

Differentiating Instruction:
The effects of differentiating by topic and by interest

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Abstract

Differentiating instruction is a method of instruction that has been used in the classroom for years. It was of interest to determine how this method could be applied and used in an everyday classroom; it was of interest to determine if there are benefits, what they are and whether or not students excel. In order to answer some of these questions, literature that supported and refuted differentiated instruction was looked at and reported. Furthermore, in preparation for a New York State math exam, the teacher used methods of differentiating instruction to explore its effect on students' learning and growth in the classroom. Students were given a preliminary assignment to determine student readiness and then were given follow-up assignments based on student readiness and interest. Three groups were used in the research: one that did not include a teaching approach geared toward differentiating instruction and two that did include the approach. The results were taken from student input, teacher input, and quantitative data that demonstrated growth in varying areas of the curriculum. It seemed that differentiating instruction proved to be beneficial.

Dedication

This paper is dedicated to the students at Honeoye Central Schools, without whom this research could not have been completed.

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Differentiating Instruction: What is it, what are its benefits and how is it implemented?

Differentiating instruction (DI) is a method of educating students in a diverse classroom. It is believed that this type of education is not simply a new fad; in fact, DI was the basis of the one-room schoolhouse in that the teacher addressed a variety of different needs in a single classroom (Anderson, 2007).

It seems that DI warranted that what a student learns, how the student learns it, and the means through which the student validates what he or she has learned corresponds to the student's ability level, interests, and preferred mode of learning (Tomlinson, 2004). The primary of differentiating is to maximize the learning capability of each student, with the ultimate goal of proficiency (Tomlinson, 2005; Anderson, 2007). Research suggests that this can be accomplished through varied learning options, different learning paces, and individualized instruction based on interests and needs (George, 2005).

The research seemed to indicate that differentiating instruction is beneficial to ideally all students in the classroom. It was of interest to determine how to implement these strategies in the classroom to see if the students did, in fact, benefit from the differentiated instruction.

This paper will discuss the literature that supports and refutes differentiating instruction, an action-research plan based on the literature to implement differentiating instruction in a classroom, and the results that come about from the action-research that was conducted.

Literature Review

Differentiating instruction is a process in which teachers educate their students based on readiness, ability, and interest. Each student is unique in his or her way and differentiated instruction allows the teacher to highlight students's strengths, as well as to capitalize on their strengths to create a better and more educated learner that shows growth throughout a learning process. The literature seemed to support that differentiating the instruction in the classroom is beneficial to most learners. This review of the literature will include the benefits of differentiating instruction, the types of learners that gain educational opportunities, what types of assessments are necessary, methods and strategies for differentiating instruction in the classroom, and groupings that are necessary in the differentiated classroom. It also discusses differentiating mathematics instruction and the social advantages of differentiating instruction.

Benefits of Differentiating Instruction

The homogenous classroom does not exist. Students of different races, genders, religious backgrounds, familial backgrounds, and socio-economic status all must learn in the same classroom. Students of different interests, abilities, and talents all must benefit from instruction that is provided in the classroom. Historically, integration of less than traditional students in the classroom has occurred in stages in the United States. Black, disabled, and non-English-speaking students were gradually introduced into the mainstream classroom. Separate but equal was the original philosophy when integration was first introduced, however, the class progressively transformed into a place where all students were incorporated (Broderick, Mehta-Purekh, & Reid, 2005). Gregory and

Chapman (2007) stated that one size does not fit all. It is not practical to ask students to wear the same size clothing; similarly, it seems that it is not practical to require the students to learn, and furthermore enjoy learning, in a classroom that requires students to learn in one particular way, mainly by completing the same type and amount of practice of the content (Anderson, 2007).

Because research has shown that students cannot be expected to learn in one particular way, the teacher assumes responsibility, not only of teaching content, but also of educating each student in an appropriate and beneficial manner (Nordlund, 2003; Tomlinson, 2006). Some schools have failed to meet the needs of a considerable number of students with diverse needs and learning styles (Hendrickson & Gable, 1997; Lawrence-Brown, 2004). Students tended to prioritize what they enjoy doing based on strengths, needs, interests, and preferences, and if the students were finding the information they were learning was not relevant to their lives, the priority of learning becomes low (Lawrence-Brown, 2004).

To deal with this, DI allowed for a shift from teacher-centered instruction to student-centered instruction (Rock, Gregg, Ellis, & Gable, 2008). DI heightened teacher awareness of individual differences (George, 2005), and thus he or she was able to create individualized lesson plans that addressed the students' needs. The teacher was perceived as a coach in the classroom and facilitated student learning. Through direct instruction, teacher-talk was greater than student-talk, and the teacher did 84% of the acting in the classroom (Tieso, 2003). However, the Research has shown that the teacher is generally happier when facilitating than when providing direct instruction (Broderick, Mehta-Purekh, & Reid, 2005). Additionally, through DI, not only was the student the

main worker (George, 2005), student talk was the main discourse, making the lesson “interactive, dynamic, and communicative” (Benjamin, 2006, p. 58). Because the classroom was student-centered, DI also allowed students to connect content to their personal lives (Rock, Gregg, Ellis, & Gable, 2008) and thus students enjoy learning (Noble, 2004).

It was typical that each student entered the classroom at a different level of readiness than his or her peers and the goal is to grow from that initial level (Tieso, 2003). The instruction was catered to the students’ entrance level and continued to improve and motivate students to learn through modes that were of interest to the student (Anderson, 2007; Hendrickson & Gable, 1997; Lewis & Batts, 2005; Tomlinson, 1999; 2000; 2003; 2004; 2005; 2006). Through DI, teacher and student collaboratively established clear learning goals that increased student satisfaction with learning, which in turn increased intrinsic motivation and engagement, and decreased extrinsic motivation (Tomlinson, 2005; Gregory & Kuzmich, 2004; Noble, 2004). Students were also given opportunities to participate in learning activities that they choose, and thus they find meaning in the learning process (Anderson, 2007; Benjamin, 2006). Accordingly, life-long learners were developed through DI, and old tactics of “bribery, coercion, and fear” are no longer necessary (George, 2005, p. 18). Additionally, student attention was obtained more easily and lasts much longer (Tieso, 2003). Since it appeared that students were intrinsically motivated, it was much easier to put responsibility into students’ hands (Tomlinson, 2005; Anderson, 2007; Brimijoin, Marquissee, & Tomlinson, 2003) and thus students were held more accountable for their learning (Gregory & Chapman, 2007).

Moreover, students learned how to learn through DI (Benjamin, 2006; Nordlund, 2003). Not only did they learn about metacognition, but students also learned how to be critical thinkers and how to improve their study skills (Broderick, Mehta-Purekh, & Reid, 2005). Students of all abilities were introduced to higher-level thinking skills and open-ended problems that produced positive learning results (Gregory & Kuzmich, 2004; Benjamin, 2006). This was only possible in a safe and challenging learning environment, one that DI promotes (Tomlinson, 2005).

Since DI addressed all types of learners, it seemed that everyone benefited from this instruction. Low-ability students and students with learning disabilities, average students, and gifted students were all able to learn within the same classroom; they could learn from the teacher and from one another. Through DI, low-ability students were successfully brought up to higher standards, students with learning disabilities reaped more benefits in the general classroom than in a special education setting, the average student became special, and gifted students were pushed to levels that they might not necessarily be pushed to in a traditional classroom (George, 2005).

According to Tomlinson (2003), “Students consistently want teachers who respect them, listen to them, show empathy toward them, help them work out their problems, and become human by sharing their own lives and ideas with their students” (p. 58). Research suggested that teachers promote this positive environment (Tomlinson, 2005; Anderson, 2007; Noble, 2004).

The Learners

Research has shown that all types of learners benefited from DI. Direct instruction or whole classroom teaching may have assisted some average learners, but DI reached out and assisted all learners. In a traditional classroom, sometimes students on either end of the learning spectrum were asked to leave the classroom for disciplinary issues, when, in fact, they may be out because of learning problems. Gifted students may have been acting out because they were bored with the seemingly easy material. Students with disabilities may have been acting out because they were struggling and were looking for anything to distract the teacher from their assumed deficiencies (Broderick, Mehta-Purekh, & Reid, 2005). Regardless of the cause, it appeared that DI helps to deal with these behavioral issues by addressing each student's needs.

