Senior Project Coversheet

Comparing Mathematic Abilities of Children with Autism in Middle School Self-Contained Setting and Inclusive Setting

Honors Project

In fulfillment of the Requirements for

The Esther G. Maynor Honors College

University of North Carolina at Pembroke

By

Lori Vignali

Special Education

December 6, 2012

Lori Vignali 12/6/12

Lori Vignali
Honors College Scholar

Date

12/6/2012

Gretchen Robinson, Ph.D., CCC-SLP
Faculty Mentor

Date

12/6/12

Mark Milewicz, Ph.D.
Dean, Esther G. Maynor Honors College

Date

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ABSTRACT

COMPARING MATHEMATIC ABILITIES OF CHILDREN WITH AUTISM IN MIDDLE SCHOOL SELF-CONTAINED SETTING AND INCLUSIVE SETTING

by Lori Vignali

Special Education

University of North Carolina at Pembroke

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The question of autism and placement in general education is a rising one. This research examines if there is a significant difference of mathematical ability of students with autism in middle school between self-contained and inclusive settings. This study is a literature review of recent articles in the areas of autism, mathematics, inclusion, self-contained, and middle school. This paper also includes mathematical EOG scores of students with autism in North Carolina. All information was found using electronic databases, such as ERIC and Education Research Complete, and the website for North Carolina Public Schools. Further research needs to be completed in order to come to a concrete decision, as there is not much research that clearly defines which setting is the most appropriate for mathematic abilities at a middle school level.

Comparing Mathematic Abilities of Children with Autism in Middle School Self-Contained Setting and Inclusive Setting

Autism is the most common developmental disability under the autism spectrum disorder and is caused by a neurological disorder that affects normal functioning of the brain (Noonan, 2009; Barett, n.d.; Su, Lai, & Rivera, 2010; Kurth, & Mastergeorge, 2009; Kurth, & Mastergeorge, 2010). Autism spectrum disorders (ASD) are characterized by abnormities in social communication, social interaction, and repetitive behaviors and can be described as a neurological variation (Kurth, & Mastergeorge, 2010; Jordan, & Caidwell-Harris, 2012). Autism spectrum disorders include Asperger syndrome, Pervasive Developmental Disorders-Not Otherwise Specified, and Autistic Disorder (Kurth, & Mastergeorge, 2010). Students with Autistic disorder will be discussed within this literature review. Qualities of persons with Autistic disorder include narrow repetitive activities and "rigidity and constriction affecting thought, memory, and actions" (Haas, 2010). Symptoms include problems developing nonverbal communication skills, lack of "normal" interest in emotion, problems with verbal communication skills, preoccupation, and stereotyped behaviors (Berret, n.d.). Autism also impairs one's ability to socialize, communicate, process sensory information and experience the full interest common to most people (Su, et al., 2010). There are currently as many as 1 in every 150 children diagnosed with Autism and providing an appropriate education for these students is a growing challenge (Kurth & Mastergeorge, 2012). Many children with autism do not have a typical developmental sequence when developing academic skills yet laws require that students have access and make progress in the general education curriculum (Kurth & Mastergeroge, 2012). Students with autism are most commonly educated within a self-contained or inclusive setting, but it is not yet known which is most appropriate.

The purpose of this literature review is to detect the differences of mathematic abilities of students with autism across self-contained and inclusive settings and to determine which setting students with autism are mores successful with their mathematical abilities.

Methodology

To locate articles to include in this review, the library catalog and electronic databases in special education and education subject guides (i.e. ERIC, Education Research Complete) were searched using the following key terms: Autism, self-contained, inclusion, mathematics, middle school, and scores. The North Carolina Middle School EOG scores were found by searching EOG on the North Carolina Public Schools website.

Autism and Mathematical Skills

Students with autism can struggle with mathematics within the school setting for many reasons. Often they have trouble explaining their answers or showing their work. Students with autism have much less synchronization and connectivity between frontal and parietal areas of activation within the brain (Haas, 2010). These functional connectivity deficits cause autistic students to take longer to solve a math problem because the connections between the regions of problem solving, the front-parietal network, do not communicate as effectively (Haas, 2010). More learning characteristics of students with autism include narrow interest, inflexible adherence to routines, repetitive motor movements, unusual sensory preference, and rigidity to change (Crouch & Frohnapfel, 2008).

Lack in working memory is another issue that can cause students with autism to be less successful in mathematics. A larger working memory capacity has been linked to faster information processing and higher performance in complex problem solving (Haas, 2010).

Students with autism can have difficulty with retrieval as well, since it requires searching long-term memory and comparing outputs to try and find the correct answer; this is why they have difficulty applying appropriate strategies and answers to more difficult problems that are stored in the long-term memory (Haas, 2010).

