

Supporting SPED Students Learning Geometry

E. Georgette Jordan

Texas A&M University-Commerce

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Special Education (SPED) students struggle in many areas of academics. Mathematics in general, and geometry specifically, is extremely challenging for many children and becomes even more challenging for students with learning disabilities. Geometry concepts such as area, volume, perimeter, measurements, and understanding shapes is a vital skill for everyday life. These skills become even more important for individuals who desire to work in a trades-based profession (such as construction) after completing high school. My desire with this study would be to discover improved interventions geared toward specific learning disabilities which would enhance the quality of the students' learning experience.

Statement of the Problem

The Texas Education Agency (TEA) has listed geometry as a required course for graduation. The Texas Essential Skills and Knowledge (TEKs) criteria is determined by TEA for all courses of study in the state of Texas. The TEKs for geometry classes are difficult for many general education students to master. Students with learning disabilities most often find geometry even more challenging than other mathematics classes. Finding appropriate accommodations and/or modifications of curriculum for students with disabilities that meet TEKs criteria is challenging for even the most experienced teacher. The proposed study would compare students with specific learning disabilities, the required learning objectives for these students, and develop enhanced interventions to support the students' educational success in regard to learning geometry. Emphasis would be placed on the differences of successful interventions and link these interventions to the type of learning disability for which the intervention was most successful.

Review of Related Literature

In research from Louie et al. (2008) extensive practices in educational reform occurring at six different schools in the Eastern United States was covered. The schools in the report are targeting struggling students with or without disabilities that are having difficulties with learning math. Each school in the report is examined to determine the supports provided and the challenges incurred to provide appropriate education for a very diverse set of learning necessities. NCLB (The No Child Left Behind ACT of 2001) mandates that schools in all states ensure an adequate yearly progress (AYP) level of proficiency in the areas of English and Mathematics. This study intensified its focus on struggling learners with and/or without disabilities. The information from this research was intended to assist teachers and other educational professionals with suggestions for improvement in the support of these struggling students. The participating schools had to go through a predetermined screening process to participate in the study. Ultimately, three schools from Massachusetts and three from New York state made the cut from the original thirty-eight schools originally nominated to participate.

Evaluation of the campuses involved occurred over six visits of two days each, in which all levels of educational staff who are involved in math instruction were observed and evaluated. The evaluation process chosen by Louie et al. (2008) collected information on how math instruction is implemented for the affected students (those with disabilities and those struggling) and what the effect of the types of instruction had on these students. Researchers also took into consideration what the educators perceived as the biggest challenges are for this demographic of students in learning mathematics.

Additionally, what the educators perceived as their best/most successful practices were being used to support student learning improvements.

Despite the initial differences in beginning practices for instruction for this high-risk group of students, many of the schools ended up using very similar techniques to promote a successful outcome. All schools use assessment to gauge student knowledge, but other areas were also deemed equally important. Collaboration between math and special education teachers at individual schools and between participating schools occurred, and was deemed extremely important. The professional development of, and the retention of teachers was spotlighted. Additionally, Louie et al. (2008) stated that it was recognized that school culture also played a major role in maintaining the highly qualified staff needed to support the critical learning needs of these students.

In research conducted by İBili et al. (2019) there was a study to determine and evaluate the effectiveness of using augmented reality (Augmented Reality (AR) is when a technology superimposes a computer-generated image on a user's impression of the real world) in the process of teaching three dimensional (3D) concepts of Geometry to students. The researchers had to develop a scale to evaluate the students' three-dimensional thinking abilities. Once the scale was developed it was evaluated by several groups in pre-test and post-test scenarios. An Augmented Reality tutoring system was developed and implemented using the same test groups. The purpose was to increase the three-dimensional cognitive skills of the test subjects. The study ultimately showed that using Augmented Reality as a teaching method for Geometry did significantly enhance student understanding of the concepts addressed.

