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Leaving the Traditional Classroom: A Look at Direct Instruction versus Differentiated instruction

Robert D. Dunham
St. John Fisher College

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The purpose of this study is to determine the effect of pedagogy on a students' performance on their formal assessment at the end of a unit. In the literature review direct instruction and differentiated instruction are compared and contrasted as the articles are synthesized to offer insight on the opposing views of instruction. In this study two classes were taught the same content for a unit; one class was taught by direct instruction while the other class was taught via differentiated instruction. Results indicated that students can be successful in learning the content no matter which method was used to convey the content. Nevertheless there were still some contrasting results found within different factions of the students.

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Dedication

I would like to dedicate this research paper to my parents, whose decision to leave their home in Rochester, NY back in April of 1982 and make the pilgrimage to Medeiin, Colombia to take a chance on a malnutritioned infant presented me with more opportunities then I could have ever dreamed possible. Their undying love, dedication and support are the pillars which serve in my growth as an individual and as a professional. For this is I am truly grateful.

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A Look at Direct Instruction versus Differentiated Instruction

At the University of Illinois during the 1960's Siegfried Engelmann and Wesley Becker were two of the first educators to research and document information regarding direct instruction (Heward, 2000). According to Heward (2000), two major rules underlie direct instruction: (1) teach more in less time, and (2) control the details of the curriculum. However, Tomlinson, Brighton, Hertberg, McCallahan, Moon, Brimijoin, Conover, and Reynolds (2003) found that in today's educational system there is an emphasis on heterogeneity and special education inclusion, combined with an increase in cultural diversity in classrooms which makes the challenge of serving academically diverse learners in regular classrooms seem an inevitable part of the teacher's role. With this burden put upon teachers to ensure the education of all students, comes a need to differentiate how the content is taught (Tomlinson et al., 2003). As a result the need for responsive instruction as opposed to a traditional pedagogy may lead to a change in the educational system as it is known (Tomlinson, et al., 2003).

Direct instruction was defined by Magilaro, Lockee and Burton (2005) as "an instructional model that focuses on the interactions between teachers and students. Key components of direct instruction include modeling, reinforcement, feedback, and successive approximations" (p. 41). This type of teaching style is still used in the classroom today and whether or not it can be useful under certain conditions will be explored thoroughly in this study.

With Howard Gardner's (1983) *Frames of Mind* came the birth of the multiple intelligences theory (Armstrong, 1994). The idea that people have a single intelligence which French psychologist Alfred Binet had conjectured and labeled "g" for general intelligence, was countered by Gardner who developed a set of eight criteria as to what counts as intelligence (Gardner, 2005). It was from the idea of these eight intelligences that differentiated instruction started to make its way into educational discussions, although history shows that differentiated instruction has been around for thousands of years.

The idea of differentiated instruction has been around since the time of the ancient Greek philosopher Socrates. Only during his time they did not refer to his Socratic Seminars as a means of differentiated instruction. The Socratic method of teaching is based on Socrates' theory that the teacher should use questioning to guide the discussion to the subject matter, with the process as important as getting the correct answer (Koellner-Clark, Stallings, & Hoover, 2002). The use of questioning to clarify and extend students' thinking creates an inquiry-based learning environment which is a form of differentiating instruction (Koellner-Clark et al., 2002). Socrates' idea of letting students learn via discovery has come to the forefront of the educational community today (Koellner-Clark et al., 2002).

Consider Jean Piaget's philosophy of constructivism (Capon & Kuhn, 2004) where the students construct knowledge as a result of their actions with the environment whether it be physical or mental (Harlow, Cummings & Aberasturi, 2006). Along with John Dewey's philosophy of pragmatism (Koellner-Clark et al., 2002) which allows students to bring situations they have experienced outside of the classroom into daily classroom discussion (Heaven, 2007). Combined with Lev Vygotsky's idea of the zone of proximal development (Kapusnick & Hauslein, 2001) that places students on the verge of academic independence in an environment slightly beyond their competence with assistance from a peer tutor or an adult to give them the help so that they may reach beyond their current competence level (Lynch, 2007). All of these educational philosophies lend themselves to the idea of learning by questioning, which carries with it a very Socratic flavor. The ideas conceptualized by these men are studied tirelessly by education majors worldwide today, and the methods so thoroughly described by the forefathers of education are implemented in daily school settings.

Are the forefathers of education correct in their teaching through exploration ideas with minimal direct instruction or will students find more academic success when they are taught solely by direct instruction? It is this question which invigorates the quest to see how students can best be taught and maximize their academic potential.

This study will investigate direct instruction, its influences in today's classroom and outcomes as a result of using direct instruction. Differentiated instruction will also be investigated along with the rationale behind differentiated instruction and examples of differentiated instruction. The results of using both pedagogies will be thoroughly analyzed and compared to see if either lends itself to be of greater use in the classroom.

Literature Review

The essential question asked by educators of themselves is: What will it take to modify instruction to ensure that all learners come away with an understanding that lends itself to the next phase of learning (Tomlinson, 1999). There is no simple answer to the aforementioned question. The research will point in a variety of directions which lends itself to situational-based answer system. Currently, the role of direct instruction has diminished as a means of teaching students while the idea of differentiated instruction has come to the forefront of the educational means of instruction. This is not to say direct instruction is dead, as it is used to close the educational gaps faced by at-risk students (Grossen, 2004). However, responding to a variety of student needs, backgrounds and learning styles (Heacox, 2002) just may be the new driving force in education. This literature review will investigate direct instruction, its influences in today's classroom and outcomes as a result of using direct instruction. Differentiated instruction, the rationale behind differentiated instruction along with examples of differentiated instruction will also be explored thoroughly in this literature review.

Direct Instruction

The teaching pedagogy of direct instruction has enjoyed renewed prominence over the past several years (Mac Iver & Kemper, 2002). Direct instruction as a whole school reform initiative grew out of the earlier instruction of Engelmann and his associates who developed the Direct Instruction System for Teaching Arithmetic and Reading program in the 1960's (Mac Iver & Kemper, 2002). In order for direct instruction to be successful research shows that three steps must be followed: first, modeling the problem; second, a detailed explanation of how a solution was reached; and third, and most important, practice with immediate feedback. Magilaro et al. (2005) defined direct instruction as "…an instructional model that focuses on the interaction between teachers and students" (p. 41). Key components of direct instruction include modeling, reinforcement, feedback and successive approximation (Joyce, Weil, & Calhoun, 2000). Kirschner, Sweller, and Clark (2006) define direct instructional guidance as "…providing information that fully explains the concepts and procedures that students are required to learn as well as learning strategy support that is compatible with human cognitive architecture" (p. 75). The common thread that brings together these three pieces of literature is that they all include modeling, explanation and finally practicing the procedure. This idea is further supported by Flores and Kaylor (2007) who stated, "The premise of Direct Instruction is that all students can learn with appropriate instructional design and implementation" (p. 85). In their research Flores and Kaylor observed a classroom in which the teacher used direct instruction. "The teacher used modeling, guided practice, independent practice, and cumulative review. The students who participated in direct instruction outperformed their peers on the informal and formal measures" (Flores & Kaylor, 2007, p. 86). Maccini, Gagnon, Mulcah and Leon (2006) conducted similar research in which the teacher used direct instruction which consisted of "…five key components (a) review of previously learned skills; (b) teaching content using modeling, guided and independent practice; (c) monitoring student performance and providing feedback to students; (d) providing corrective feedback and use of review and reteaching when needed; (e) use of cumulative review" (p. 215). This gave further evidence that supported the three mainstays of direct instruction which act as a catalyst for success in the classroom.

The reasoning behind direct instruction as given by Kirschner et al. (2006) is to make sure "that novice learners should be provided with direct instructional guidance on the concepts and procedures required by a particular discipline and should not be left to discover those procedures by themselves" (p. 75). In concurrence with Kirschner et al. (2006), Magliaro et al. (2005) discussed how the direct instruction model should be presented with the idea that the designer can and should use the model effectively based on appropriate assessment of learners, content, context, and task at hand. This was in opposition to those who believe that people learn best in an unguided or minimally guided environment, where one must discover or construct the essential information for themselves (Kirschner et al., 2006). Kirschner et al. (2006) followed up this statement by stating, "Minimally guided instruction is likely to be ineffective" (p. 76). According to Magliaro et al. (2005) few educational models have been researched as extensively as direct instruction, including the largest educational evaluation ever conducted comparing it with twelve other models, across nearly 30 years, and involving 175,000 students at 180 sites. "…Direct Instruction was found to be effective and superior to other models in everything from learning engagement to achievement to student affect" (p. 42). Research by Flores and Kaylor (2007) was consistent with Magliaro et al. who found that direct instruction demonstrated decreases in off-task behavior and increases in student engagement. Much of the literature thus far has dealt with direct instruction in the classroom and its positive effect on testing and student learning. Direct instruction is also used in developing literacy for students.