The No Child Left Behind Act requires assessing mathematical achievement on state standards for all students regardless of disability (Browder, et al., 2008). This, in turn, brings about challenges for teachers to address more domains of mathematics than simply using a purely functional approach (Browder, et al., 2008). There are five main components of mathematic instruction: number and operations, measurement, data analysis and probability, geometry, and algebra (Browder, et al., 2008). It has been found that students with cognitive disabilities, such as Autism, can learn target skills such as computation, graphing, matching shapes, and counting money successfully (Browder, et al., 2008; Crouch, & Frohnapfel, 2008). Regarding functional applications, studies show that there is ability in applying money use to real-life scenarios and that students can learn computation and measurement more adequately than data analysis, geometry, and algebra (Browder, et al., 2008).

The knowledge of basic math skills including money, measurement, and time are critical for independent functioning, as well as independent living skills like purchasing, banking, and budgeting (Su, et al., 2010). The understanding of these functional math skills enhance autistic individuals' participation in daily routines and increases their opportunities for volunteer activities, community involvement, jobs, and leisure enjoyment (Su, et al., 2010).

Students with autism often have difficulty acquiring knowledge of mathematical concepts, furthering the importance that educators use the most effective methods for teaching students mathematical skills such as interventions emphasizing frequent feedback, explicit instruction, and practice (Su, et al., 2010). It has been shown that students with autism are able to increase their knowledge of mathematical concepts when exposed to systematic instruction, which accelerated learning (Su, et al., 2010). Direct instruction has been shown to be the most effective intervention for increasing basic mathematic skills while problem solving skills are more enhanced by self-instruction (Browder, et al., 2008).

Middle School Settings

Teaching math to middle school students, with or without a disability, is a challenge (Falcon, n.d.; Bouck, Kulkarni, & Johnson, 2011). "Trying to keep every student engaged and interested especially in an inclusive setting, can seem an impossible feat…there is an issue of many middle school students coming into the classroom with the attitude of 'I'm terrible at math. I have always been and will always be, and therefore I'm not even going to try because I know I will fail'" (Falcon, R, n.d.). There are issues concerning the best way to teach mathematics to students; in a traditional manner or in a standards based manner (Bouck, Kulkarni, & Johnson, 2011). The Individuals with Disabilities Education Act (IDEA) states that students with autism are to be taught in the least restrictive environment (Campbell, & Barger, 2011). This can lower the amount of time students with autism are around students without disabilities, especially within the middle school setting, which can affect their learning ability (Campbell, & Barger, 2011). Many of autistic student's peers, are not completely aware of what Autism is (Campbell, & Barger, 2011). This can hinder the disabled students' abilities depending on the other students' opinions. It is necessary to find the best setting in order to enhance middle school level students with autism's ability to succeed by taking all of these factors into consideration.

Appropriate placement is important for success among students with autism. Educators need to understand how students with autism respond to specific teaching tools such as visual teaching, verbal teaching, and practice mechanisms; knowing effective ways to communicate is necessary to improve their understanding (Haas, 2010). The growing increase of students with autism has increased the necessity of understanding the skills and needs of these students among education placement (Kurth & Mastergeorge, 2010). Many schools offer the option for the students to be in a self-contained classroom or an inclusion classroom.

Inclusive/Self-Contained Practices

The IDEA mandates that children with disabilities be provided with the opportunity to receive equivalent education that typically developing children receive, which is how the concept of inclusion was introduced (Noonan, 2009). Inclusion is where students with disabilities are placed within the general education classroom with hopes to enhance their educational success (Noonan, 2009; Falcon, n.d.). Inclusion contains four dimensions: support services within the classroom for children with disabilities; the effect of inclusion on children with disabilities must be evaluated in order to determine whether or not there is progress across the specific goals; interaction between children with disabilities and typically developing peers; and services provided by professionals from various disciplines (Noonan, 2009). A proactive inclusion classroom has disabled students participate in the learning process, empower themselves through activities and lessons, and connect math concepts (Falcon, n.d.). These settings attempt to provide a more stimulating and responsive environment and give the opportunity for students with disabilities to also learn through observation.

The self-contained classroom is defined as the most restrictive classroom since the children spend the entire day in a classroom with other children with disabilities (Noonan, 2009; Kurth, & Mastergeorge, 2010). Self-contained classrooms normally have a small student-teacher ratio, which promotes the ability to meet individual needs. Exceptional children, such as those with Autism, are still taught content linked to the general curriculum and can be successful with explicit instruction in mathematic skills by using research-based instruction and learning techniques (Browder, Spooner, Ahlgrim-Delzell, Harris, & Wakeman, 2008; Bouck, Kulkarni, & Johnson, 2011).