The study conducted by Hannafin et al. (2001) followed an approach that concentrated on the study of consciousness as it related to the instruction of geometry. This project was a small part of a larger research project which used mixed methods. The authors used information from teacher and student capacity in the learning environment, and took into consideration the feelings experienced by both. Seventh grade students were exposed to a new student-centered geometry program, Geometer's Sketchpad, for two weeks. Use of the program occurred during their normal mathematics class. The program gave students the opportunity to visualize three dimensional shapes and be able to explain their relationships in a way that paper lessons could not accommodate. Interviews of the teachers and students had opposite outcomes. Students enjoyed using the program and focused at/on a higher level than before, but the teacher had a hard time giving up control of the learning environment.

The goal of Liu et al. (2019) in their research was to study interventions for students with learning disabilities in relation to learning Geometry. The authors focused on information related to teaching Geometry as they gathered information from several intervention studies. Methods of interventions used, methods of instruction, and the difficulty level were considered. Typical geometric concepts considered during the study were area, volume, perimeter, and angle comprehension. The study showed that the use of known interventions for learning disabled students were effective when used appropriately in the instruction of these geometric concepts. Short comings were additionally identified as a lack of training for the instructors. Future study possibilities were indicated as a possibility.

Dyscalculia is the term used to describe students with a learning disability in mathematics. Secondary students with a learning disability often struggle even more due to the faster pace of high school and the pressure from counselors to take advanced placement classes. A study by Satsangi and Bouck (2014a) attempted to address the lack of interventions geared to support these struggling students. Supports and interventions for the learning disabled who struggle with the simple concepts of area and perimeter were difficult to put into place due to the fast pace of the secondary curriculum. The study indicates that using virtual tools and technology are a feasible option in teaching mathematical concepts to students with learning difficulties. This is very similar to the research conducted by İBili et al. (2019) which supports using augmented reality to assist students with disabilities in learning geometry. Hannafin et al. (2001) also supports using software as an intervention. According to newer research (Satsangi et al., 2019), high school students with disabilities exhibiting unmistakable difficulty with mathematics, both algebra and geometry, as the courses advance in the degree of difficulty. Technology was again explored as a teaching tool and intervention for learning by using video modeling, which was an uncharted form of instruction for students with specific learning disabilities. Specifically, geometry word problems were addressed with three learning disabled students. All three of the students in this study displayed increased ability in solving word problems in all the areas used for the study.

It is difficult to teach children who are not engaged. As pointed out by Rangvid (2018), students that are emotionally invested in learning achieve at a higher level. This emotional investment in wanting to learn also includes students that have learning disabilities. Participation and motivation lead to successful learning and this study reveals

the importance of inclusion support and its assistance in motivating SPED students to succeed. To support these needs, student teachers need to be taught how to be more inclusive with SPED students. (Lambe, 2007) In her findings, Lambe (2007) states that enhanced training is imperative for these teachers to become equipped with the tools to support SPED students' varied needs and support these students in the current digital learning platforms. Ultimately, the teachers must be appropriately trained before they can provide the diverse support needed to support SPED educational needs.

Previous data indicates that individuals with Down syndrome have significantly more difficulty with mathematics than some other forms of disabilities. In a qualitative research study from Gil Clemente and Cogolludo-Agustín (2019) it is suggested that students with Down syndrome are visual learners and have an inherent interest in abstract shapes. The study showed that Down syndrome students who had difficulties grasping the rudimentary concepts of basic math operations could be successful in coordinate geometry when specialized/individualized teaching methods were deployed. Their intention was to prove that students with Down syndrome have the same desire to learn as regular students, and that by using specialized techniques for instruction they also can be successful in some forms of mathematics. Findings indicate the specialized use of geometry instruction shows potential in developing the cognitive skills of students with Down syndrome.

Geometry and the ability to recognize/understand the representation and visualization of geometric shapes is a fundamental element of learning mathematics. According to newer research (Zhang et al., 2013) many students struggle with understanding of geometric shapes. In this study, using elementary students as subjects,

the recognition of contextual objects was studied. Zhang et al. (2013) developed a geometry test for regular students and those that received accommodations. All of the students were tested with and without accommodations. The students with documented difficulties answering geometry questions scored low in the regular testing scenario and higher in the test when receiving accommodations. When compared to the regular education students, those who had learning deficits benefited more from the accommodations than the regular education students.