Gifted and Talented. Although natural ability was important in the classroom, it seemed that diligence, persistence, and conscientiousness were crucial for success, not only in the classroom but also in the real world (George, 2005). Due to past experiences, some students may have believed that getting good grades required little effort; they had the natural ability to accomplish the middle-of-the-road standards established in the traditional classroom, and thus they are able to succeed without exerting effort. Even more, some students may have developed the belief that they were entitled to good grades (Tomlinson, 2005). DI allowed for a balance between successes and challenges, without frustration, both of which are essential in the learning process (George, 2005). This allowed students to strive for, not only excellence, but expertise as well (Tomlinson, 2005).

Additionally, in a differentiated classroom, students were able to remain in the classroom with their peers. According to George (2005), gifted students' self-concept could have declined if they were pulled out of the general classroom. Lawrence-Brown (2004) maintained that a sense of isolation decreased if the student was allowed to stay in the classroom. Because gifted students remained in the classroom, an additional dimension of learning was added: peer-to-peer interaction. With different types of grouping available in a differentiated classroom, gifted students were given more opportunity to explain concepts to students, a process which required higher-level thinking. Thus, critical thinking was heightened (George, 2005).

With regards to gifted students, it seemed necessary that the teacher must have taken extra precaution in differentiating their instruction. Some parents and students believed that they were punished by being given extra work because they have shown they are more able (Fahey, 2000; Olenchak, 2001). In fact, some argue that differentiating the instruction generated inconsistent interpretations and results. When gifted students were taught through differentiated instruction, some students responded negatively. One gifted student stated that DI is only a way of relieving teachers of their guilt in the classroom. They believe they are assigned more work that is not meaningful to their lives and as a result do not enjoy the learning process (Olenchak, 2001). Therefore, it seemed that it is of utmost importance to create meaningful and interest-based lessons to challenge and promote growth in the gifted student.

Students with Disabilities. According to Broderick, Mehta-Purekh, & Reid (2005), "Disability does not reside in the individual, but rather in the interactions between the individual and the environment" (p. 196). This implied that the student was classified

as having learning disabilities because the environment in which the student was learning was one in which the student truly is disabled and at a disadvantage while learning. It seemed that classrooms that have large percentages of less successful students were those in which a traditional tell them and test them method was present, which was insufficient for diverse learners (George, 2005). DI reduced failure in the classroom (Noble, 2004) and broke down barriers that that may otherwise hinder a student with a learning disability (Anderson, 2007).

Research has shown that students found greater success when they were receiving supports in the general education classroom as opposed to those who were in a self-contained special education classroom (Lawrence-Brown, 2004). Due to this integration, it seemed that these students may not benefit from a traditional learning setting.

Response to Intervention, RTI, was incorporated in some differentiated classrooms (Johnson & Smith, 2008). Through RTI, students were assessed to determine if they were at-risk and if they were, intervention was required. It seemed that student success was an outcome (Lewis & Batts, 2005).

In a standards-based educational world, standards held all types of students accountable. Thus, it seemed that differentiating was even more important. The general classroom did not water down material for students with learning disabilities, and the teacher was required to develop valuable and meaningful lessons that addressed all learning types (Lawrence-Brown, 2004). Consequently, students had access to high-quality curriculum, curriculum they may not necessarily had access to in a self-contained classroom (Rock, Gregg, Ellis, & Gable, 2008). Research also showed that students who may have not mastered basic skills can still participate in higher level thinking activities.

It seemed that accommodations are necessary to allow this participation, another way to differentiate instruction (Broderick, Mehta-Purekh, & Reid, 2005).

Stronger students who could individually think on a higher-level were characteristically able to focus on key ideas and determine minor details as being less important. In the differentiated classroom, through peer-to-peer interaction, students with learning disabilities were able to learn from their peers how to focus in on key ideas. Additionally, further modifications could be made to promote this skill through teacher-student interaction (Lawrence-Brown, 2004).

It seemed important to indicate that, while differentiating instruction was beneficial to students with learning disabilities, it was also essential that any activities are structured. A more disorganized student needed to have a more structured activity in order to succeed (Nordlund, 2003).

Assessment

The Research has shown that differentiating is important in instruction and assessment, but also assessment is a vital characteristic of differentiating instruction. According to Tomlinson (2006), assessment and instruction were inseparable. Grading and assessment, however, did not appear to be the same. Because there was no one correct way to grade, DI allowed students several opportunities to demonstrate what they had learned (Tomlinson, 2005). Students were assessed to determine what they gained from a lesson, an activity, or a unit. Grades, however, were based on criteria (Tomlinson, 2005) and, in the differentiated classroom, were based on student growth. The literature also supported that grades should not be normative as the learning curve did not have to

exist. The ultimate goal for students was to learn and thus the students do not necessarily have to fall within a learning curve (Tomlinson, 2005) as teachers strive for 100% success.

Assessment, especially informal assessment, formed instructional plans (Tomlinson, 2005; Rock, Gregg, Ellis & Gable, 2008; Edwards, Carr & Wiegel, 2006; Gregory & Kuzmich, 2004). An example of this is a method that Ms. Martez used in her fifth grade classroom. At the end of instruction, she asked her students to describe their level of comprehension of the instruction: Are they clear as glass, are there bugs on the windshield or is the windshield covered with mud? After students answered these questions, they were asked to work on a corresponding station in order to develop their comprehension based on their readiness. She used a red-yellow-green cup strategy. While students were working independently or in groups, they had a cup on their workspace. If the students were experiencing difficulty and were unable to continue working, they placed the red cup on their desks. If the students were struggling, but can go on to something else until the teacher is available for assistance, then they placed the yellow cup on their desks. If they are progressing comfortably, the green cup was placed on the student's desk (Brimijoin, Marquissee, & Tomlinson, 2003).

Additionally, decisions related to student accommodations should include the students (Hendrickson & Gable, 1997) and a collaborative analysis of student work could prove to be beneficial to the student. This increased student accountability and responsibility (Gregory & Kuzmich, 2004; Tomlinson, 2005). Because DI addressed students' interests and needs, it seemed beneficial to allow students to demonstrate what they have learned through a variety of different assessments (Anderson, 2007), including

self-assessment (Brimijoin, Marquissee, & Tomlinson, 2003) and evaluating checklists (Tomlinson, 2003). Consequently, the assessment gave students a goal or an endpoint to reach (Tomlinson, 2005). This may have seemed difficult, especially in a standards-based classroom (Anderson, 2007), but “what constitutes a proper response is based on objectives” (Broderick, Mehta-Purekh, & Reid, 2005, p. 199), and as long as the objectives were based in the standards, then it seemed that several different methods of demonstrating learning were acceptable as an assessment.

If students were given more choice in assessment, Tomlinson (2005) asserted, then fairness was promoted in the classroom. Students also had positive experiences in the classroom; they were met with success, fulfillment, and positive interaction with teachers and peers, promoting active, life-long learners (Tomlinson, 2005; Anderson, 2007; Noble, 2004).

Authentic assessment also promoted life-long learners because students were shown real-life applications of the content they were learning (Tomlinson, 2005). Authentic assessment was not an additional assignment in the classroom but another way to differentiate instruction (Lawrence-Brown, 2004).

Learning and individual contracts, portfolios, and narrative reports also served as another means of assessing students. Student and teacher can develop contracts in which the student can pursue individual interests and work at their own pace to demonstrate teacher-established objectives. Multiples grades could serve as a method of assessing the learning outcome. Students can be evaluated based on content, effort, transfer of knowledge, and growth in the process. Checklists can offer students a chance to demonstrate a list of objectives. They can also serve as self-assessment as well as self-

comparison. Weighted grades and pass-fail could also serve as effective forms of assessment (Hendrickson & Gable, 1997; Nordlund, 2003).