As of 2006, 32.3% of students with autism spend 80% or more of their day instructed in inclusive general education settings while 38.7% spent less than 40% of their day in self-contained general education settings showing an increase in the prevalence of inclusion (Kurth & Mastergeorge, 2010). Although there are many noted benefits of inclusion (Ryndak, Ward, Alper, Montgomery, & Storch, 2010; Falcon, n.d.), many families prefer specialized placements for students with autism (Kurth & Mastergeorge, 2010).

Kurth & Mastergeorge (2010) found that intelligence scores do not differ by placement meaning that students with more significant autism were not more likely to be placed in non-inclusion settings and vice versa. They also found this to be true regarding skill level, however the academic achievement of students placed in inclusion and self-contained classes were significantly different: students in inclusion settings performed significantly better (Kurth & Mastergeorge, 2010). Thus, one must question, whether the placement in inclusion settings positively affects academic skill development or that students with higher academic aptitude are more likely to be placed in inclusion settings (Kurth & Mastergeorge, 2010).

The percentages of academic mathematic goals are found to be quite similar across settings: thirty-nine point six percent within the inclusion classroom and thirty-five point six percent within the self-contained classroom (Kurth & Mastergeorge, 2010). A significant difference in education programs were found between inclusion and self-contained settings for students with autism regardless of their statistically equivalent intelligence and adaptive behavior skills (Kurth & Mastergeorge, 2010). Students within inclusion settings have more IEP goals targeting higher order academic skills while self-contained settings had goals primarily addressing functional routine and procedural learning tasks (Kurth & Mastergoerge, 2010).

It is found that students with autism in general education classrooms spend more time in teacher-directed activities than those in self-contained settings whereas students with autism in a self-contained classroom spent more time in individual work than those in the general education classroom (Kurth & Mastergeorge, 2010). It seems as though students are acting in comparison to their peers regardless of their settings, further emphasizing the importance of setting with regards to performance. Students with autism in inclusive settings spend 91.3% of their math instruction on task while only 60.6% of students with autism stayed on task in the self-contained setting (Kurth & Mastergeorge, 2010). Yet it has been argued that there is "no significant difference in student achievement whether they are in an inclusion or non inclusion setting" (Falcon, n.d.). There is no statistically relevant evidence that indicates better placement, meaning that both self-contained and inclusive teachers need to focus rather on their ability to teach students with autism mathematical skills.

Instructional Practices/Supports

Educators should allow students with autism to focus on items of interest while also widening their interest and ability (Haas, 2010). These students often deal with frustration and emotional consequences of doing "unnatural" activities, which needs to be taken into consideration (Haas, 2010). "According to Caron et al (2004), 'operations that require conscious manipulation of information such as planning or switching from one mental set to another are impaired in autism'" (Haas, 2010); meaning that students with autism may need more practice and knowledge regarding novel problems and situations (Haas, 2010).

There are seven instructional principles of effective practice regarding mathematics interventions: instructional explicitness, instructional design to minimize the learning challenges, strong conceptual basis, drill and practice, cumulative review, motivate to help regulate attention behavior and hard work, and on-going progress monitoring (Crouch & Frohnapfel, 2008). Within these principles there are tips to help teaching students with autism successfully. It is important to provide a predictable environment, preparing students for changes in advance; ensure classroom structure, teaching a strategy for coping with unexpected changes; minimize transitions, exposing students to new activities before hand; allow sensory breaks when needed; and beware of what is reinforcing students, using them to your advantage (Crouch & Frohnapfel, 2008).

It is important to have supports within a mathematics class to guarantee students with autism are learning to their highest ability. These include being explicit and concrete within language use during instruction, teaching multiple meanings of mathematic vocabulary, checking for clarification often, and carefully considering the impact of social deficits when using cooperative learning groups (Crouch & Frohnapfel, 2008).

The use of pre-taught vocabulary, graphic organizers, rubrics, and highlighting can all help students focus on the important information and be prepared for what the day holds (Crouch & Frohnapfel, 2008). When teaching students with autism mathematic vocabulary it is necessary to use explicit instruction. Students adopt informal terms as if they are mathematic terms more successfully, for example: corner for vertex, plus for add, minus for subtract, and diamond for rhombus (Crouch & Frohnapfel, 2008). Figure 1 gives an example of how math vocabulary could be successfully taught to students with autism.