In addition to disabilities, cultural differences have been studied. In research from Shumate et al. (2012) students with learning disabilities who were also of Latino decent were studied. The study was done using five Latino students who all had specific learning disabilities. The lessons these students received were modified to be both culturally and learning disability appropriate for the middle school age group. The results of the study showed that the adaptations to culture in addition to the adaptations for the learning disabilities had a successful outcome.

Research Questions

1. How are accommodations applied and still meet TEK's criteria?
2. How are modifications applied and still meet TEK's criteria?
3. Which interventions work best for students with disabilities?
4. Which learning disabilities struggle most with geometry concepts?
5. Does a student's culture influence their learning in addition to a disability?

Significance of the Study

Knowledge of mathematics plays a critical role in the understanding of other subjects in school such as science, technology, engineering, art, music, and even social

studies. Geometry teaches students geospatial reasoning skills which not only help in upper-level mathematics courses, but is an effective way of building logical reasoning skills and develop mental rigor. Understanding how to level the learning environment for students with learning disabilities is crucial to these students' success in academia and in life. This study would seek to discover the best practices for supporting SPED students learning objectives in a geometry classroom setting. In addition to supporting the learning of students with disabilities, the influence of TEA mandates and student culture would be taken into consideration. Teachers, parents, and students would all benefit from added knowledge of how to support these students who struggle learning geometric concepts.

Method

Experimental and survey research methodologies will be used to conduct this quantitative research project.

Participants

Participants would be chosen using convenience sampling. The students studied would be enrolled in the geometry classes at the high school where I work as a case manager/geometry inclusion teacher for the Special Education department. Student numbers in geometry are approximately 150 per school year, including SPED students. Student numbers fluctuate by school year. Based on historical data 20% of these students typically have learning disabilities and are under the umbrella of the special education department. Student participants would be contacted through their geometry teachers and case managers. The targeted students are a good representation of varied levels of

learning capabilities and cultural diversity from the immigrant population of the neighborhood.

The Math department is required to track data on all students attending any campus within the district and report it to the district level office. Taking into consideration the current data tracking methods, gaining permission from the principal to use only the SPED students for tracking data in this study could be easily obtained. Parental permission would be requested by sending home detailed information regarding the study with an attached permission slip to be signed and returned to the school granting participants permission to join the research study. Anonymity of the participant students would be provided by using only their student identification numbers on all research paperwork instead of using names.

Instrumentation/ Design/Procedure/

Experimental research will be conducted by manipulating characteristics in the survey environment to meet the modifications needed to meet SPED student's IEPs (individualized education plans). Participating students will be divided into two groups based on diagnosed disabilities. One group will have longer times to do practice problems/assignments prior to testing and additionally have longer times to complete tests, in addition to providing after school tutoring. The second group will receive after school tutoring, but will not receive the additional time for completing practice problems/assignments and tests. Both groups will take a pre-test over geometry concepts, and then after a set period of time and instruction take a post-test on the same information. This could include their attitude toward geometry in addition to testing on the mathematical concepts taught in the class. The pre-test would be performed prior to

developing any interventions. Post-testing would occur after implementation of interventions. The pre and post tests are where the Survey method comes into play. In addition to asking geometry related questions, the students could be questioned in regard to their attitudes toward math and school in general. A student's attitude influences their learning.

Pre and post-tests and would be conducted using Google forms, All in Learning, Class Kick, and/or other available/appropriate technology platforms. Student assignments and practice problems can be distributed in the same manner. These platforms have the capabilities of designating how many attempts the students have to complete the task. Pre-test scores on geometry knowledge would be recorded and saved to compare to the post-test scores, after interventions have been applied during the designated time frame for the research.

Documentation of TEKS requirements for course instruction, IEPs for each student, and the interventions/modifications/accommodations utilized will be tracked and compared according to participants. The cultural background of the participants will also be compared with the success rates of the interventions. This type of data is needed to address the proposed research questions.

Data Analysis

1. Determine time frame for study
2. Determine participants
3. Gain permissions
4. Have participants take pre-test

5. Provide participants with geometry assignments and interventions dependent on group assignment.
6. Have participants take post-test after appropriate time frame.
7. Compare outcomes by using Excel to graph the gathered data for analysis.

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