Performance tasks and open-ended assessments were another means of assessing students. Any task can be individualized and differentiated based on student ability, readiness, and interest (Benjamin, 2006). Rubrics can also evaluate students on their growth and can provide positive and effective feedback (Lawrence-Brown, 2004; Tomlinson, 2003).

Differentiating Mathematics Instruction

According to Bryant (2005), five to eight percent of students exhibited mathematical disabilities, making it seemingly necessary to differentiate mathematics instruction starting in kindergarten. In a traditional mathematics classroom, whole-class instruction can be common. More capable students tended to dominate the discussion that occurred in this type of a classroom. Even in small group work, the capable students dominated this discussion. In order for students to learn, however, it was important for students to understand math on a conceptual level, a comprehension that was achieved through authentic, interest-based explorations. A combination of instruction and open-ended problems were also beneficial to the student (Bryant, 2005). Building arithmetic fluency (Bryant, 2005), but including higher level thinking (Broderick, Mehta-Purekh, & Reid, 2005), was necessary for students to think about mathematics in complex ways (Woodward & Baxter, 1997).

Struggling learners had difficulty explaining their thinking and students needed an opportunity for extended speech, an opportunity offered in a classroom that is differentiated (Woodward, 2008). This can be explored further when students use the

think, pair, share method of learning. Students were asked to think about concepts individually, pair up with a partner, preferably mixed-ability partnerships, and then share their responses with the class. Because the more capable learner dominated the discussion, it was crucial that the lower-ability student is required to verbalize the process (Woodward, 2008). According to Bryant (2005), peer-assisted tutors and the articulation of cognitive strategies were crucial for mathematical development. Furthermore, problem solving, activities, and manipulatives all promoted active, differentiated learning (Bryant, 2005; Lawrence-Brown, 2004; Woodward & Brown, 2006).

Grouping

Grouping was an integral part of differentiating instruction. Grouping could be based on curriculum or classroom management. Grouping can also consist of whole-class, small group and individualized grouping. All forms of grouping have proven to be beneficial in the classroom (Rock, Gregg, Ellis, & Gable, 2008; Tieso, 2003; Tomlinson, 2005). It seemed that flexible grouping is essential in the differentiated classroom. Flexible grouping consisted of differing grouping in the classroom. Students were grouped together based on ability levels, mixed-abilities, interests, and readiness (Rock, Gregg, Ellis & Gable, 2008). Students needed to be able to move freely (Broderick, Mehta-Purekh & Reid, 2005). It was important, however, to note that flexible grouping must change, placing students in different types of groups, based on the activity and content (Tieso, 2003; Lawrence-Brown, 2004).

Using the jigsaw method is another method of differentiating the instruction through grouping. Students were assigned different roles in the groups, and the roles

were based on teacher-established growth areas (Gregory & Chapman, 2007). The most crucial aspect of group work was peer-interaction (Rock, Gregg, Ellis & Gable, 2008). It also seemed that an important aspect of group work is that it reduced teacher dependence and promoted learning independence, which was a main educational goal in most classrooms, regardless of the philosophy of education (Broderick, Mehta-Purekh, & Reid, 2005; Lawrence-Brown, 2004).

Although it seemed that grouping was important in DI, the literature supported that it is imperative that grouping did not reproduce tracking in the classroom (Lawrence-Brown, 2004). Additionally, it seemed that it is necessary to note that grouping only has a positive effect in the classroom when accompanied by differentiated curriculum (Tieso, 2003).

Methods and Strategies

According to Benjamin (2006), an effective classroom consists of ritual and variety. Benjamin claimed that ritual is necessary because students needed structure and familiarity in the classroom. Variety was necessary because students need novelty and excitement.

In the differentiated classroom, teachers adjusted content, process, and product (Lewis & Batts, 2005; Nordlund, 2003). An example of this was shown through literature circles. A teacher chose several books to teach the same content to her class. Students were allowed to choose the book they will read based on their interest, and the teacher reviewed the choices made to ensure that students reaped the most benefit from the instruction. Generally, the students chose books appropriate for their readiness level.

Then, the teacher created individualized lessons to address the students' abilities and to promote growth (Lewis & Batts, 2005).

Questioning tactics were also another method of differentiating the instruction. The types of questions and the way they were asked seemed to be a fundamental of differentiating instruction and thinking based on interests, readiness, and learning profile (Rock, Greg, Ellis & Gable, 2008; Noble, 2004; Anderson, 2007; Lewis & Batts, 2005). Because of this interaction, positive motivation tended to be a result (Tomlinson, 2005). Assistive technology, such as books on tape, writing and editing software, java applets on the internet, and manipulatives also served as appropriate means of differentiating instruction (Rock, Gregg, Ellis & Gable, 2008).

Choice boards were also an appropriate means of differentiating the instruction. Students were given several choices that each is linked to the standards and objectives of the lesson (Anderson 2007). Think-Tac-Toes were also similar to choice boards (Tomlinson, 2003).

Learning centers allowed for students to explore topics and practice skills. Students were grouped and they work their way through each station. Students could also work on learning or independent contracts, an agreement between the teacher and the student (Lewis & Batts, 2005).

Thematic units could be another key method of differentiating instruction. Students could participate in interdisciplinary study based on their interests and a common theme (Lewis & Batts, 2005).

Compacting the material could also function as an appropriate way of differentiating the instruction. Teachers can modify the curriculum so that students who

may be relearning concepts they have already mastered can advance and learn at their own pace. Similarly, tiered activities can also be of benefit for learners of different abilities (Lewis & Batts, 2005; Noble, 2004).

Concept maps and graphic organizers allowed students to have visual worksheets that enhance the learning. It allowed students to focus on key or big ideas, which was a skill that lower-level students seem to benefit from (Tomlinson, 2003).

Performance tasks and open-ended activities seemed to be beneficial means through which instruction can be differentiated. Students can apply their knowledge to meaningful real-life applications that appeal to their individualized interests. The activities were based on their abilities, readiness, and learning styles, which are all components of differentiating instruction (Benjamin, 2006; Tomlinson, 2003).

The Research has shown that there are many formats, strategies, and methods that teachers can incorporate in their teacher toolboxes that promoted not only an opportunity for students to grow intellectually and socially, but also provided meaningful activities that increase intrinsic motivation in order to encourage life-long learning.

Social Aspect of Differentiating Instruction

Equity is fundamental in the United States. Students have a right to education. Unfortunately, this right has been interpreted to a physical education. That is, students only need to be present in the classroom to have their rights fulfilled. However, students also have a right to an education that allows the students to benefit from the instruction. “Equity is a noble goal, but not at the expense of students who lie on either end of the

normal curve, especially in these days of political rhetoric and a heightened concern for educational accountability” (Tieso, 2003, p. 33).

According to George (2005), differentiating instruction was “a key to the survival of the American public school as society has come to know it” (38). If learning differences were not addressed or appreciated, then public schools could cease to exist in the future. Public schools will become “pauper schools serving the few remaining uncategorized students,” while magnet programs, charter schools, and schools for students with special needs continued to flourish. “This scenario may be all too likely if...parents...withdraw their children from conventional public schools, and join the already sizable system of quasi-private and private education based largely on the ability to pay or the capacity to serve special needs” (George, 2005, p. 38). Without DI, heterogeneous classrooms and authentic assessment will cease to exist, and one wonders, if this will prepare students for real-life situations (George, 2005).

In the past, students with learning disabilities were only taught by special education teachers (Nordlund, 2003) and in the traditional classroom, general education students had little to no interaction with students with learning disabilities (Broderick, Mehta-Purekh, & Reid, 2005). Consequently, students in the general education classroom could harbor misconceptions about the students with learning disabilities (Broderick, Mehta-Purekh, & Reid, 2005). Now, 60% of disabled students are in the classroom (Hendrickson & Gable, 1997). Research has shown that students with learning disabilities who were receiving supports in the general education classroom reported higher results than those who are educated in the special education classroom

(Lawrence-Brown, 2004). Furthermore, it seemed that students' self-esteem is improved in the differentiated classroom (Tieso, 2003).

