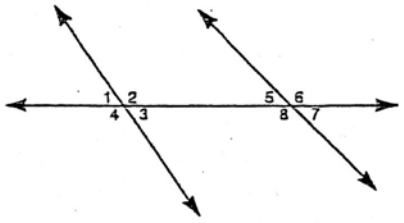


Name the segments in the prism that are skew to the given segment.

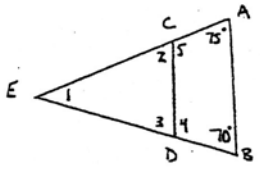
4. $\overline{AB}$ 4. _____
5. $\overline{EH}$ 5. _____
6. $\overline{CG}$ 6. _____

Identify each pair of angles as interior angles, corresponding angles, alternate interior angles, or alternate exterior angles.

7. $\angle 1$ and $\angle 5$. 7. _____
8. $\angle 2$ and $\angle 8$. 8. _____
9. $\angle 3$ and $\angle 8$. 9. _____
10. $\angle 4$ and $\angle 6$. 10. _____

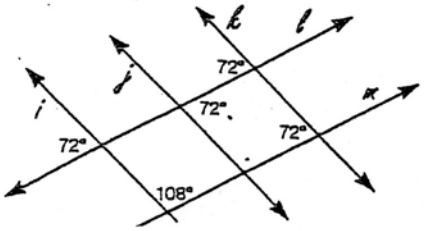


In the figure on the right, $\overleftrightarrow{AB} \parallel \overleftrightarrow{CD}$. Find the measure of each angle. 11. _____

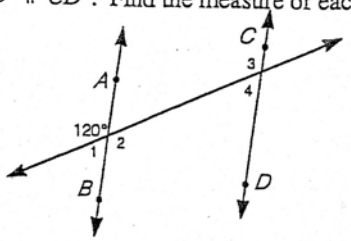


Tell why each given pair of lines are parallel.

12. i and j. 12. _____
13. j and k. 13. _____
14. i and k. 14. _____
15. ℓ and m

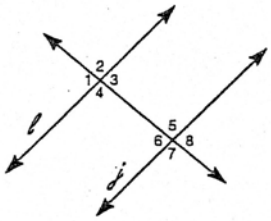


In the figure on the right, $\overleftrightarrow{AB} \parallel \overleftrightarrow{CD}$. Find the measure of each angle.



16. $m\angle 1$ — 16. _____
17. $m\angle 2$ — 17. _____
18. $m\angle 3$ — 18. _____
19. $m\angle 4$ — 19. _____

In the figure on the right, $\ell \parallel j$.

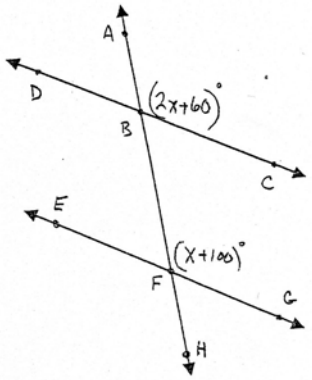


20. Which angles, if any, are congruent to $\angle 1$? — 20. _____
21. Which angles, if any, are supplementary to $\angle 3$? — 21. _____

For 22-32, answer the following questions for each drawing given two parallel lines and a transversal. Show all work!