Sinatra (2000) stated, "Direct instruction in text organizational patterns before, during, or after reading improves comprehension, strengthens content understanding and report writing" (p. 266). Keaton, Palmer, Nicholas, and Lake (2007) support the statement made by Sinatra by saying, "Direct instruction teaching methods have been found to promote the acquisition of literacy in developing readers" (p. 229). There is empirical evidence supporting the use of direct instruction to acquire literacy and as a general pedagogy in the classroom to support the education of students (Keaton, 2007).

Influence of Direct Instruction

According to the literature, direct instruction has the greatest influence on students with special needs. Grossen (2002) stated that "During the last two decades, research and development efforts in education have focused on the goal of closing the gap between students with disabilities and general education students. The Direct Instruction model has emerged as one of the most successful models for accomplishing this goal" (p. 241). Also, in accordance with the literature, besides being used for special education students, direct instruction has been a useful instructional tool in educating those students who are considered to be at-risk (Grossen, 2004). There are a number of characteristics which define a student who would be considered at-risk. The research by Flores and Kaylor (2006) dealt with students who were identified as at-risk for failure in mathematics. Grossen (2004) studied the direct instruction model and its use at a high-need school district in Sacramento, California called Charles M. Goethe Middle School. The following is a description of the school:

> For years, Goethe Middle School had the reputation of being the poorest performing school in one of the poorest performing districts in California. Forty-eight percent of Goethe's seventh- and eighth-grade student body read at or below the fourth-grade level. The average percentile score in reading was the eighth percentile for a seventh grader and the sixth percentile for an eighth grader…65.7% of the students lived with families receiving Aid to Families with Dependent Children, 87% received free- or reduced lunch…The three largest population groups (African-American, Hispanic, and Hmong) were fairly represented and prone to racial conflict…The Middle School faced all of the most serious problems that middle schools serving large numbers of at-risk students face across the nation. (Grossen, 2004, p. 163)

The direct instruction model would be used at the Goethe middle school which had the worst conditions imaginahle for a productive learning environment.

In Maccini et al. (2006) research was conducted on how to best carry out math instruction to students who are located in a juvenile commitment facility. The facility researched by Maccini et al. was located in a large metropolitan area, where youths ranged in age from twelve to eighteen. Eighty committed youth were enrolled in the educational program, witb 40% (n = 32) of the student population receiving special education services.

The influence of direct instruction reaches well beyond the spectrum of at risk students. Direct instruction has come under intense observation by educators in recent years with the development of differentiated instruction. Mac Iver and Kemper (2002) discussed how much of the research noted tbat positive outcomes for direct instruction were based on special education student populations. As a result of this data Mac Iver and Kemper focused their article on studies of direct instruction and in reading among regular education students. Chung's (2004) research investigated the effectiveness of two theoretical models, constructivism and traditionalism, on third grade students' academic achievement in establishing mathematical connections in learning multiplication basic facts. Twyman, McCleery, and Tindal (2006) took two groups of middle school students who were taught United States colonial history during a five-week period using two different instructional strategies. In the experimental group, concepts and problem-solving strategies were explicitly taught; in the control group, content was presented using lectures and reading (Twyman et al., 2006). Ryder, Burton and Silberg (2006) took the study of direct instruction even further by conducting a three-year longitudinal study, where the authors examined the effect of direct instruction on students' reading achievement, teacher perceptions, nature of the classroom, and special education referral rate. Keaton et al. (2007) conducted a study on emergent literacy development. This research was very similar to Chung's (2004) in that both researchers were trying to see how the use of direct instruction can be used to teach emergent literacy and mathematical development. Whether it was for research purposes, educating students with special needs or trying to save those students who have been labeled at-risk, the positive results of the use of direct instruction as pedagogy are incontrovertible.

Outcomes of Direct Instruction

Flores and Kaylor (2007) used direct instruction on the premise that all students can learn with appropriate instructional design and implementation. They continued by stating, "The efficiency of this methodology is particularly beneficial for students with disabilities, who have many learning needs but little time to address them" (p. 85). The study, however, was conducted on students without disabilities who were at-risk for failure in mathematics. This particular group of seventh graders had failed the annual state assessment in mathematics two or more times (Flores & Kaylor). The mean performance on the pre-test for the fractions unit was a 20% (Flores & Kaylor, 2007). The unit on fractions would be taught using direct instruction and the post-test results yielded a mean of 77%. However, Flores and Kaylor were quick to note that three students performed worse on the post-test. This generates a slightly contradictory result after considering the overwhelming improvement in the mean score of the exams. Although the quantitative data is an outstanding source of reference, the literature also points to a significant qualitative data. According to Flores and Kaylor (2007):

> Students appeared to be more engaged in the fraction instruction using Direct Instruction…There were more instances of students responding, correct responses and on-task behavior and fewer instances of off-task behavior when students participated in the Direct Instruction group… (p. 90)

The major significance from this study is the improved on-task behavior and the lack of off-task behavior which is supported through the Magliaro et al. (2005) model of direct instruction.

In Grossen (2002, 2004) the use of direct instruction was put to the test inside one of California's lowest performing middle schools in one of the lowest performing districts in northern California at the time of the study. In order to improve the literacy of the students in the middle school the Goethe school staff made reading a required subject for all students (Grossen, 2004). This reading class would be taught using direct instruction during the last period of the school day for the entire year. Grossen (2004) described the study as follows:

> In the first year of the study, the middle student at Goethe improved by two grade levels the first year in both reading comprehension and mathematics. The middle student in reading moved from the fourth-grade level to the sixth-grade level, and the middle student in math moved from the fifth-grade level to the seventh-grade level. No differences in performance were found between seventh-and eighth-grade students…On the pre-test, only 22% of the students read at their approximate grade level (grade 7 or higher); on the post-test, this number had doubled to about 47%. (p. 167)

During the second year of the study, results were similar in that students showed a two-year gain for one-year of instruction in reading and mathematics (Grossen, 2004). The third year of this program, Goethe started to become recognized for its staggering improvements in the areas of literacy and mathematics and the people at Goethe turned their attention to developing an efficient model for training and replication for schools under similar circumstances (Grossen, 2002). With a bleak starting point, the Goethe middle school efficiently used direct instruction to overcome dire academic circumstances and succeed academically. A final point from Grossen and the Goethe model was that during the period in which the students were taught with direct instruction there were rarely any referrals for behavior issues. This correlated with Magliaro et al. (2005), and Flores and Kaylor (2007), in that all studies have shown a lack of off-task behavior.

The Maccini et al. (2006) article focused on the academic needs of those students who are in a Juvenile Correctional School. Many of these students are special needs students that suffer from emotional disturbance and various learning disabilities. Following their outline for direct instruction "the direct instruction approach of five key components…" (Maccini et al., 2006, p. 215) discusses how the cumulative review supports maintenance of student skills; time allowed for students to complete guided practice, while monitoring their performance and providing immediate feedback and positive reinforcement. For students with emotional disturbances and learning disabilities the constant support, monitoring and positive feedback is essential in keeping students focused on work that has not yielded much success in the past (Maccini et al., 2006). At the conclusion of the lesson, independent practice is given out so students may continue practicing. This repetition of skills is crucial for students with difficulty retaining information and a great model for direct instruction.

In Twyman et al. (2006) a five-week study was conducted on two groups of middle-school students who were taught United States colonial history during a five-week period using two different instructional strategies. In the experimental group the direct instruction model was followed precisely: (a) began each day with a review of the previous lesson, (b) scaffolded the instruction of new lessons incrementally, (c) provided opportunities for guided and independent practice (with correct and feedback), and (d) conducted weekly reviews (Twyman et al., 2006). Students in the control group were provided with a more traditional, textbook-based approach to instruction that included (a) introducing the lesson and day's task, (b) group and teacher reading of a portion of the day's next passage, (c) individual silent reading of the remaining day's text, and (d) completing text comprehension questions (Twyman et al., 2006). The study focused on declarative knowledge tasks measuring factual content knowledge and domain vocabulary acquisition; procedural knowledge was measured with problem-solving essays (Twyman et al., 2006). Although results were statistically insignificant when comparing the two groups' results on the factual portion of the tests, there was an overwhelming amount of evidence supporting the use of direct instruction on the vocabulary test, as well as the problem-solving essays. In the vocabulary portion there was nearly a 6.5 to 1 vocabulary acquisition ratio from the experimental group compared with the control group (Twyman et al., 2006). Twyman et al. (2006) discusses how the results from the problem-solving essays support the effectiveness of direct instruction in enhancing students' skills in applying conceptual knowledge by integrating information allowing teaching and learning to be equally represented. As a result, students in the experimental group showed significant improvement in transferring their conceptual knowledge in their responses (Twyman et al., 2006). From this research one can conclude how using direct instruction (even for just five weeks) can increase relational thinking and problem solving with reference to concepts learned with middle school students. Thus far, numerous examples have been given in the literature supporting the use of direct instruction with adolescents and those students labeled "at-risk."