It seemed natural that accommodations were made for students with learning disabilities; differentiating instruction, however, addressed the equity in the classroom and ensured that accommodations are made for all students (Hendrickson & Gable, 1997).

Material, processes, and assessment promoted fairness in the classroom—fairness in the sense that each student is given opportunity to learn, grow, and succeed based on their individual needs (Tomlinson, 2005). Additionally, flexible grouping allowed for students who may not customarily be in an advanced placement to receive enrichment, such as students of color or of lower socio-economic status (George, 2005). Even more, since flexible grouping is temporary, students of different backgrounds can move in and out of the enriched groups, further promoting equity in the classroom (Tieso, 2003).

According to George (2005), contact theory was also important. The more students interact with others, the more likely they will consider each other friends, creating a positive social atmosphere, not only in the classroom, but in the school community as well. Thus, a community of learners was built in which each student holds responsibility (Tomlinson, 2005).

Research has shown that social skills are improved through differentiated instruction. Students learned to manage their emotions and they were able to empathize with others. Empathy can also be upheld through role-playing in the classroom. Appropriate language, listening to others, and asking for help were all encouraged in the differentiated classroom. Also, the classroom expected students to

disagree, requiring students to accept others' opinions. Additionally, conflict resolution can be an integral part of the differentiated classroom (Gregory & Chapman, 2007).

Because each student is different, teachers became more aware of diversity in the classroom, allowing the teachers to diversify while planning lessons (Broderick, Mehta-Purekh, & Reid, 2005), entailing teachers, administrators and support staff to collaborate with one another. As a result, DI developed collegiality in the work place (Benjamin, 2006).

Not only do students benefit academically from DI, but students learn to become integral members of the communities in which they are involved. According to Tomlinson (1999),

Schools must belong to all of these children. Educators often speak of equity as an issue with children of the former group (children without experience and support) and excellence as an issue for the latter (children with experience and support). In truth, equity and excellence must be at the top of the agenda for all children.” (p. 35)

Thus, it seems necessary that students are treated with the utmost respect and equity; they should be allowed to feel safe to learn in an environment in which they are challenged, and because each student is challenged in a different manner, the differentiated classroom allows for students to develop skills, acquire content, and demonstrate comprehension in a fair, socially equitable environment.

Summary

The research overwhelmingly showed that all types of learners benefit from instructional strategies that incorporate teaching strategies in the classroom. Very little research can be found that indicated otherwise, and the research that was found indicated that gifted and talented students did not benefit from the instruction as others in the classroom did. Many other sources, however, indicated that if the instruction is differentiated appropriately, then all students, especially those on opposite ends of the learning spectrum, were given opportunities to learn and to succeed.

There are many strategies that were highlighted in the differentiated classroom that prove to be beneficial. Proper and meaningful implementation of these strategies seem to be valuable to different students in the classroom. Not only did students learn through differentiated instruction, their ability to understand themselves as learners who think about learning is heightened, promoting higher level and critical thinking skills. Students could also demonstrate their comprehension and growth through varied forms of assessment that uphold success in the classroom. Differentiated instruction also promoted social equity in the classroom as well as behavioral and managerial opportunities that create positive learning environments.

Methodology

Based on the literature, some questions arised in regards to the implementation of differentiated instruction in the classroom. How was the mathematics instruction differentiated? What strategies appeared to be beneficial to students in the classroom? Before these were addressed, the demographics of the subjects needed to be addressed first.

Demographics

The research was completed in Honeoye Central School, which is classified as a rural school. The average class size ranged from 70 to 100 students. Specifically, the research was implemented in eighth grade classrooms.

Three classrooms were looked at: two of which had a differentiated approach and the third, which did not see any changes from how the class normally ran. The two variable groups, called group B and group C, consisted of 16 and 15 students respectively, and group A, the control group, consisted of 14 students.

Group B was a special integrated classroom, in which students with special needs who, in the past may have been pulled out for math class, were integrated in the traditional classroom. This particular classroom consisted of four special integrated students, each of which had an Individualized Education Plan, or IEP. Additionally, this particular group was taught by a general education teacher and a special education teacher, both of which were co-teachers in the classroom. The remaining twelve students in the classroom did not have any learning disabilities, and thus did not have an IEP or a

504 plan. Only one member in group B received remedial math services, which were administered three times a week.

Group C did not have any special integrated members in the classroom, but did have four members classified with learning disabilities in math, and one student who was at one point classified, but is now declassified. Although a special education teacher was not in the classroom on a daily basis, the teacher would be in the classroom at least twice a week. When the teacher was in the classroom, a co-teaching model would also be followed. Furthermore, a teaching assistant would be in the classroom when the special education teacher was not available, and provided more opportunities of assistance to the students than the general education teacher was able to provide individually. Additionally, two members of the group, who were not classified as special education students, received remedial math services three or four times a week.

Like group C, group A did not have any special integrated members in the classroom. Group A did have, however, three members who were classified as special education students, one of which also received remedial math services three times a week. This class was not co-taught, as the special education teacher did not come to the classroom. A teaching assistant was present in class at least three times a week, again to provide extra support in the classroom.

Differentiated Strategies

The experiment was completed during the time that the students studied and reviewed for their state exam in math in March. The students were given about four weeks of time to study. In order to determine each student's needs, to successfully differentiate the instruction, preliminary assignments were given to each student in

groups B and C. The students were given a model of the New York State Math 8 exam. Then, item analysis was used to determine the areas that the students demonstrated proficiency and the areas in which the students, individually, needed more help in.

Students were then given agendas or learning contracts in which each student was required to complete an assignment specific to the areas in which they showed they needed to improve, as shown in Appendix B. The classroom was set up in stations that have mathematical topics the students had trouble with, and each student completed the stations that the teacher and the student agreed upon in their learning contracts.

The mobile lab was also an option that students were able to use in the classroom. The mobile lab was a set of laptops that have wireless connection to the internet. The students were asked to sign into the website, www.castlelearning.com. As soon as they signed in, each student saw a list of assignments that they needed to complete. There were eight different question sets based on the topics and areas of needed, and each student was assigned based on the topics they struggled with. The website provided instantaneous feedback, indicating which questions the students were able to complete correctly on the first and second attempts, and which questions the students were not able to complete successfully.

In addition to the instantaneous feedback that the Castle Learning software provided, both teachers, where applicable, informally assessed the students while working at their stations. This informal evaluation provided the teachers an opportunity to modify the differentiated instruction and adjust. If students were showing that they were capable in one station and did not require extra help, they were given opportunities to work in other stations.

Furthermore, while working in stations, and based on the informal and formal evaluation, students were then placed in peer-tutoring groups. Students who showed strong conceptual understanding of specific concepts were grouped with students who still needed additional help in those areas. The students were then given a few problems in each topic to discuss with each other. The students who showed strong understanding tutored their peers.

The students who were in group A were required to complete a set of problems that contained all the topics that were present on the state exam. They were not required to work on the laptops using Castle Learning to complete each set of topics.

Data Evaluation

Students were evaluated on their initial starting point based on the preliminary assignment, an assignment that had review questions from each of the eight units of review. Qualitative and quantitative data was collected. Both teachers informally assessed the students as they worked on the preliminary assignment, taking notes on the students' strengths and weaknesses. The teachers also determined the percentage of accurate responses on each assignment, determining the students' best units and units that required improvement. Then, students were informally evaluated by both teachers during the stations review. They were also formally evaluated using the online software as well as periodic quizzes throughout the unit. Informal notes were taken on the students during the stations and computer assignments and quantitative data was gathered on the assignments they worked on at stations or on the laptops.

Conversation also occurred between the teachers; they determined which students were benefiting from the assignments and which students needed adjustments to their

assignments. Conversation also occurred between the teachers and the students, getting insight as to what the students found beneficial and what they wish could have been changed. A vocabulary quiz was administered as a means of assessment and lastly, the state exam served as a means of assessment.