22. Are the two angles shown AEA, AIA, CORA or IA? _____

23. Solve for x below and put your answer in the blank:

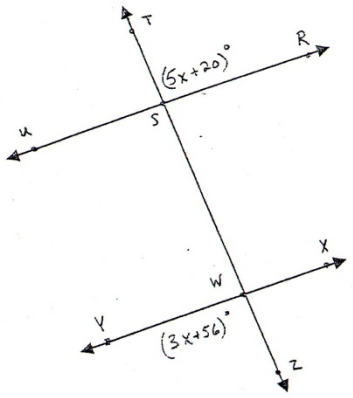


X = _____

24. What is the measure of <ABC? _____

25. Are the two angles shown AEA, AIA, CORA or IA? _____

26. Solve for x below and put your answer in the blank:



X = _____

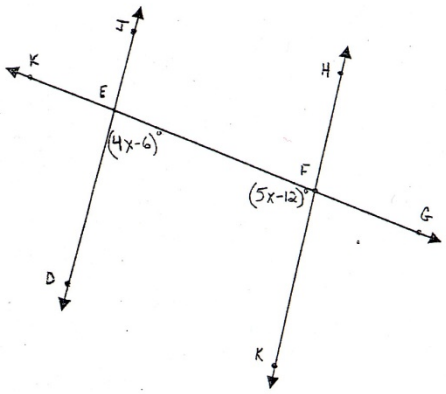
27. What is the measure of <RST?_____

28. What is the measure of <YWZ?_____

---

29. Are the two angles shown AEA, AIA, CORA or IA? _____

30. Solve for x below and put your answer in the blank:



X = _____

31. What is the measure of <DEF?_____

32. What is the measure of <EFK?_____

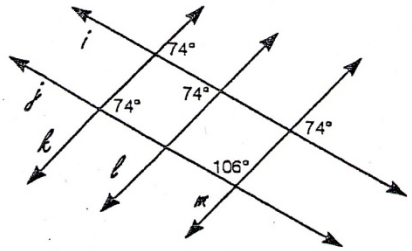
Tell why each given pair of lines are parallel.

33. k and ℓ.

34. ℓ and m.

35. k and m.

36. i and j.



33. _____

34. _____

35. _____

36. _____

Name the segments in the prism that are parallel to the given segment.

37. $\overline{BC}$

38. $\overline{EF}$

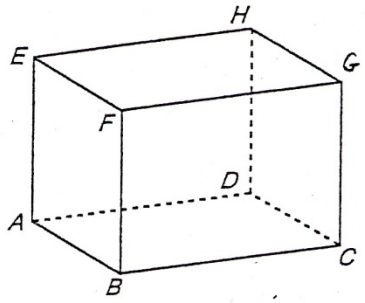
39. $\overline{DH}$

Name the segments in the prism that are skew to the given segment.

40. $\overline{BC}$

41. $\overline{EF}$

42. $\overline{DH}$



37. _____

38. _____

39. _____

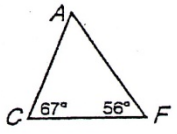
40. _____

41. _____

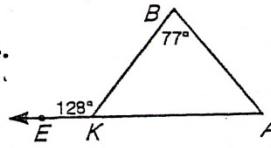
42. _____

Find $m\angle A$ in each figure.

43.



44.

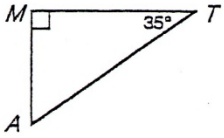


43. _____

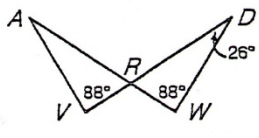
44. _____

Find $m\angle A$ in each figure.

45.



46.



45. _____

46. _____

Appendix F

Name _____

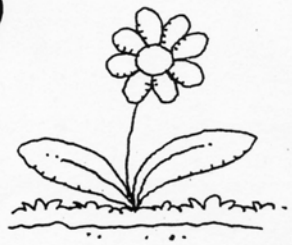
Chapter 7 Test Form A

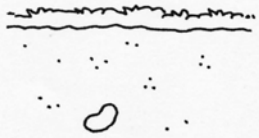
1

MAY

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
5	6	7	8	9	10	11

2



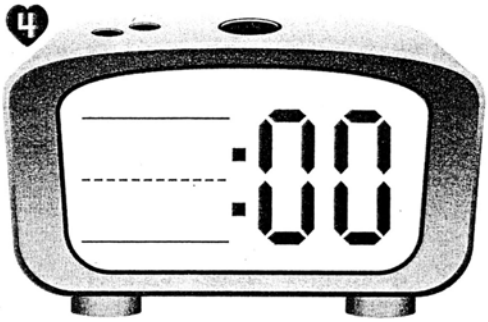


_____ _____ _____

_____ _____ _____

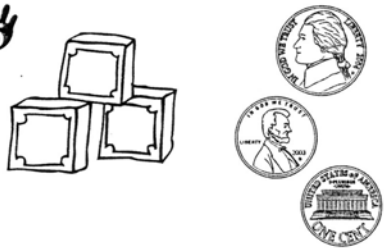
3

4



8 o'clock

5



_____

_____

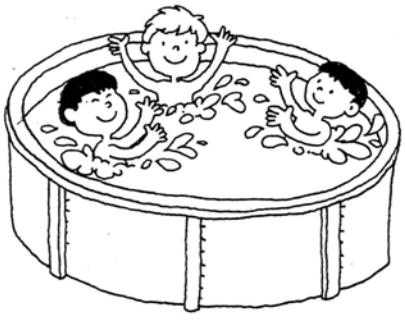
_____ ¢

_____

_____

_____ ¢

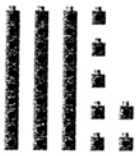
6



Directions Have children: 4 show 8 o'clock by writing the number on the digital clock and drawing the hour hand on the analog clock; 5 write the value of the coins and circle the toy that costs more; 6 circle the picture that shows winter.