Direct instruction was helpful to adolescents and at-risk students now the literature points to the use of direct instruction on novice learners. Research done by Keaton et al. (2007) and Mac Iver and Kemper (2002) was unique in that it involved using direct instruction with kindergartners. Both Keaton et al. and the Mac Iver and Kemper studies expressed the academic significance of starting direct instruction in kindergarten with the Mac Iver and Kemper article discussing the long term effect of having direct instruction in kindergarten. Keaton et al. (2007) supported the use of direct instruction in the acquisition of literacy by emergent readers. In Keaton et al. direct instruction was used to educate a class of regular education kindergarten students. It is imperative to note that in the Keaton et al. (2007) research all learners made significant gains in various reading categories. Students who were initially the academically lower students saw significant gains in identifying letter sounds and in applying letter-sound knowledge to making spelling approximations. The kindergarten students with the highest academic abilities initially made the greatest gains in sight word recognition (Keaton et al., 2007).

Mac Iver and Kemper's (2002) article looked at the long range effect of direct instruction on students' academic progress. In their research Mac Iver and Kemper noted findings in which three groups of students' standardized test scores were followed. Group one, the control, was taught with various forms of direct and differentiated instruction from kindergarten through third grade; group two was taught with direct instruction from first through third grade; and group three was taught by means of direct instruction from kindergarten through third grade (Mac Iver & Kemper, 2002). Their findings were that students with four years of direct instruction (including kindergarten) significantly outperformed control students on the Metropolis Achievement Test (MAT) for reading at the end of third grade, whereas there was no difference between control students and those students who had experienced just three years (first through third grade) of direct instruction (Mac Iver & Kemper, 2002). The findings by Mac Iver and Kemper are consistent with the Ryder et al. (2006) article in which Ryder et al. examined the use of direct instruction on students' reading achievement. The conclusions drawn from the Mac Iver and Kemper (2002) in that "…there was no difference between control students and those students who had just experienced just three years (first through third grade) of direct instruction" (p.109) were supported by research done by Ryder et al. (2006), whose results of a longitudinal study on the effects of direct instruction on students from first through third grade yield statistically insignificant results.

Ryder et al. (2006) examined the effect of direct instruction on students' reading achievement. The participants of the research conducted by Ryder et al. (2006) were from Milwaukee Public Schools (MPS) and Franklin Public Schools (FPS). Approximately 98% of the students at the three MPS schools were African-American, 95% of those students qualified for free lunch; whereas 86% of the students were Caucasian in the four FPS schools and only 10% qualified for free lunch (Ryder et al, 2006). The results attained showed that students who received direct instruction during their first-grade year displayed less growth in reading achievement from year to year compared with their non-direct instruction counterparts (Ryder et al. 2006). These results were similar to the results attained by Mac Iver and Kemper (2002), although their research showed no difference. Ryder et al. (2006) actually saw a deficiency in the reading ability of students who received direct instruction from first through third grade. The research conducted by Ryder et al. (2006) led to the questions: What if they had started teaching the students from kindergarten through third grade? Would the results mirror that of the Mac Iver and Kemper study?

Other Solutions

It seems as though in order for direct instruction to be successful in educating novice learners it is best to start when those students are in kindergarten and continue the use of direct instruction from that point. This was supported by Mac Iver and Kemper (2002), who give empirical evidence for the use of direct instruction from kindergarten through third grade and the positive test results achieved by students on standardized tests. The research done by Ryder et al. (2006) also gave additional support in that the effects of direct instruction from first through third grade hold minimal significance in student achievement compared with those students taught by non-direct instruction methods. Chung's (2004) article further supported this idea through his research conducted on comparing constructivist and traditionalist approaches to establishing mathematical connections in learning multiplication to four classes of third graders. For one unit comprised of ten lessons, two classes were taught using a constructivist approach while the other two classes were taught using direct instruction. Results from the three tests which all students took revealed that both teaching techniques increased the students' multiplication skills and understanding of the multiplication concept which involves basic facts 0 to 5 (Chung, 2004). In concurrence with Ryder et al. (2006) and Mac Iver and Kemper (2002), results from Chung (2004) yielded no statistical difference between two groups of students with respect to their achievement of multiplication concepts and skills. After seeing how little effect or possibly negative effect direct instruction can have on students' educational development, educators must formulate a new plan to ensure the academic success of America's next generation. This leads to adjusting instruction to fit the skills and experience level of each student in the classroom, better known by educators as differentiating instruction (Smutny, 2003).

Differentiated Instruction

The idea of present-day differentiated instruction has been around for thousands of years dating back to the time of Ancient Greece and the Socratic Seminars held by the Philosopher Socrates. So even though much of the literature talks of differentiated instruction as though it is a novel idea the truth is quite the contrary as its roots are deeply imbedded throughout educational history.

The new principles of differentiated instruction are founded upon Howard Gardner's (1983) theory of Multiple Intelligences, which were introduced in his book *Frames of Mind: The Theory of Multiple Intelligences.* Since the early 1980's, inclusion efforts have challenged all educators to modify curriculum and instruction to meet diverse learning and behavior needs in the classroom in lieu of Gardner's multiple intelligences (Hoover & Patton, 2004). Gardner (2005) defined multiple intelligences as follows:

1. Linguistic Intelligence: the intelligence of a writer, orator, journalist.
2. Logical mathematical intelligence: the intelligence of a logician, mathematician, scientist.
3. Musical intelligence: The capacities to create, perform, and appreciate music.
4. Spatial intelligence: The capacity to form mental imagery of the world-the large world of the aviator or navigator, or the more local world of the chess player or the surgeon-and to manipulate those mental images.
5. Bodily-Kinesthetic intelligence: The capacity to solve problems or fashion products using you whole body, or parts of your body (i.e. athletes, dancers actors, craftspersons, and, again, surgeons.)

6. Interpersonal intelligence: involves the understanding of other persons-how to interact with them, how to motivate them, how to understand their personalities etc. (i.e. business people, teachers, politicians etc.)
7. Intrapersonal intelligence: is the capacity to understand oneself.
8. Naturalist intelligence: involves the capacity to make consequential distinctions in nature-between one plant and another, among animals, clouds etc.
9. (Speculative) Existential intelligence: 'intelligence of big questions' i.e. children ask the size of the universe, adults ponder death, love, conflict, the future of the planet etc. (pp. 7-9)

Gardner (2005) continued by making one of his most critical points: that no two individuals have exactly the same profile of intelligences, not even identical twins. Educators have taken the research of Gardner and developed pedagogy which accounts for individuals' needs, styles and interests, called differentiated instruction.

Defined

Heacox (2002) defined what it means to differentiate.

> Differentiating instruction means changing the pace, level, or kind of instruction you provide in response to individual learners' needs, styles or interests. Differentiated instruction specifically responds to students' progress on the learning continuum - what they already know and what they need to learn. It responds to their best ways of learning and allows them to demonstrate what they've learned in ways that capitalize on their interests. (p. 1)

Adams and Pierce (2003) add that differentiating instruction involves structuring a lesson at multiple levels so that each student has the opportunity to work at a moderately challenging, developmentally appropriate level. Adams and Pierce (2003) continue by stating that differentiating instruction can occur on three levels: differentiating content (what you want students to learn), process (the way students make sense out of the content), or product (the outcome at the end of a lesson, lesson set, or unit-often a project). Tomlinson (2003) supports the aforementioned statements by reiterating that the goal of a differentiated classroom is to plan actively and consistently to help each learner move as far and as fast as possible along a learning continuum. Another factor in the push for differentiated instruction is the amount of diversity in classrooms today exemplified by inclusion classroom settings which put special education students into the same classroom with regular education students. Tomlinson et al. (2003) describe a present-day classroom:

> Seated side by side in classrooms are students with identified learning problems; highly advanced learners; students whose first language is not English; students who underachieve for a complex array of reasons; students from broadly diverse cultures, economic backgrounds, or both; students of both genders; motivated and unmotivated students; students who fit two or three of these categories; students who fall closer to the template of grade-level expectations and norms; and students of widely varying interests and preferred modes of learning. (p.119)

This point is further supported by Mastropieri, Scruggs, Norland, Berkeley, McDuffle, Tornquist and Connors (2006) when they talk about the ongoing challenge for inclusive classroom teachers in meeting the instructional needs of all learners, especially when content is challenging and when student needs are diverse. Given the literature thus far it is easy to see that there are a multitude of complexities involved with differentiating instruction, hut Tomlinson (2003a) surmises the process in two words: responsive instruction (Tomlinson, 2003a). This undoubtedly characterizes what it is to differentiate, and the literature next takes a closer look as to the questions surrounding differentiation.