Results

The research that was conducted in the three classrooms indicated in the methodology produced several results. Students were asked to complete a preliminary assignment, and then were given a choice between stations or computers to work on assignments with which both the students and the teacher felt they needed extra practice. Because the research was multi-faceted, there were several aspects to consider when reporting the results.

Preliminary Assignments

In all three classes, the students were given a preliminary assignment in which they were required to solve assigned problems based on given units throughout the school year. This served as a means of determining in which subject areas in the curriculum each student required extra reinforcement. Throughout the assignment, teachers and students noted with which assignments the students were most comfortable, and with which assignments the students required additional practice. Tables 1, 2, and 3 indicate the percentage of accurately answered questions for groups A, B, and C respectively. As shown in the tables, group A averaged 80.35%, 85.00%, 85.71%, 88.02%, 85.99%, 94.05%, 80.96%, and 80.10% on each of the eight units respectively, for a total average of 85.15% accuracy. Group B averaged 73.95%, 77.81%, 80.41%, 84.58%, 81.50%, 91.15%, 75.56%, and 75.44% , with a total average of 80.05%. Group C averaged 72.23%, 81.43%, 80.85%, 85.53%, 80.54%, 92.78%, 76.67%, and 76.19%, with a total average of 80.78%.

Table 1.

Group A—Percentage of Accurate Responses from the Preliminary Assignment

Student	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
A	89.9%	95.0%	95.7%	100.0%	95.2%	100.0%	91.7%	85.7%
B	83.3%	90.0%	95.7%	100.0%	90.5%	100.0%	91.7%	85.7%
C	89.9%	90.0%	91.3%	95.8%	90.5%	100.0%	91.7%	78.6%
D	83.3%	85.0%	91.3%	91.2%	85.7%	100.0%	83.3%	85.7%
E*	72.2%	95.0%	95.7%	91.2%	95.2%	100.0%	83.3%	78.6%
F*	94.4%	100.0%	95.7%	100.0%	100.0%	100.0%	91.7%	92.9%
G*	55.5%	65.0%	60.9%	58.3%	61.1%	83.3%	58.3%	71.4%
H	61.1%	60.0%	69.6%	66.7%	81.0%	83.3%	50.0%	42.9%
I	83.3%	85.0%	82.6%	87.5%	85.6%	91.7%	83.3%	71.4%
J	78.8%	80.0%	78.3%	87.5%	71.4%	91.7%	75.0%	85.7%
K	83.3%	90.0%	91.3%	83.3%	90.5%	91.7%	83.3%	71.4%
L	83.3%	85.0%	86.7%	87.5%	90.5%	100.0%	91.7%	85.7%
M	72.2%	75.0%	65.2%	83.3%	71.4%	83.3%	66.7%	85.7%
N	94.4%	95.0%	100.0%	100.0%	95.2%	91.7%	91.7%	100.0%
Total Questions	18	20	23	24	21	12	12	14
Average	80.35%	85.00%	85.71%	88.02%	85.99%	94.05%	80.96%	80.10%

* Student with IEP or 504.

Table 2.

Group B—Percentage of Accurate Responses from the Preliminary Assignment

Student	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
A	94.4%	95.0%	95.7%	100.0%	90.5%	100.0%	91.7%	100.0%
B	83.3%	85.0%	87.6%	91.7%	85.7%	100.0%	83.3%	85.7%
C*	55.6%	55.0%	69.6%	83.3%	76.9%	83.3%	67.7%	64.3%
D	77.8%	85.0%	91.3%	91.2%	85.7%	100.0%	83.3%	85.7%
E*	77.8%	55.0%	87.6%	66.7%	61.1%	91.7%	58.3%	71.4%
F	77.8%	90.0%	87.6%	91.7%	81.0%	100.0%	91.7%	64.3%
G	72.2%	80.0%	87.6%	75.0%	85.7%	91.7%	75.0%	71.4%
H*	61.1%	60.0%	69.6%	66.7%	81.0%	75.0%	41.2%	35.7%
I	83.3%	90.0%	86.9%	100.0%	90.5%	91.7%	91.7%	85.7%
J	94.4%	90.0%	87.6%	100.0%	95.2%	91.7%	100.0%	85.7%
K	72.2%	95.0%	87.6%	100.0%	90.5%	91.7%	91.7%	92.9%
L	94.4%	95.0%	91.3%	100.0%	90.5%	100.0%	91.7%	85.7%
M	55.6%	75.0%	69.6%	83.3%	76.2%	75.0%	66.7%	64.3%
N	38.9%	65.0%	69.6%	66.7%	76.2%	83.3%	58.3%	64.3%
O	94.4%	85.0%	69.6%	91.2%	61.1%	100.0%	75.0%	85.7%
P*	50.0%	45.0%	47.8%	45.8%	76.2%	83.3%	41.7%	64.3%
Total Questions	18	20	23	24	21	12	12	14
Average	73.95%	77.81%	80.41%	84.58%	81.50%	91.15%	75.56%	75.44%

Table 3.

Group C—Percentage of Accurate Responses from Preliminary Assignments

Student	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
A	88.9%	95.0%	87.6%	100.0%	85.7%	100.0%	91.7%	100.0%
B	66.7%	85.0%	69.6%	91.7%	61.1%	100.0%	66.7%	64.3%
C	77.8%	75.0%	69.6%	66.7%	76.2%	83.3%	58.3%	71.4%
D*	61.1%	85.0%	91.3%	100.0%	85.7%	100.0%	75.0%	64.3%
E	77.8%	80.0%	87.6%	83.3%	81.0%	91.7%	91.7%	85.7%
F	66.7%	75.0%	69.6%	83.3%	81.0%	83.3%	75.0%	64.3%
G	72.2%	85.0%	69.6%	75.0%	85.7%	91.7%	75.0%	64.3%
H	88.9%	90.0%	87.6%	100.0%	90.5%	91.7%	91.7%	85.7%
I	77.8%	85.0%	86.9%	100.0%	90.5%	91.7%	83.3%	85.7%
J*	94.4%	95.0%	91.3%	100.0%	95.2%	100.0%	91.7%	92.9%
K	38.9%	75.0%	87.6%	75.0%	76.2%	83.3%	66.7%	64.3%
L	55.6%	85.0%	87.6%	66.7%	81.0%	100.0%	83.3%	85.7%
M*	55.6%	75.0%	69.6%	75.0%	76.2%	83.3%	66.7%	64.3%
N*	66.7%	65.0%	87.6%	75.0%	81.0%	91.7%	58.3%	64.3%
O	94.4%	85.0%	69.6%	91.2%	61.1%	100.0%	75.0%	85.7%
Total Questions	18	20	23	24	21	12	12	14
Average	72.23%	81.43%	80.85%	85.53%	80.54%	92.78%	76.67%	76.19%

* Students with IEP's or 504's.

Stations vs. Computers

After the students completed the preliminary assignment, students in class A were asked to complete all the stations that were provided. Students in classes B and C were asked to choose between stations and computers to complete their review. The students chose whether they would work on stations or computers on a survey that was provided. They were also asked to indicate, based on their results and comfort level, from the preliminary assignment, which unit in which they felt the most confident and which unit in which they felt they needed the most help. See Appendix A for the survey.

As a result, 50 percent of the members in group B (8 students) chose stations and the remaining 50 percent chose computers (8 students). In group C, 100 percent of the students chose to work at stations. Furthermore, students in group A were required to complete all the stations. Students in groups B and C were asked to complete the stations that the teacher and the students determined were the topics in which they needed the most practice.

Students completed the assignments that were given to them in the order that they desired in class. For homework, they were also assigned practice exams in preparation for the state exam. The results from the practice exams are given in Table 4. Each practice exam had 27 multiple choice questions. The first two tests were practice exams and the third test was the state exam. As shown in the table, the students overall improved from the first practice exam to the final state test in multiple choice. However, group A improved 3.202%, group B improved 13.944%, and group C improved 21.535%.

Table 4.