Appendix G

-

❶ 

____ + 20 = ____

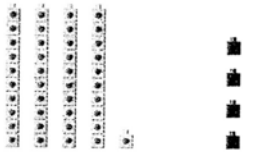
❷ 

____ + 30 = ____

Add ones. Use mental math or cubes.

❸ 

23 + 8 = ____

❹ 

41 + 4 = ____

Add. Use mental math or cubes.

❺ 52 and 

____ + ____ = ____

❻ 70 and 

____ + ____ = ____

Add on to find the other part of 100.
Use mental math or cubes.

❼ 25 and _____ is 100.

❽ 90 and _____ is 100.

Estimate. Circle **yes** or **no** to answer the question.

❾ 

You have:	Can you buy these toys?	Answer:
50¢	 and 	yes no

Name _____ Diagnostic Checkpoint

Put cubes on Workmat 4.
Subtract. Regroup if you need to.

Show.	Subtract.	Do you need to regroup?	Find the difference.
❶ 41	6	_____	41 − 6 = ____
❷ 78	8	_____	78 − 8 = ____

Subtract. Regroup if you need to.

❸

Tens	Ones
4	5
− 3	7

Tens	Ones
9	3
− 6	8

Tens	Ones
7	2
−	4

Tens	Ones
6	6
− 4	1

Write the subtraction problem. Find the difference.

❹ 91 − 63

Tens	Ones
−	

48 − 14

Tens	Ones
−	

53 − 29

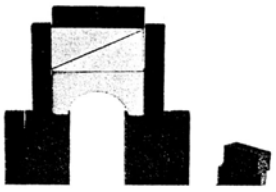
Tens	Ones
−	

74 − 61

Tens	Ones
−	

Write a number sentence to solve the problem.

❺ Ben counted 34 blocks.
Kay counted 27 blocks. How many blocks did they count altogether?



Tens	Ones

( ) ( ) blocks

Name _____ Diagnostic Checkpoint

Add. Regroup if you need to.

Show.	Add.	Do you need to regroup?	Find the sum.
❶ 19	6	_____	19 + 6 = ____
❷ 27	4	_____	27 + 4 = ____
❸ 75	2	_____	75 + 2 = ____
❹ 54	8	_____	54 + 8 = ____

Add. Regroup if you need to.

❺

Tens	Ones
□	
2	4
+	7

Tens	Ones
□	
3	3
+	5

Tens	Ones
□	
6	7
+ 2	8

Tens	Ones
□	
1	3
+ 4	9

Write the addition problem. Find the sum.

❻

77 + 16

Tens	Ones
□	
+	

36 + 45

Tens	Ones
□	
+	

21 + 29

Tens	Ones
□	
+	

58 + 10

Tens	Ones
□	
+	

Appendix H

Observation Checklist – Pre-Documentation

Day	On Task	Finished	Needing Assistance	Performance
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Appendix I

Chapter 9 Review – Name_____

Date_____

Fill in the missing blanks with vocabulary words from the chapter:

1.) Ratios can be written _____ different ways.

2.) The number that you multiply the original lengths by to get the new length is called the _____.

3.) Fractions can also be called _____.

4.) A _____ is formed when two ratios are equal.

5.) If I am comparing two numbers with different _____, I need to convert one into the other before I reduce the ratio.

6.) Ratios always need to be _____.

7.) If two figures are similar, they have the same _____ but different _____.

8.) When we did the computer lab, we examined _____ with all sorts of scale factors.

9.) A scale factor of _____ than one increases the size of the pre-image.

10.) A scale factor of _____ than one decreases the size of the pre-image.

11.) A scale factor of _____ keeps the size of the image the same as the pre-image.

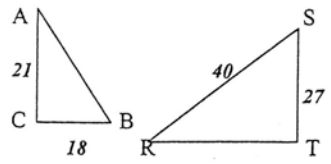
12.) To solve proportions, we _____ and solve for the unknown values.