Rationale

The textbook answer as to why educators differentiate is found in Gardner's explanation of the multiple intelligences and the need to address all learners at different levels of academic readiness and learning style. The scientific answer to this question is addressed by Kapusnick and Hauslein (2001).

> When a student experiences a learning situation, the brain responds with a release of the chemical noradrenaline. Students who feel intimidated and rejected because their level of readiness is over-challenged have an over production of noradrenaline, causing the brain to be over-stimulated. Attention is diverted from learning and focused on self-protection, resulting in misbehavior or withdrawal, with more time heing spent on learning to cope rather than learning concepts. Conversely, if student readiness is beyond what is needed for a particular task, the brain is, quite literally, not engaged, releasing fewer neurochemicals. (p.156)

This is supported by DiMartino & Miles (2005), when they discuss the ultimate goal of educators: to make sure that students are experiencing an enjoyable learning experience and it is differentiated instruction pedagogy which allows educators to engage all types of learners. Differentiated instruction is unique in that it recognizes a range of intelligences (Gardner's multiple intelligences) and each student can capitalize on strengths, receive remedial help for areas of weakness, and compete with previous achievements (Smutny, 2003). Edyburn (2004) reiterated this quality of differentiated instruction by discussing how the philosophy is based upon learning that focuses on designing instruction in ways that enable students to be successful. Whenever educators can engage a classroom of students it is an accomplishment in and of itself, but what does it take to be able to utilize differentiated instruction in the classroom successfully?

The answer to the above question is simply…time. In order to differentiate instruction in the classroom the teacher must be aware of the specific needs of students with whom they are working, which literature acknowledges takes time. Hoover and Patton (1997) identify four necessary elements for addressing effective implementation and differentiation of curriculum and instruction:

> 1. Content-specific subject-area skills and knowledge associated with each curriculum standard (i.e. content standards)
>
> 2. Instructional strategies-various techniques or methods used to assist students in acquiring content and managing behavior.
>
> 3. Instructional settings-includes small groups, independent work, paired learning, and large groups.
>
> 4. Student behavior-students' abilities to manage and control their own behaviors within a variety of learning situations and grouping in the classroom.
>
> (p.10-11)

Eight years later and in concurrence with Hoover and Patton (1997), Powell and Napoliello (2005) cite their four keys of differentiating instruction:

- Deep knowledge of the student as a learner;
- Deep knowledge of the content of the curriculum;
- A broad repertoire of instructional strategies; and
- A willingness to engage in collaboration planning, assessment, and reflection. (p. 53)

Both articles state these four key points as the mainstay by which differentiated instruction is based. In order for differentiated instruction to occur it undoubtedly takes time, but the other key element which will be discussed is the "buy-in" factor. Research shows that success with differentiated instruction requires faculty buy-in; this can be facilitated by administrators and seen through by professional development opportunities for those educators involved.

Many school districts have implemented a differentiated instruction approach to educating their students. With this came many reservations from faculty members. However, Lewis and Batts (2005) addressed those fears when they stated, "adjusting the curriculum does not mean changing the curriculum" (p. 27). This is a common misconception by educators when their employing district is changing to a differentiated instruction approach to teaching. Differentiated instruction is a daunting task for any teacher and it practically cries out for helpers (Smutny, 2004). Research shows that school administrators implementing differentiated instruction recognize that considerable time and combined efforts with teachers and parents are essential for success (Kapusnick & Hauslein, 2001). This is in agreement with Lewis and Batts (2005) who recently researched a school district that implemented differentiated instruction into their schools. To begin with, teachers, administrators and parent-teacher association members attended a two-day midsummer retreat dedicated to differentiated instruction. Teachers attended workshops and seminars throughout the course of the first two years of implementation. Twice-a-month faculty meetings were devoted to differentiation. This encompassing support helped to build the confidence of the faculty who began sharing ideas with one another and, in turn, student engagement and success increased (Lewis & Batts, 2005). When implementing differentiated instruction it is best to start small and aim for gradual change as opposed to trying to revolutionize teaching methods (Smutny, 2003). There are many forms of differentiated instruction, and the research will take a closer look at a few of the methods most commonly practiced in the classroom today.

Types of Differentiated Instruction

When differentiating instruction it is important to remember that the differentiation can occur at three levels: students' readiness, learning profile or interests (Adams & Pierce, 2003). A significant amount of literature points to tiered learning, compacting, problem-based learning (PBL), and multiple intelligences as the commonly used points of reference from which to differentiate instruction.

Teachers use tiered activities so that students focus on essential understandings and skills but at different levels of complexity, abstractness, and open-endedness (Tomlinson, 1999). Smutny (2004) corroborated the definition by stating, "The idea behind tiered activities is that all students-regardless of differences in ability, skill, and experience-can focus on the same learning goal…" (p. 7). Hughes (1999) tiered her lessons based on students' readiness. She states, "Providing…opportunities as part of my daily lessons appears to best meet the needs of the high-ability students within my regular education classroom" (p. 285). The following is an example lesson from Smutny (2004) where point of view is being taught to a language arts class.

> Group 1: Kids write descriptions of themselves as though they are a character in a popular fairytale and what they think of the other characters in the story.
> Group 2: Kids take it a step further and write an essay on how they, as this character, feel about the whole story. Whose story is it? Do they agree with it?
> Group 3: Taking it even further, kids choose a character and write a fracture fairytale based on this character's point of view. (p. 7)

Compacting is a form of differentiated instruction which allows students who have mastered content to explore the content further via an independent project which is given by the teacher and comes with guidelines and due dates. Compacting assumes that some children, because of prior experience, high ability, high motivation, interest or learning outside of the classroom, may possess knowledge and skills that places them at a different level than other classmates (Smutny, 2003). Tomlinson (1999) adds that compacting begins with a focus on student readiness and ends with an emphasis on student interest. Compacting usually ends with a learning contract and a timeline for the student to follow (as to when to turn in) assignments (Smutny, 2003; Smutny 2004). Assignments associated with compacting are usually a more accelerated, more complex version of an assignment; another assignment in the same subject but in the child's area of interest; or an independent project of the student's choosing (Smutny, 2004).

Problem-Based Learning puts the onus on the students to develop the meaning of their investigations. The teacher will present the students with an unclear, complex problem to solve and the students must define the problem, seek additional information to answer the problem, derive solutions and assess the effectiveness of their found solution (Tomlinson, 1999). In research done by Capon and Kuhn (2004) there were two classes of students trying to attain their Master of Business Administration degree. One class was taught using problem-based learning for one concept (concept #1) and the other concept (concept #2) was taught where lecture/discussion was the exclusive method (Capon & Kuhn, 2004). In the other class the matching of the concept and method (problem based or lecture/discussion) was reversed (Capon & Kuhn, 2004). The results from Capon and Kuhn (2004) were as follows after two assessments:

> At the initial assessment, the lecture/discussion group showed superior learning for 1 concept and the groups performed equivalently for the other concept. At the later assessment, however, the 2 groups showed equivalent ability to access each of the concepts, but each group showed superior explanation of the concept which they had experienced with problem-based learning. Results support the hypothesis of integration of new information with existing knowledge structures activated by problem-based experience as the mechanism by which problem-based learning produces its benefits. (p. 61)

One conclusion as a result of this experiment was problem-based methods promoted active engagement, but lecture methods allowed more material to be covered (Capon & Kuhn, 2004). This seems to be a logical conclusion, but results from the assessments are irrefutable in that the concepts experienced through active participation yielded a better-quality response from the students.