Results from Multiple Choice Practice Exams and State Exam

Group	Multiple Choice Test 1	Multiple Choice Test 2	Multiple Choice Test 3	Percent Increase
A	24.36	24.57	25.14	3.202%
B	20.12	22.48	23.38	13.944%
C	18.76	20.94	22.80	21.535%

The results from the station and computer assignments can be found in Tables 5, 6, and 7 for groups A, B, and C respectively. Group A was required to complete all the stations and members of groups B and C were only required to complete five of the eight assignments. Students in-group B completed their assignments either on the computers or on the laptops while students in groups A and C completed their assignments only at the stations. Group A averaged 84%, 89%, 86%, 90%, 88%, 93%, 84%, and 85% on each of the eight units respectively, with a total average of 87.38%. Group B averaged 82%, 83%, 82%, 69%, 86%, 91%, 82%, 78%, with a total average of 81.63%. Group C averaged 81%, 85%, 83%, 79%, 84%, 80%, 82% on units one, two, three, four, five, six, and eight respectively with a total average of 82%.

In group B, student E was visibly frustrated with the computer assignments and switched to work on the stations. Similarly, both teachers working in group B noticed that student M was not benefiting from the stations and was asked to switch to computers. Both students experienced more success in the accuracy of completion of the work; in fact, student E's accuracy increased seven percent and student M's accuracy increased 12 percent. They also experienced a visible increase in the diligence of their work and a significant decrease in the level of frustration the students appeared to feel

The students were also asked to provide feedback through the survey that was discussed in Appendix B. The results from the survey can be found in Figures A, B, and C. When members of group B and group C were asked if the stations or computers were helpful, some of the students said that they found the stations helpful and other students

Table 5.

Group A—Percentage of Accurate Responses from the Stations Assignment

Student	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
A	92%	96%	96%	96%	96%	100%	92%	92%
B	88%	92%	96%	96%	92%	100%	92%	88%
C	88%	92%	92%	96%	92%	96%	92%	84%
D	86%	86%	88%	92%	88%	100%	86%	88%
E	76%	96%	100%	92%	96%	100%	92%	88%
F	96%	100%	96%	100.0%	100.0%	100%	96%	96%
G	64%	68%	64%	72%	64%	88%	68%	76%
H	80%	88%	72%	64%	84%	84%	60%	64%
I	84%	88%	84%	88%	88%	88%	84%	76%
J	80%	84%	76%	92%	76%	72%	76%	88%
K	80%	96%	92%	92%	96%	100%	88%	76%
L	88%	88%	92%	88%	92%	100%	92%	88%
M	76%	80%	68%	88%	76%	80%	68%	88%
N	92%	96%	100%	100%	95%	92%	92%	100.0%
Average	84%	89%	86%	90%	88%	93%	84%	85%

Table 6.

Group B—Percentage of Accurate Responses from the Stations and Computer Assignments

Student	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
A	96%	96%	100%	---	96%	---	96%	---
B	88%	88%	---	---	88%	---	92%	88%
C*	72%	76%	76%	---	---	---	72%	68%
D	84%	88%	---	---	92%	---	92%	92%
E*	---	72%	---	64%	72%	---	80%	72%
F	92%	92%	88%	---	88%	---	---	68%
G	80%	84%	---	88%	---	---	80%	72%
H*	68%	68%	72%	---	---	---	80%	72%
I	92%	96%	88%	---	92%	---	---	88%
J	100%	92%	96%	---	---	96%	---	88%
K	92%	---	88%	---	92%	96%	96%	---
L	96%	96%	100%	---	---	---	92%	92%
M	80%	---	72%	---	---	80%	64%	68%
N	52%	72%	---	72%	---	---	56%	68%
O	---	88%	72%	---	68%	---	80%	88%
P*	56%	52%	52%	52%	---	---	80%	68%
Average	82%	83%	82%	69%	86%	91%	82%	78%

Table 7.

Group C—Percentage of Accurate Responses from the Stations Assignment

Student	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
A	96%	96%	92%	---	92%	---	96%	---
B	88%	---	92%	---	76%	---	76%	80%
C	---	---	80%	80%	80%	---	68%	78%
D	80%	92%	---	---	88%	---	80%	80%
E	78%	80%	---	84%	80%	---	---	88%
F	84%	78%	72%	---	---	---	80%	88%
G	80%	---	78%	80%	---	---	84%	72%
H	92%	92%	88%	---	88%	---	---	88%
I	77.8%	85.0%	86.9%	---	90.5%	---	88%	88%
J	96%	---	92%	---	96%	---	92%	96%
K	64%	---	---	76%	80%	---	80%	76%
L	84%	88%	---	76%	84%	---	80%	84%
M	60%	76%	72%	---	---	---	68%	68%
N	72%	76%	---	80%	---	---	64%	72%
O	---	88%	72%	---	68%	---	80%	88%
Average	81%	85%	83%	79%	84%	---	80%	82%

said that they found the computers helpful. For the most part, the students claimed that they enjoyed being able to choose whether they could work on stations or computers.

One student claimed said that it was extremely important to work on computers because he works much better with computers than stations. Another student who initially worked on stations and switched to computers rated stations as an eight on a scale from one to ten, in which a one was not helpful at all and a ten was extremely helpful, and then rated computers as a ten. The student claimed that “the stations kind of helped but not all that they could have. The computer was very helpful cuz it showed me the rite work if I got a question wrong.”

At the end of the stations and the computerized assignments, the students were given a vocabulary quiz. Students in group A averaged an 86.79 percent, students in group B averaged an 87.93 percent, and students in group C averaged an 88.60 percent. Furthermore, the tentative results of the state exam can be found in Table 6. The state exam is scored on four scale level. According to New York State, a level one is defined as not meeting learning standards, a level two is defined as partially meeting learning standards, a level three is defined as meeting learning standards, and a level four is defined as meeting learning standards with distinction. Group A averaged a 90% on the exam, and 43%, six out of fourteen members, tentatively earned a level three and 57%, eight out of fourteen members, tentatively earned a level four. Group B averaged an 85% on the exam, and 6%, one out of sixteen members, earned a level two, 63%, ten out sixteen members, earned a level three, and 31%, five out of sixteen mebers, earned a level four. Group C averaged an 84%, and 67%, ten out of fifteen members, earned a level three and 33%, five out of fifteen members, earned a level four.