Word Bank

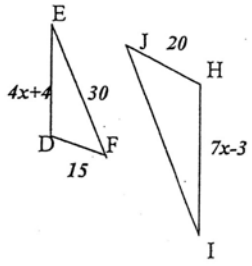
less	size	three
cross multiply	shape	more
units	one	reduced
proportion	ratios	dilations
	scale factor	

Solve for the missing sides of the similar triangles:

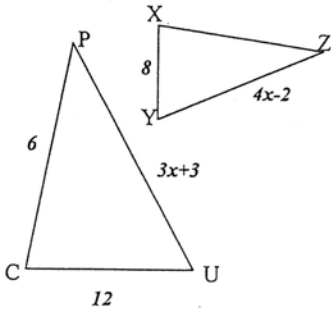
13.) $\Delta ABC \sim \Delta RST$



14.) $\Delta DEF \sim \Delta HIJ$

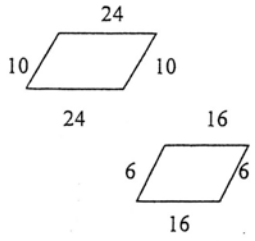


15.) $\Delta CUP \sim \Delta XYZ$

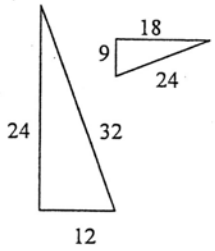


Are these figures similar, and if so, what is the scale factor from left to right?

16.)



17.)



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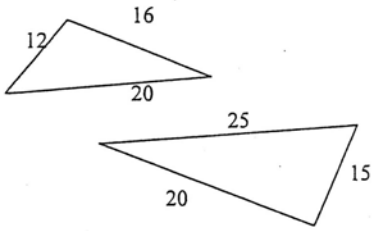


Chapter 9 Review **Name**_____

Date_____

Fill in the missing blanks with vocabulary words from the chapter:

1.) Ratios can be written _____ different ways.

2.) The number that you multiply the original lengths by to get the new length is called the _____.

3.) Fractions can also be called _____.

4.) A _____ is formed when two ratios are equal.

5.) If I am comparing two numbers with different _____, I need to convert one into the other before I reduce the ratio.

6.) Ratios always need to be _____.

7.) If two figures are similar, they have the same _____ but different _____.

8.) When we did the computer lab, we examined _____ with all sorts of scale factors.

9.) A scale factor of _____ than one increases the size of the pre-image.

10.) A scale factor of _____ than one decreases the size of the pre-image.

11.) A scale factor of _____ keeps the size of the image the same as the pre-image.

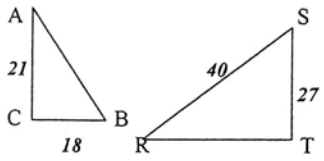
12.) To solve proportions, we _____ and solve for the unknown values.

Word Bank

less	size	three	proportion	ratios
cross multiply	shape	more	dilations	fraction
units	one	reduced	scale factor	negative
mini-me	zero	angles	similarity	comparison

Solve for the missing sides of the similar triangles:

13.) $\Delta ABC \sim \Delta RST$



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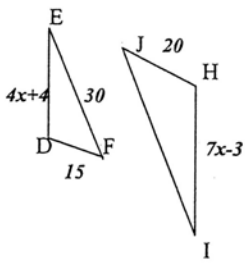

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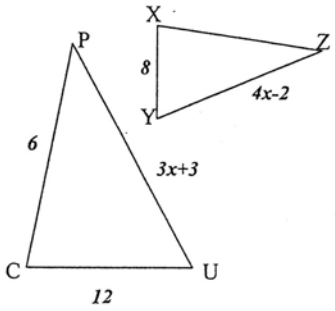

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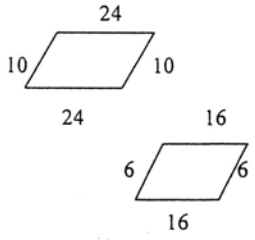

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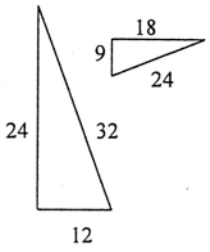
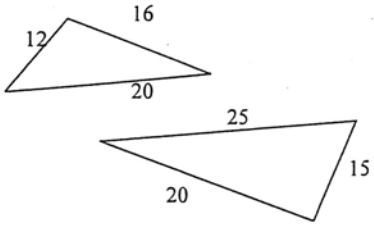


18.)