Howard Gardner (1983) contributed greatly to the awareness that students vary in intellectual preference and strengths. This was also supported by Tomlinson (1999). Gardner's eight documented intelligences (the ninth intelligence-existential intelligence is speculative to this point) have opened up educators' thinking to the fact that every student does not learn the same and thus, the need to differentiate instruction. It is the teacher's job to discover what these are and then teach to students' strengths (Smutny, 2003), which has been mentioned, takes time. Campbell and Campbell (1999) researched six schools, all of which had claimed to have implemented multiple intelligence programs for five or more years. The schools that were involved in the study were very diverse in nature and are described by Campbell and Campbell (1999): Russell Elementary School in Lexington Kentucky, 94 percent of its population on free and reduced lunch, and 65 percent African-American students; Expo for Excellence Elementary Magnet School in St. Paul, Minnesota, 50 percent of the students are minority and 35 percent are limited-English-proficient; The Key Learning Community in Indianapolis, Indiana, 50 percent minority students and nearly half on free and reduced lunch; Skyview Junior High School in Bothell, Washington, houses three levels of special needs students: profound and medically fragile, self-contained and those included in a regular classroom; Lincoln High School in Stockton, California, 50 percent are minority, 26 percent are on free and reduced lunch and 13 percent limited-English-proficient; and Mountlake Terrace High School in Mountlake Terrace, Washington, 25 percent minority, thirteen percent on free and reduced lunch. The results attained by the students of these schools are irrefutable, as described by Campbell and Campbell (1999):

> At the inner-city Russell Elementary School students scores have doubled on Kentucky's state test and the discrepancy between black and white student scores have disappeared. At the inner-city EXPO, students' scores on the new Minnesota basic skills tests were among the highest in St. Paul and on the standardized Metropolitan Achievement Tests, EXPO students significantly outperformed their peers locally and nationally. Students at Skyview outperformed their state and national peers by 20 percentage points in reading, language arts, and math. At the Key Learning Community, 6th, 7th, and 8th graders score at grade level or above in all areas by the California Test of Basic Skills. At Mountlake Terrace high school, state-administered test scores have risen from below to above district averages since adopting multiple intelligence practices. At Lincoln high school, Lincoln students score the highest in their county in nearly all subjects. (pp. 95- 96)

Smutny (2003) brings the idea of the different strategies used to differentiate instruction by saying "as teachers become familiar with the strategies that work best for themselves and their students, they can adapt and adjust instruction gradually" (p. 45). Smutny (2003) continues, by discussing how a differentiated classroom promises to reach many more students in the education system by responding to their individual learning styles, abilities, disabilities, and cultural and linguistic backgrounds. This is in agreement with Adams and Pierce (2003), who also conclude that time, energy, and patience are required to effectively differentiate instruction in an academically diverse classroom.

The literature leaves no doubt that with time and patience success using differentiated instruction is inevitable.

Summary

Based on the literature there seems to be a change in the educational tools being used by teachers in the education of students. The need to differentiate instruction based on learners' readiness, interest and learning profile are all focal points of educators in the classroom today (Tomlinson et al., 2003; Smutny 2003; Kapusnick & Hauslein, 2001; Adams & Pierce, 2003; DiMartino & Miles, 2005; Lewis & Batts, 2005; Hoover & Patton, 2004; Heacox, 2002). Although this is not to say that direct instruction does not have its place and time in the classroom. When educating students with special needs, at-risk students, and novice learners, direct instruction has led to great academic gains for these groups of students (Heward, 2000; Ryder & Burton, 2006; Flores & Kaylor, 2007; Grossen, 2004; Maccini et al., 2006; Sinatra, 2000; Keaton et al., 2007; Kirschner et al., 2006; Magliaro et al., 2005). One topic that was not addressed specifically by the literature was the experience and educational history of the teachers that were teaching the students. This would have a great influence on the comfort level of the educators as they try new pedagogical techniques. Another topic that was left unaddressed in the literature was the lack of research done on schools using the combination of direct instruction with differentiated instruction. The academic benefits of using both methods to teach a single class may outweigh using either direct instruction or differentiated instruction.

Methodology

This inquiry into comparing direct instruction versus differentiated instruction was part of a unit-long study consisting of six lessons, one day for a review, and a day for a comprehensive unit exam.

Participants

The study was conducted in a suburban school district outside of Rochester, New York. The participants in the study were two ninth-grade regents-level algebra classes. Both classes meet every other day for eighty minutes. Students were on a four-day rotating schedule. Class A, the experimental group, meets on days one and three, during the second block which meets from 9:05am 10:25am; Class B, the control group, meets on days two and four, during the second block which meets from 9:05am – 10:25am.

Class A is composed of twenty-one students; three of the students receive math academic intervention services. Ages range from thirteen years old to fifteen years old, with fifteen female students and six male students, a 14% African-American population and an 86% Caucasian population. Class B is composed of nineteen students; two of the students receive math academic intervention services and one of the students never attends class. Ages range from thirteen years old to sixteen years old, with six female students and thirteen male students, a 16% African-American population and an 84% Caucasian population.

Materials

In order to complete the study, an overhead projector, pull-down screen, transparencies, a laptop computer, TI SmartView, Applied Vision, which is a program that allows a camera to be hooked up to a laptop and used to project video onto a screen, a projector, a Texas Instruments (TI) 83 graphing calculator, a TI overhead projection viewer for a TI-83 plus graphing calculator, rulers, glue, and graph paper would be needed. The resources used to compile the notes for chapter three on graphing equations and inequalities were: Prentice Hall New York Math A; Amsco's Mathematics A, Amsco Algebra 1, McDougal Littell Algebra 1, Glencoe Algebra 1, Online Resources from www.quia.com and www.mathbits.com.

Procedure

In Class A, every member of the class was given a sixty-page spiral notebook to use for taking notes, and completed the warm-ups given at the beginning of class as they were taught by direct instruction. Class procedure went as follows:

1) Students would come in and copy down and complete a warm-up which consisted of review questions from the previous day's notes and material covered earlier in the year.
2) The homework would be displayed with solutions on the screen in the front of the room using an overhead copy of the homework completed by the teacher.
3) Notes were written on the dry-erase board. A blank overhead was used as well as a means of writing down the notes for the students to put in their notebooks.

There was six days' worth of notes for chapter three, notes 3.1 through 3.6:

Notes 3.1 Solving and Graphing Inequalities

Notes 3.2 Absolute Value

Notes 3.3 Graphing Lines and Slope

Notes 3.4 Direct Variation and Functions

Notes 3.5 Equations of Lines

Notes 3.6 Graphing Inequalities

On the day of notes 3.3 and 3.5 a quiz was given. The quiz was given after the class had had a chance to review the overhead copy of the homework completed by the teacher.

Notes 3.1 and 3.2 were taught using the dry-erase board and notes 3.3 through 3.6 were taught on the overhead. Prior to starting notes 3.3 through 3.6, pre-cut graphs were distributed to the students along with glue sticks so they could glue the graphs into their notebooks as was deemed necessary throughout the note-taking. At the conclusion of the notes the homework was passed out to the students.

On the review day, class was started with a warm-up, followed by a review of the homework using an overhead copy of the homework completed by the teacher. Next, the class went over the vocabulary from the unit that was given to them on the first day of the unit. After completing the vocabulary, the teacher passed out the two key concepts sheets from the unit along with a chapter three review packet. With the remaining time the teacher went through the packet page-by-page and answered any questions students may have had.

On the test day all students are handed an answer key for the review packet and asked to self-correct and circle any questions they may have for the teacher. This lasted for ten minutes. The teacher then went over any questions students had trouble with on the board which took another fifteen minutes. During the remaining fifty-five minutes students completed the examination.

In Class B, the class was taught using differentiated instruction through use of guided notes. Class procedure would go as follows:

1) Students would come in and copy down and complete a warm-up which consisted of review questions from the previous day's notes and material covered earlier in the year.
2) The homework would be displayed with solutions using the Applied Vision program and the projector.
3) Guided notes were handed out to students immediately after going over the homework.

There was six days' worth of notes: notes 3.1 through 3.6. On the day of notes 3.3 and 3.5 a quiz was given. The quiz was given after the class had had a chance to review the homework shown using the Applied Vision program.

Notes 3.1 through 3.6 were taught using transparencies of the notes on the overhead projector. When the notes necessitated the use of the graphing calculator, the SmartView program was used to display the graphing calculator on the screen using the projector. At the conclusion of the notes the homework was passed out to the students.

On the review day, class was started with a warm-up. Homework would be displayed with solutions using the Applied Vision program and the projector. Next, the class went over the vocabulary from the unit that was given to them on the first day of the unit. After completing the vocabulary, the teacher passed out the two key concepts sheets from the unit along with a chapter three review packet. With the remaining time the teacher had the students work in small-group settings to complete as much of the packet as possible before the end of the block.

On the test day all students are handed an answer key for the review packet and asked to self-correct and circle any questions they may have for the teacher. This lasted for ten minutes. The teacher then went over any questions students had trouble with on the board which took another fifteen minutes. During the remaining fifty-five minutes students completed the examination.

Table 1

Mean Number of Correct Responses Based on Class Scores

	M.C	S.A	T.P	Percent
Class A	21.24	46.52	67.76	78.79
Class B	20.33	47.44	67.78	78.81

Note: Multiple Choice (M.C) Total of 28 points
Short Answer (S.A) Total of 58 points
Total Points (T.P) Total of 86 points
Percent Total of 100%

Table 2

Mean Difference of Number of Correct Responses Based on Class Scores

	M.C.	S.A	T.P	Percent
Class A - Class B	0.91	-0.92	-0.02	-0.02

Note: Multiple Choice (M.C) Total of 28 points
Short Answer (S.A) Total of 58 points
Total Points (T.P) Total of 86 points
Percent Total of 100%

Next the results focus on those students who receive state-mandated academic intervention services (AIS) which gives those students an extra forty minutes of math every other day. The results are given in table 3; along with this is included table 4 which accounts for the point differential among the AIS students in the two classes. The results generated for the AIS students are quite significant in the study. Students from Class A (the direct instruction teaching model) fared much better than the students from Class B who were taught using differentiated instruction, with the greatest result shown in the mean total percent where the difference was nineteen percent.