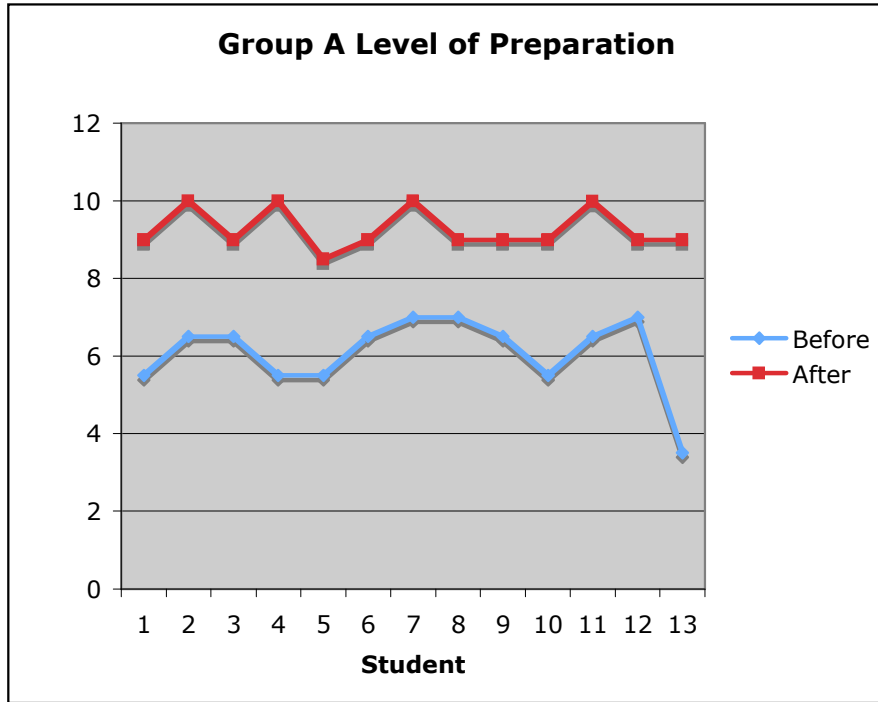


Figure 1. Group A Self-evaluation of Preparation Level

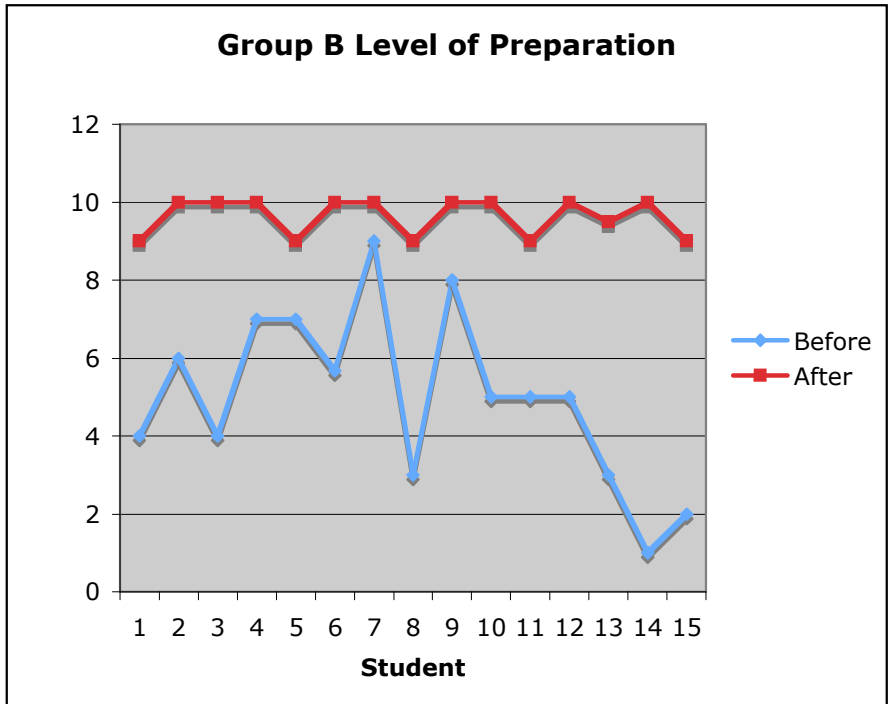


Figure 2. Group B Self-Evaluation of Preparation Level.

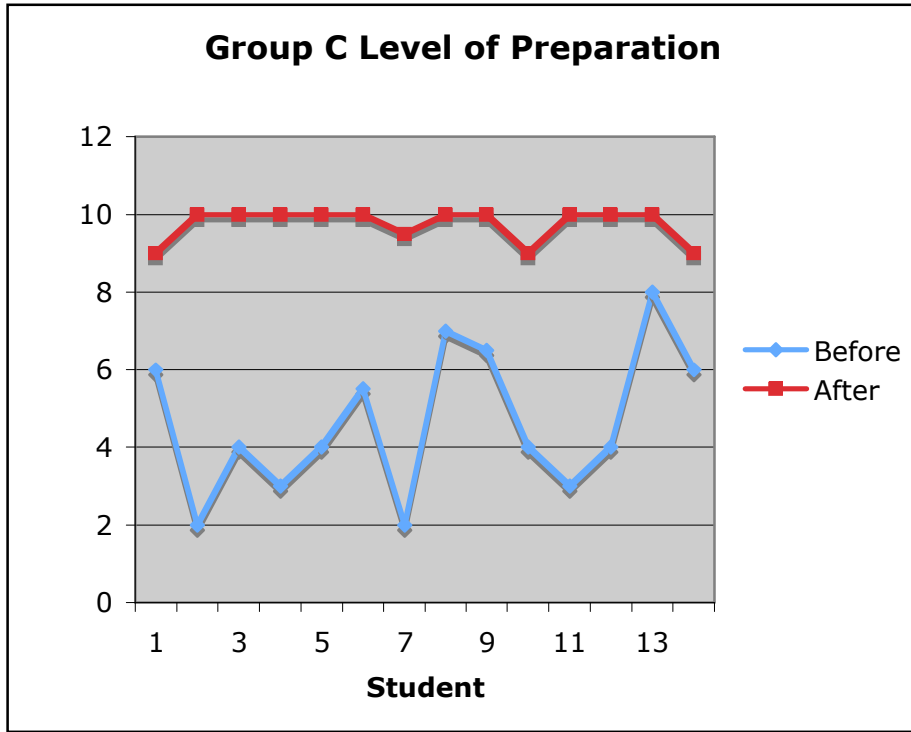


Figure 3. Group B Self-Evaluation of Preparation Level.

Discussion

Based on the results, it seemed that differentiating the instruction was beneficial to the students. Because there were many aspects to the differentiation, it is important to look at each piece and determine how beneficial the differentiation was to the students.

Looking at the results, without looking at the students' starting points, it appears that group A benefited the most from the instruction, although they did not receive the differentiated instruction. However, growth was a key aspect of differentiated instruction (Tieso, 2003), and looking at the results, it appeared that all three groups exhibited growth. From the preliminary assignments to the computerized or station assignments, control group A's average went from 85.15% accuracy to 87.38%, and variable groups B and C went from 80.05% to 81.63% and 80.78% to 82.00%, respectively. As a whole, it seemed that all three groups improved generally the same amount. However, it must be noted that the students in group A were required to complete every assignment, while groups B and C were asked to complete the five lowest out of the eight assignments. Thus, the students who performed well initially in group A continued to perform well for the stations assignment, affecting the average accuracy. The students who performed well, however, in the other two groups were not required to complete those assignments, and thus the high outliers were not considered when calculating the averages. Therefore, it seems appropriate to conclude that the students in groups B and C overall had greater improvement. This is also shown in the students' individual scores.

The multiple choice scores also served as evidence that the students in groups B and C found more benefit and grew more throughout the process. As shown in Table 4,

while students in group A earned better multiple choice scores on their exam, the multiple choice scores improved by 3.202%, while groups B and C improved by 13.944% and 21.535%, respectively.

Furthermore, group A outperformed groups B and C on the state exam. It seemed that although the differentiated instruction was beneficial to the students of groups B and C, other factors played a role in student success across the board, including grouping and the fact that students in group A were given the opportunity to reinforce and practice *all* skills that were required. On another note, however, students in group A were generally stronger test takers than students in groups B and C.

Students enter the classroom at different levels of readiness (Tieso, 2003), which is shown Tables 1, 2, and 3. Some students showed strength in the material across the board, others were weak in some areas and excelled in others, while others struggled in several areas. Consequently, it did not seem to be beneficial to the students to have a one size fits all type of classroom (Gregory & Chapman, 2007). Because Anderson (2007) stated that it was not practical to require the students to learn in a classroom that asked students to learn in one particular way, mainly by completing the same type and amount of practice of the content, the students were asked to complete different types and different amounts of practice in order to individually benefit each student. According to the literature, it seemed that students in groups B and C were able to grow because the instruction was catered to the students' entrance level and continued to improve and motivate students to learn through modes that were of interest to the student (Anderson, 2007; Hendrickson & Gable, 1997; Lewis & Batts, 2005; Tomlinson, 1999; 2000; 2003; 2004; 2005; 2006). This is the basic definition of differentiated instruction, and it

seemed, through the research, that because these occurred in the classroom, students found success, and in turn were able to grow. Additionally, all students were included in the classroom (Broderick, Mehta-Purekh, & Reid, 2005), each with their individualized lesson plans, which also seemed to have been of benefit to the students.

Grouping was key in differentiating the instruction. Stronger students were partnered with students who needed additional help. Thus, peer tutoring provided as a method of interaction and created a positive environment for the students. Both students in each pair benefited from the peer tutoring: the students who needed the one-on-one attention were able to receive it and the tutors not only were able to reinforce what they know by communicating the ideas to their classmates, but they were also given a challenge in an assignment that might have been relatively easy to complete.