Chapter 9 Review – Name_____

Date_____

Fill in the missing blanks with vocabulary words from the chapter:

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2.) The number that you multiply the original lengths by to get the new length is called the _____.

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Word Bank

less	size	three
cross multiply	shape	more
units	one	reduced
proportion	ratios	dilations
	scale factor	

Solve for the missing sides of the similar triangles:

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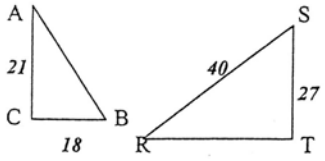

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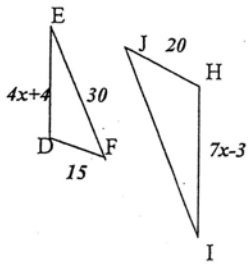

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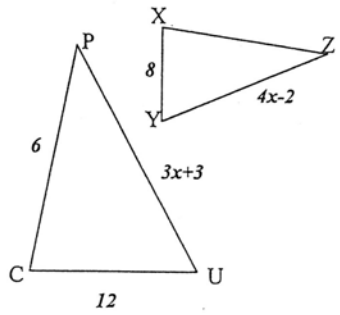

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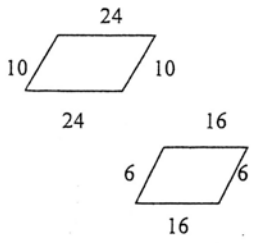

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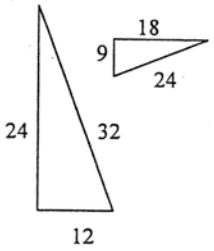

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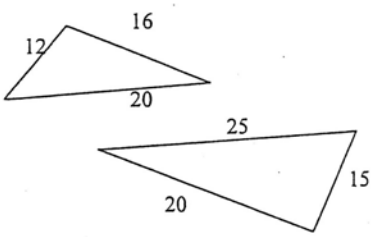
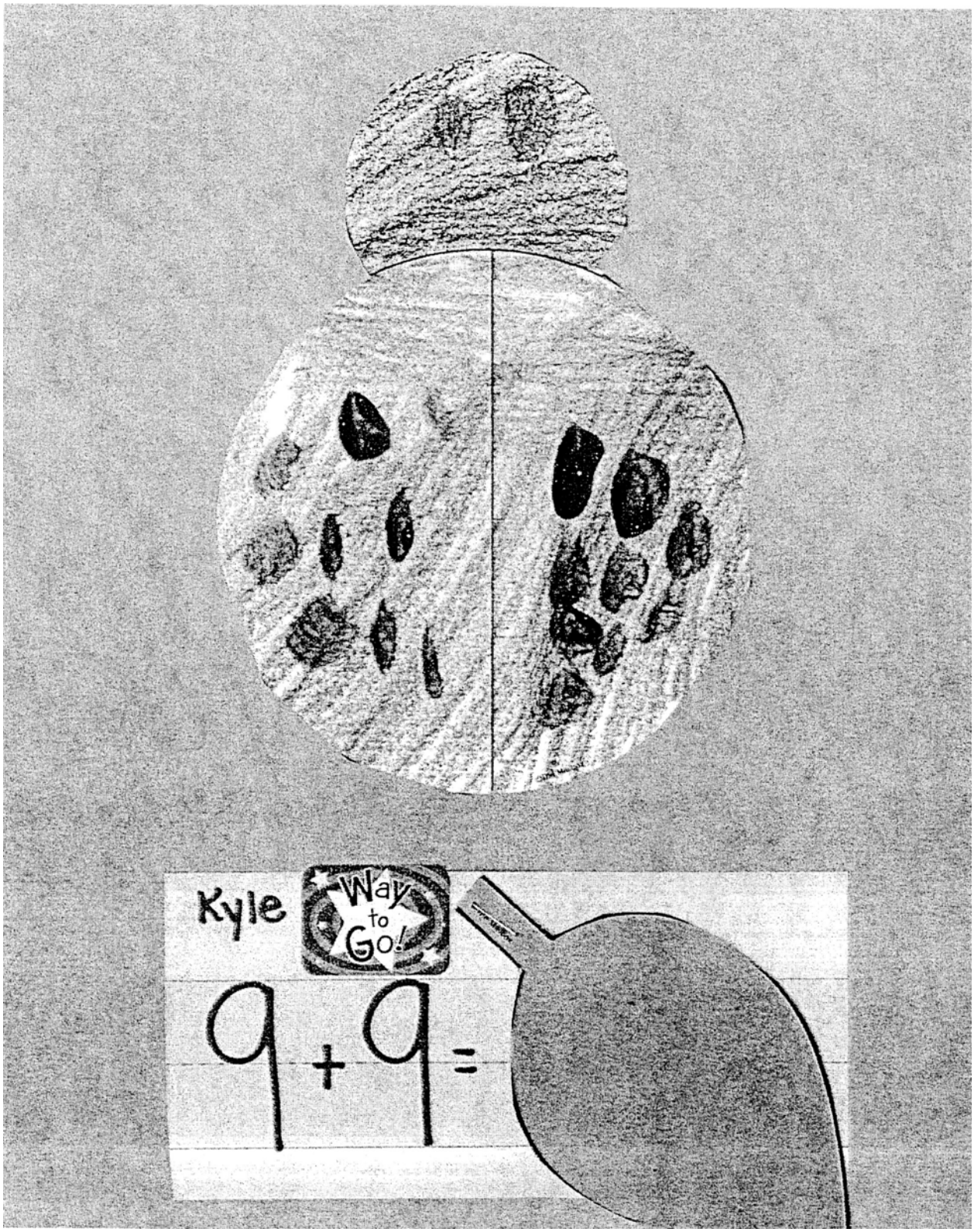