In the final breakdown of the data the effect of direct instruction versus differentiated instruction on gender was analyzed. In table 5 the mean correct responses from the boys and girls from Class A was recorded; the difference in the means was recorded in table 6. The results found were very interesting in that the girls' mean score was nearly nine points higher then their gender counterpart. Class B's data was analyzed in similar fashion and that data is broken down in table 7 and table 8. This data also proved extremely interesting in that the boys' mean score was fourteen points greater than that of the girls. Table 9 broke down the difference in mean scores from the boys in Class A to that of the boys of Class B. This data was also intriguing in that the boys in Class B had more than an eleven percent higher mean score than that of the boys in Class A. The final table, table 10, investigated the difference in mean scores from the girls in Class A to that of the girls in Class B. This data was also noteworthy in that the girls in Class A had nearly a twelve percent higher mean score than that of the girls in Class B.

Table 3

Mean Number of Correct Responses Based on AIS Student Scores

	M.C	S.A	T.P	Percent
Class A	21.3	46.3	67.67	79.00
Class B	14	37.5	51.5	60.00

Note: Multiple Choice (M.C) Total of 28 points
Short Answer (S.A) Total of 58 points
Total Points (T.P) Total of 86 points
Percent Total of 100%

Table 4

Mean Difference of Number of Correct Responses Based on AIS Student Scores

	M.C.	S.A	T.P	Percent
Class A - Class B	7.3	8.8	16.17	19.00

Note: Multiple Choice (M.C) Total of 28 points
Short Answer (S.A) Total of 58 points
Total Points (T.P) Total of 86 points
Percent Total of 100%

Table 5

Mean Number of Correct Responses Based on Gender (Class A)

	M.C.	S.A	T.P	Percent
Girls	22	47.9	69.9	81.32
Boys	19.3	43	62.3	72.48

Note: Multiple Choice (M.C) Total of 28 points
Short Answer (S.A) Total of 58 points
Total Points (T.P) Total of 86 points
Percent Total of 100%

Table 6

Mean Difference of Number of Correct Responses Based on Gender (Class A)

	M.C.	S.A	T.P	Percent
Class A (Girls - Boys)	2.7	4.9	7.6	8.84

Note: Multiple Choice (M.C) Total of 28 points
Short Answer (S.A) Total of 58 points
Total Points (T.P) Total of 86 points
Percent Total of 100%

Table 7

Mean Number of Correct Responses Based on Gender (Class B)

	M.C.	S.A	T.P	Percent
Girls	17.33	42.3	59.67	69.38
Boys	21.83	50	71.83	83.53

Note: Multiple Choice (M.C) Total of 28 points
Short Answer (S.A) Total of 58 points
Total Points (T.P) Total of 86 points
Percent Total of 100%

Table 8

Mean Difference of Number of Correct Responses Based on Gender (Class B)

	M.C.	S.A	T.P	Percent
Class B (Boys - Girls)	-4.5	-7.7	-12.16	-14.15

Note: Multiple Choice (M.C) Total of 28 points
Short Answer (S.A) Total of 58 points
Total Points (T.P) Total of 86 points
Percent Total of 100%

Table 9

Mean Difference of Number of Correct Responses Based on Gender (Boys)

	M.C.	S.A	T.P	Percent
Class A - Class B	-2.53	-7	-9.53	-11.05

Note: Multiple Choice (M.C) Total of 28 points
Short Answer (S.A) Total of 58 points
Total Points (T.P) Total of 86 points
Percent Total of 100%

Table 10

Mean Difference of Number of Correct Responses Based on Gender (Girls)

	M.C.	S.A	T.P	Percent
Class A - Class B	4.67	5.6	10.23	11.94

Note: Multiple Choice (M.C) Total of 28 points
Short Answer (S.A) Total of 58 points
Total Points (T.P) Total of 86 points
Percent Total of 100%

Discussion

The purpose of the research was to determine whether direct instruction or differentiated instruction better lent itself to the education of students. Results attained from the study generally were in consensus with the literature with hardly any examples of the study contradicting the literature. With results showing such a positive correlation to previous research, the research in this study gains validation in its conduction and conclusions based upon the results.

Based upon the research conducted in this study teaching a unit via direct instruction or differentiated instruction has a minimal effect on the mean class score. However, there were notable differences in mean scores when discussing groups of students within the class. Scores were first broken down by students who receive math academic intervention services (AIS). The students who received the direct instruction scored a mean score that was nineteen points greater than that of the students who were taught using differentiated instruction. Next, the scores were broken down by gender within each class. This produced significant data in which the mean scores in each class varied greatly between the boys and girls within the class. Finally, the scores among genders from opposing classes also yielded a large gap in the mean score. All of these results will be thoroughly analyzed throughout the discussion.

Class A was taught using direct instruction and throughout the study was taught in a manner which exemplified the model of direct instruction as stated by Magliaro et al. (2005) "Key components of direct instruction include modeling, reinforcement, feedback, and successive approximations" (p.41). During the course of the study students were taught each topic using a three-problem method. The first problem would be modeled for the students, the second problem would be done as a class using volunteers from the class to aid in the teaching of the subject matter, and finally a third problem would be done by the students on their own as the teacher would monitor their work closely giving immediate feedback on correct or incorrect solutions.

Class B was taught in a manner of instruction which met the diverse learning and behavior needs of learners within the classroom; this type of instruction is called differentiated instruction (Hoover & Patton, 2004). Throughout the course of the study Class B was presented with material using this approach. This method is in agreement with Heacox (2002), "differentiating instruction means changing the pace, level, or kind of instruction you provide in response to individuals' needs, styles or interests" (p.1). Undoubtedly the methods used to educate the students from both classes were in conjunction with what is in the literature. This should yield similar results found within the literature.

Qualitative data that was surmised within the research was in line with the literature. While teaching Class A using direct instruction there was an overpowering sense of student engagement and on-task behavior. This correlated with results recorded by Magliaro et al. (2005), Flores and Kaylor (2007) and Grossen (2002) which alluded to students' off-task behavior being diminished, a decrease in disciplinary referral rates, as well as an increase in student engagement. This result from the study seems logical because when students are not given guided notes and are held accountable for all the information given by the teacher they must pay closer attention to the notes so that they do not miss any key points or ideas. From this conclusion alone it is easy to conceive off-task behavior being a non-factor while teaching using direct instruction. Simply stated, it would not seem as though students would have the time to be off-task if they hoped to come away from the lesson learning the main ideas conveyed from the teacher, hence the increase in on-task behavior and student engagement.

The difference in the mean scores from the class that was taught using direct instruction from the class taught via differentiated instructed was .02% in favor of the class taught using differentiated instruction. This contradicts research by Flores and Kaylor (2007) in which students who participated in direct instruction outperformed their peers on the formal assessment. Results also contradict Twyman et al. (2006) whose results show using direct instruction aid students in problem-solving essays. In the study the students in Class A were outscored by an average of .92% on the short answer section of the exam. Students from Class B outperformed students from Class A by an average of .02%; these results quantitatively were rather insignificant, however, when comparing the results to that of the literature they become more substantial. Flores and Kaylor (2007) and Magilaro (2005) both vehemently defend the use of direct instruction and its influence on student achievement being greater than that of other forms of instruction. These results were not corroborated by the study conducted on Class A and Class B.

In order for a student to receive math academic intervention services (AIS) they must receive below a three (based on a four-point scale, where one is the lowest and four is the highest) on the eighth grade New York State math assessment. The AIS students that were taught by means of direct instruction for unit three averaged 16.27 points higher (which equates to nineteen percentage points) on their exam scores than their AIS counterparts that received differentiated instruction. These results correlate with Grossen (2002, 2004), Kirschner et al. (2006), and Flores and Kaylor (2006) whose research looked at students considered to be at-risk students in mathematics. These students according to the literature learn best and are more successful academically when being taught by direct instruction. Flores and Kaylor (2006) elaborate on this point by discussing how during direct instruction students are more engaged, less off-task and thus these at-risk students are able to learn more while being taught by direct instruction. The results and literature strongly supported the fact that the lower-level student would be more successful when being taught using direct instruction. With these documented conclusions would the definition of differentiated instruction (as a means of instruction that accounts for varying learning styles) now be in question?