Additionally, many of the students indicated on their surveys that they very much enjoyed the stations because they were able to interact with their classmates while completing the assignments. This was also supported by Lawrence-Brown (2004), as they stated that peer-to-peer interaction is a crucial aspect of differentiated instruction. The authors also held that teacher-to-student interaction was important, which was a major aspect of the differentiated instruction as the majority of the class became less teacher-oriented and more student-centered, which is a notion that Rock, Gregg, Ellis, and Gable supported (2008).

Moreover, students had wonderful behavior in class. Teachers had to tell members of groups B and C to stay on task less often than members of group A; in fact, teachers in groups B and C averaged 0.40 and 0.55 prompts a day while teachers in group A averaged 0.65 prompts a day. This corresponded to the research that Broderick,

Mehta-Purekh, and Reid (2005) provided, indicating that less behavioral problems occur in the differentiated classroom as the students are given an opportunity to grow and succeed. Tieso (2003) also asserted that student attention was obtained more easily and lasted much longer, and the results of the research seemed to align with this assertion.

At first glance, it appears that group A, the group that did not receive the differentiated instruction, was more successful throughout the process, as their scores were significantly higher than the other two groups. However, it was of utmost importance to see that there was noteworthy improvement in groups B and C. Not only did the scores improve significantly, but students indicated that they felt much better prepared for the state assessment after completing the review, and students in groups B and C showed a much greater increase in preparation than group A. Furthermore, students who were barely grasping concepts in the preliminary assignments were able to perform better in other assignments, and possibly even reach mastery on some topics, as shown in Tables 5, 6, and 7. This is supported by Tieso (2003), George (2005), and Tomlinson (1999; 2000; 2003; 2004; 2005; 2006). Differentiating the instruction improved self-esteem.

In fact, groups B and C overall felt that they were 93.53% and 110% more prepared, respectively after the differentiated review, while group A indicated they felt 52.52% more prepared. As indicated by the students, it was important to be able to gain the knowledge and comprehension through their preferred modes of learning and it was also important to practice the skills that they felt were skills they needed to practice. As the research indicated, student success and growth combine to increase motivation and confidence, which in turn improve student success and growth.

On their surveys, the overall majority of groups B and C felt that the learning process was worthwhile, and very few thought that the assignments that were given to them were not useful, which according to Tomlinson (2005), Gregory and Kuzmich (2004), and Noble (2004), increased intrinsic motivation and promoted a positive work environment. It also increased student satisfaction with learning, which is maintained by Tomlinson (2005) as an important aspect of differentiating instruction. Although this is true in all three groups, more members of group A (three members) stated that they thought one or more assignments were not meaningful than the members in group B (one) and group C (zero).

Flexibility was key in the research as well (Rock, Gregg, Ellis & Gable, 2008). Some of the students needed to change assignments, groupings, or whether they worked on stations or computers, and being able to quickly adjust was important in the process. The students who did adjust were placed in an environment that better suited their needs and the students were more successful. Although it was important to give students opportunities to choose in the classroom, it is also important to allow teachers and students to collectively revisit those choices that were made and modify based on changes in the readiness, interest, and level of the student.

Students who completed their assignments in class were given extra credit opportunities to complete assignments in areas in which they felt that they needed extra help. Many of the students took advantage of these extra credit opportunities, and thus the differentiated instruction was further applied in the classroom.

The cooperating teacher who was in the classroom every class for group B and at least three times a week for group C indicated that she felt it was extremely beneficial to

allow the students an opportunity to choose what they wanted to work on. She found it more valuable for the students in group B as more students worked on computers than group C, and thought it would be beneficial to allow some learners, although they chose stations, to work occasionally on the computers. From observations of the students, and since differentiating instruction addresses student needs, she felt that the students would have further benefited from more variety in the classroom, possibly by giving students more opportunities to choose throughout the review unit. Thus, if students felt that they were not succeeding or interested in the activities, they would be given an opportunity to find a more meaningful assignment. This aligned with what Hendrickson & Gable (1997) claimed, saying that students can be evaluated based on content, effort, transfer of knowledge, and growth in the process. Growth was the biggest factor in this process, and it seemed that the students were able to grow from their initial point to their final point.

Student-centered instruction was at the heart of differentiation (Rock, Gregg, Ellis & Gable, 2008). In this process, the students were held more responsible for their learning in all three groups. This could be a factor as to why group A also found success in the process. The teacher was only a facilitator, and the students, through collaboration and hard work, were able to succeed in the classroom. The research said that the teacher was generally happier when facilitating (Broderick, Mehta-Purekh, & Reid, 2005), and this seemed to be the case for both the general education teacher and the cooperating teacher in the classroom.

Although this research seemed to be successful, there are many alterations that could have happened to further promote student success. The assignments were differentiated by interest—choosing between computers and stations—and by

readiness—assigning based on student need. However, there was very little differentiation done based on difficulty level. It would have been more beneficial for the upper-level students—students who exhibited mastery in the preliminary assignment—to be able to be challenged by providing problems that require more upper-level thinking than the assignments that were provided. Many of the students were given extra credit opportunities, although some of the upper-level students did not want to complete the assignments as they felt that it was just extra work. This is supported by Fahey (2008) and Olenchak (2001), who stated that it is important that gifted students are given assignments that require upper-level, critical thinking skills, as opposed to more work. Another student described himself as a “hands-on kind of guy” and wished that he had an opportunity to do more hands-on work in the classroom. Although the stations were hands-on, it is important to give more opportunities for hands-on work.

Because this was lacking in the research that was conducted this year, differentiating by difficulty level will be the next area of focus. Furthermore, giving students opportunities in the future to be able to continually choose the assignments will also be of importance as well, although it was important for the teacher to assign them work based on their needs and levels of skill.

Conclusion

Differentiating instruction seemed to have been of benefit to the students. While students in all three groups were successful, it must be noted that students in groups B and C seemed to find more success in the differentiated instruction, and the literature supported the research. Students found greater satisfaction in the learning environment, felt more prepared after the differentiated lesson, and performed well on their assessments. Students were able to work collaboratively in the differentiated classroom, and the classroom became more student-centered. Most importantly, students in the variable groups seemed to have grown significantly throughout the process, which is the most important aspect of differentiation. There are many factors, however, that contribute to student success, and thus it would be interesting to determine how those different factors can be addressed through differentiation.

According to the literature, there are many other ways to differentiate instruction, and the research done was just the tip of the iceberg. Differentiating by ability level, not just readiness-level, is a type of research that would be of great interest. It seemed that in mathematics, the students in any given classroom are on completely different ability levels, and a teacher who wants to promote life-long learners, across the spectrum, has a difficult time making sure that all students benefit from the lesson. Giving students more choice and freedom in the classroom, while still maintaining a level of structure, would also be of interest, albeit a little difficult. Furthermore, addressing different learning styles to further reach students would also be of interest, especially to see if each student's learning style drives the learning or if the material drives the learning style

necessary to benefit from the instruction. The most immediate project, however, is compacting. Many students in the classroom were able to learn concepts in the classroom in moments, while their classmates require a much longer time to process the material. Thus, giving the students an opportunity to compact the material. In other words, students would be able to learn the material at their own pace and then supplement the material with higher level, critical-thinking problems in order to further promote growth in each student in the classroom.

Because this research seemed to support that differentiating instruction is of benefit to many students in the classroom, it served as a starting point to look at each aspect of the literature researched more thoroughly and determine which aspects would promote growth, success, and increased motivation in the classroom.

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Appendices

Appendix A: Survey

Please answer the following questions.

1. Would you rather work in computers or at stations? Why? _____

2. Out of all eight units, with which unit do you feel the most confident? _____

3. Out of all eight units, with which unit do you feel the least confident? _____

Appendix B: Learning Contract

Based on your interest survey and your past performance, you will be working at _____ (stations or computers), and you will be working on the following five assignments:

1. _____
2. _____
3. _____
4. _____
5. _____

You may work on any assignment in any order, but it will all be due by Friday, March 6th.