Appendix J



Appendix K

Name: _____

*** Challenge Sheet ***

Must Do …

Do Number _____ on page _____

Do Number _____ on page _____

When finished, choose an activity …

- Make up a shopping trip to the mall. Use the concepts presented in the lesson.
- Write a song that includes the math from this lesson.
- Write up questions about the math lesson, and ask someone in the class to answer them. Write down his or her answers.
- Write a paragraph about how you felt about the math concepts from this lesson. Where they easy? Hard? How did you figure them out?
- Draw a book cover for a math book based on this lesson. Be sure to include a title and illustrations that include the specific topic of the lesson.
- Make up a card game that includes the concepts from the lesson. The concepts might be used in the process of playing or in the rules for scoring. Play it with a friend.

Appendix L

Advanced Learners

Adding Three Numbers

5–10 MIN **Logical/Mathematical**

PAIRS

- Have one child write an addition problem with two multiples of 10 and a third one-digit number (e.g., 20 + 30 + 7).
- Have a partner add the multiples of 10 first, using mental math.
- Then have the other partner add that sum to the remaining number, using mental math.
- Have partners check each other's work.
- Have children switch roles and repeat.

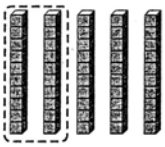
Name _____

What's Missing?

E 4-1
ALGEBRA

Circle the tens that make each addition sentence true.
Then write the number.

1. 35 + 20 = 55



2. 28 + _____ = 68

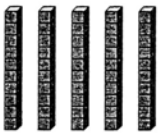
3. 42 + _____ = 72

4. 53 + _____ = 63

5. 31 + _____ = 81

6. 36 + _____ = 76

7. 73 + _____ = 93



8. 18 + _____ = 48

Reteaching

Adding Groups of Ten

10–15 MIN **Visual/Spatial**

Materials *(per group)* Connecting cubes

- Have one child create a group with more than 10 cubes and say the number of cubes.
- Then other group members count out 10 cubes each.
- Have one child add his or her group of 10 cubes to the pile and state the new total.
- The next child checks the previous child's total and adds his or her own 10 cubes to the total.
- Have children continue in this way until each group member has had a turn checking and adding.

17 + 10 = 27

27 + 10 = 37

Name _____

Adding Tens

P 4-1

Add tens. Use mental math or cubes.

1. 

35 + 20 = 55

2. 

_____ + 40 = _____

3. 

_____ + 40 = _____

4. 

_____ + 10 = _____

5. 

_____ + 30 = _____

6. 

_____ + 20 = _____

7. 

_____ + 10 = _____

8. 

_____ + 30 = _____

Problem Solving *Number Sense*

9. Allie had 38¢. On Thursday she found 10¢, and on Friday she found 10¢ more. How much money does she have now? _____¢