Differentiated instruction as defined by the literature suggests that teachers cater their teaching style to meet the needs of all the students within a given classroom, whether it is differing the content of what is being taught, the process of how the content is being taught, or the final product which the students have a chance to show what they have or have not learned (Mastropieri et al., 2006; DiMartino & Miles, 2005; Edyburn, 2004; Adams & Pierce, 2003; Tomlinson, 2003). When taking into consideration all of these facets of differentiated instruction student success, according to the literature, is supposed to be increasing. According to this study this conclusion cannot be concurred; however, the AIS students in Class A did out-perform the AIS students in Class B. This supported the literature in the fact that the at-risk students are more successful when they are taught via direct instruction.

Some possible reasoning as to why the AIS students in Class B did not fair as well as those students in Class A may be as the literature suggested that the AIS students in Class B may have been engaged in off-task behavior as opposed to paying attention and writing down what was being taught. Another missing piece is that when teaching via differentiated instruction students are indirectly asked to recall some prior knowledge that the AIS students would have a tough time recalling. This would be the point in the research where there is a lack of detail surrounding the success or lack thereof of the students who are in a math AIS program that are being taught by means of differentiated instruction. The only fact gathered from the literature is that the high-risk math students are successful when they are taught by direct instruction.

An interesting result of the study that was not addressed in the literature was the effects of differentiated instruction versus direct instruction on gender. In the class being taught by means of direct instruction, there were fifteen females and six males who took the exam. The mean score of the females outscored the males' scores by well over eight percentage points, which would lead to the conclusion that females learn better by direct instruction. This conclusion is further supported by the class being taught by means of differentiated instruction. In this class six females and twelve males took the exam. The males in the class outscored the females by over fourteen percentage points. These results which were found in the study would lend themselves to the conclusion that males learn better through differentiated instruction and females learn better by means of direct instruction. However, this is where the literature proved to be weak in its usefulness for drawing comparisons.

Conclusion

Based upon the literature and the study there are still many areas surrounding the pedagogies of direct instruction and differentiated instruction that are suited for further investigation. First, the effects of direct instruction versus differentiated instruction on those students who are not classified as special needs students but do receive math academic intervention services. How can these students best be taught to maximize their academic potential? The next topic which is in need of further research is the significance of gender in the class room. Are males and females better suited to learn from specific teaching styles, or was the research conducted simply an anomaly?

A final aspect of this study which inherently needs further investigation was the effect of using both pedagogies. In neither the research nor the literature was their ever mention of using both direct and differentiated instruction to teach a single class. It would seem as though a combination of both pedagogies on a single class would maximize the learning potential of the students. However, the conclusion is quite presumptuous given the lack of literature to support the hypothesis.

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Appendix A

Algebra 9 Chapter 3 Test: Graphing

Multiple Choice: [2 points each]

Slope (Formula)	General Equation of a Line

1) Which equation represents a line parallel to the line $y = 4x - 5$?

(1) $y = 5x \quad 4$ (2) $y = \frac{1}{4}x + 6$ (3) $y = 4x + 6$ (4) $y \quad -\frac{1}{4}x - 5$

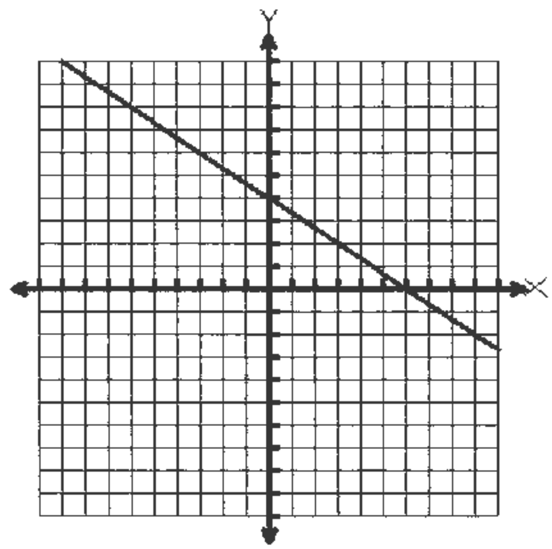
2) What is the slope of the line whose equation is $2y - 10x \cdot 14$?

(1) 5 (2) 7 (3) -10 (4) 14

3) What is the slope of the line *m* shown in the accompanying diagram?

(1) $\frac{2}{3}$ (2) $-\frac{2}{3}$

(3) $\frac{3}{2}$ (4) $-\frac{3}{2}$



4) Which properties best describe the coordinate graph of two distinct parallel lines?

(1) same slopes and same intercept (2) same slopes and different intercepts

(3) different slopes and same intercepts (4) different slopes and different intercepts

5) What is the solution to the inequality $-2x+3>5$?

(1) $x<1$ (2) $x>1$ (3) $x<-1$ (4) $x>-1$

6) Which pair of lines is perpendicular?

(1) y = 5x – 6 and y – 5x = 7 (2) y = 3x and 2y = 6x – 8

(3) y = 4x + 6 and y = $-\frac{1}{4}$ x – 4 (4) y = x + 6 and y = x – 6

7) Which equation passes through the points (4, 8) and (2, 12)?

(1) y = $-\frac{1}{2}$ x + 10 (2) y = -2x + 16 (3) y = 2x (4) y = $\frac{1}{2}$ x + 11

8) What is the slope of the line passing through (-2, 2) and (-2, 7)?

(1) undefined (2) 5 (3) 0 (4) $\frac{4}{9}$

9) If x varies directly with y, and x = 3 when y = -24, find y when x = -12

(1) 8 (2) - 8 (3) -96 (4) 96

10) Which interval notation represents the set of all numbers from 3 to 9, inclusive?

(1) (3, 9) (2) (3, 9] (3) [3, 9) (4) [3, 9]

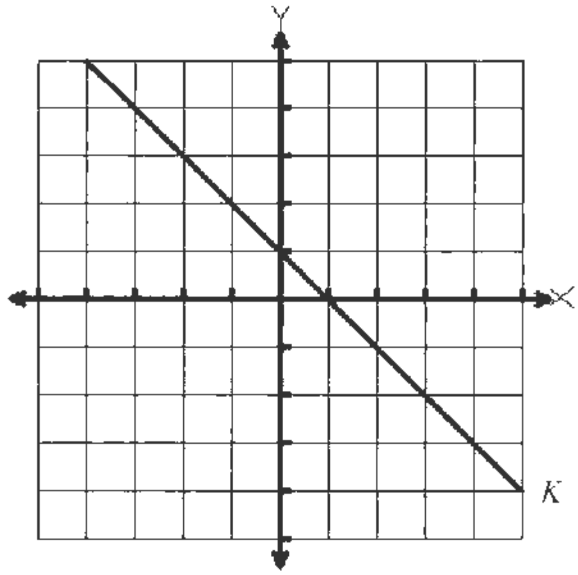
11) Determine which relation is a function.

(1) {(1, 3), (2, 6), (1, 4)} (2) {(1, 3), (3, 5), (2, 4)}

(3) {(4, 5), (4, 6), (3, 5)} (3) {(5, 3), (1, -2), (5, 0)}

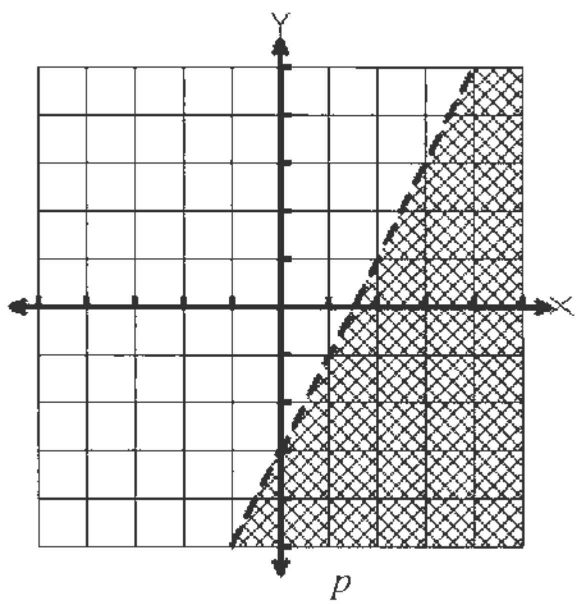
12) The accompanying diagram shows the graph of line K. Which equation represents this line?

(1) $y = x + 1$ (2) $y = \frac{1}{2}x + 2$ (3) $y = -x + 1$ (4) $y = -\frac{1}{2}x + 2$



13) The accompanying diagram shows the graph of line p. Which equation represents this line?

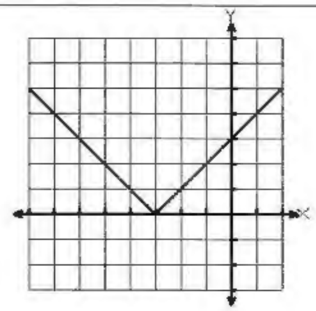
1) $y \leq 2x - 3$ (2) $y \geq -2x - 3$ (3) $y > 2x - 3$ (4) $y < 2x - 3$



Part II:

14) Match the absolute value equation to its corresponding graph.

Absolute Value Equation	Corresponding Letter
$y = -\|x\|$	
$y = \|x+3\|$	
$y = \|x\|$	
$y = \|5x\|$	
$y = \|.25x\|$	



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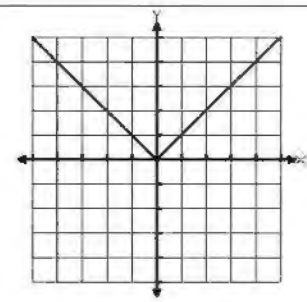

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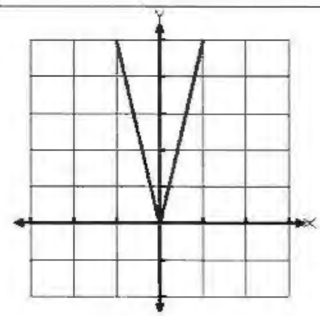

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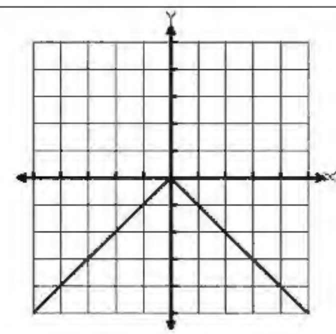

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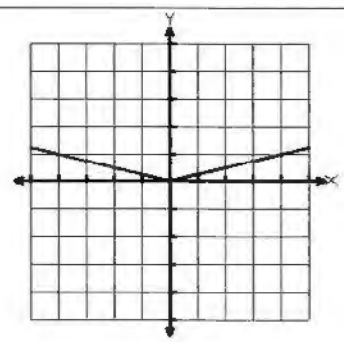

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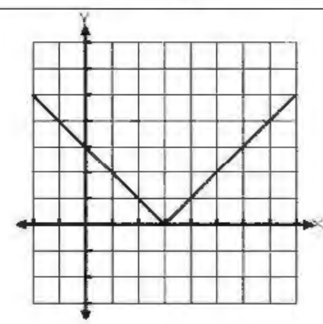
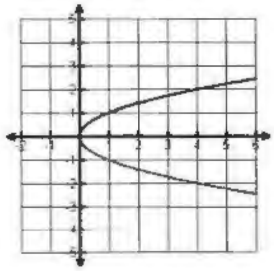


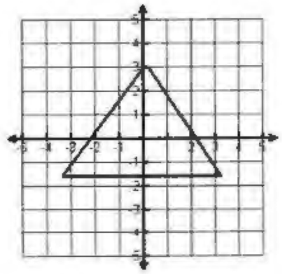
F

15) Which of the following represents a function?

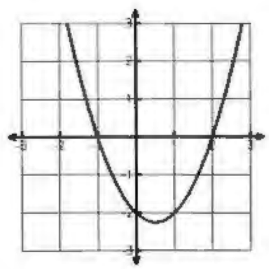
(1)



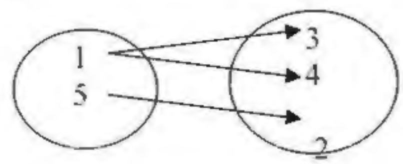
(2)



(3)



(4)



16) Solve the following absolute value questions:

a) $|x+3|=5$

b) $|3x-7|+5=16$

17) Solve the following absolute value question and graph:

$$|x+9|<7$$

18) The following table gives pairs of values for *s* and **P**, where s is the side of a triangle and **P** is the perimeter. The units of measure are the same. *S* varies directly with **P**.

s	1		3	
P	3	6		12

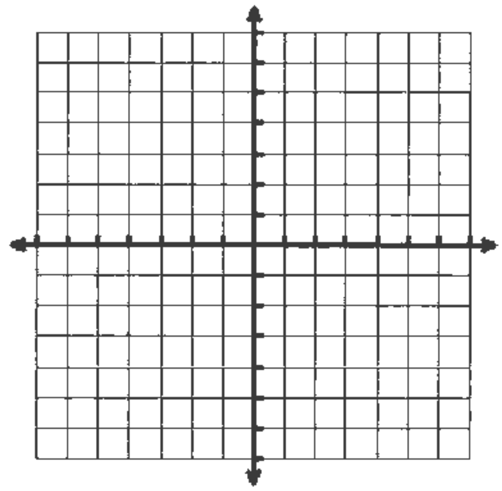
a) Fill in the missing numbers.

b) What is the constant of variation?

c) Express the relationship between *s* and **P** as a formula:

d) Find the value of s when **P** = 21.

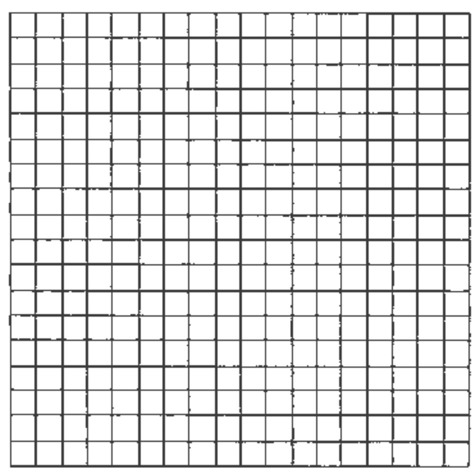
e) Graph the model.



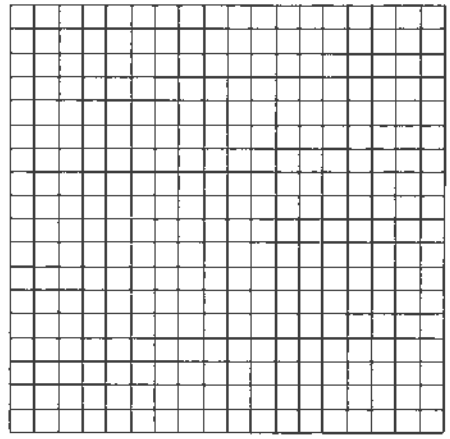
19) Write the equation of the line with the given slope and y-intercept.

a) m = 3 ; b = -2

b) Graph this equation:



20) a) Through the point (-3, 1), graph the line with the slope of -2.



b) Write the equation of this line.

21) Write the equation of the line that passes through the points (0, 4) and (-2, -2)

22) Solve the following problems and graph:

a) $x - 4 > 5$

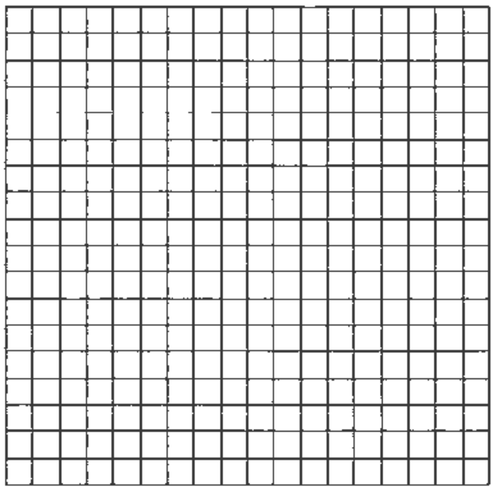
b) $(2x \leq -3) \vee (x - 1 > 2.5)$

23) Solve the following inequality and graph it on the number line:

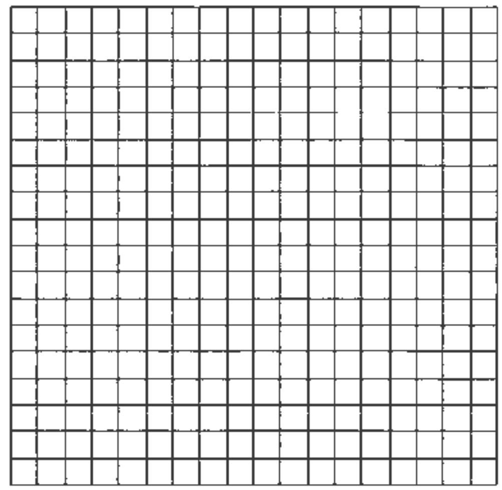
$$-6 < 3x - 3 \leq 12$$

Graph each of the following inequalities:

24) $y < \frac{3}{2}x - 3$



25) $y \geq -2x + 5$



Bonus: A straight line with the slope of $\frac{2}{3}$ contains the points (-3, 0) and (3, K). Find the value of K.