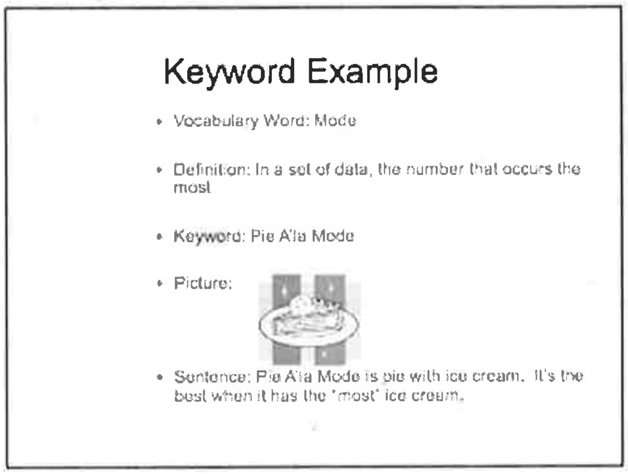

Figure 1. Keyword Examples. This figure illustrates ways for students to adopt math vocabulary (Crouch, & Frohnapfel, 2008)

More ways to promote success among students with autism include using class schedules, calendars and check lists, list of test reminders and homework, list of teacher expectations, written steps to solve a problem, and outlines from lectures (Crouch & Frohnapfel, 2008). Using outlines for notes, structured study guides, and note-taking software can help improve students with autism ability to stay organized and focused within the classroom (Crouch & Frohnapfel, 2008). More specific supports for students with autism within a mathematics class include flexibility with sensory issues, including interest within assignments, and providing chunk assignments. Students can also thrive through the use of priming and modified assignments (Crouch & Frohnapfel, 2008). Priming familiarizes students with materials and introducing predictability to reduce stress and modified assignments allows additional time, highlighting texts, and reducing number of problems (Crouch & Frohnapfel, 2008). Students with autism benefit from knowing what to expect and knowing exactly how to do it. All of these things can limit the amount of frustration students with autism experience, leading to more positive outcomes.

A proven instructional strategy is CRA. CRA is an intervention for mathematics instruction that can enhance performance among students with disabilities. It includes three stages: concrete, representation, and abstract. CRA MATH is an acronym standing for the following: **C**hoose the math topic to be taught; **R**eview abstract steps to solve the problem; **A**djust steps to eliminate notation or calculation tricks; **M**atch abstract steps with an appropriate concrete manipulative; **A**rrange concrete and representation lessons; **T**each each type of lesson to mastery; and, **H**elp students generalize what they learn through word problems, that has proven effective in teaching students with autism mathematical skills (Crouch & Frohnapfel, 2008; Witzel, Riccomini, & Schneider, 2008).

The use of high preference (high-p) strategy is a proven way to improve mathematic abilities with students with autism (Banda & Kubina Jr., 2010). The high-p strategy is when the presentation of a few preferred academic tasks are presented before the presentation of a non preferred academic task causing a student to be more likely to comply with the non preferred task (Banda & Kubina Jr., 2010).

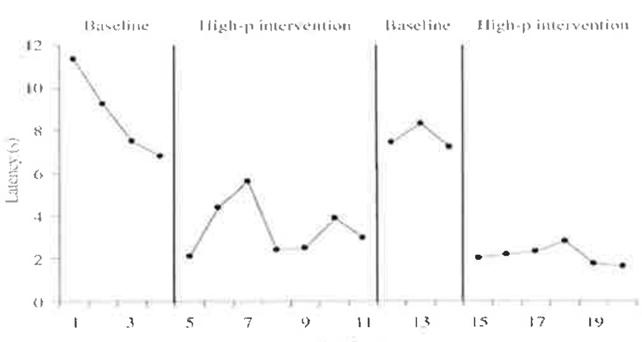

Figure 2. Example of successful high-p application. This figure illustrates the success of the high-p strategy (Banda & Kubina Jr.

Students with autism initiate and complete mathematic problems more quickly when the high-preference procedure is implemented (Banda & Kubina Jr., 2010). It is shown that students take less time initiating low preference problems that were preceded by a few high preference problems (Banda & Kubina Jr., 2010). This shows that high-p problems can create frequent reinforcement opportunities making low-p problems less aversive (Banda & Kubina Jr., 2010). The high-p strategy is effective because it is portable, practical and easy to implement for all students, including those with Autism, that struggle with mathematics (Banda & Kubina Jr., 2010). Figure 2 shows the findings of Banda & Kubina Jr.'s study that the use of high-p problems caused the students to take less time initiating low-p problems that they did when not preceding high-p problems.

Math Performance in North Carolina

The North Carolina End-of-Grade Multiple Choice Test Results (2000-2001) gives information regarding the mathematical ability of students with autism in the state of North Carolina. There are two charts: one including participation of students with special needs; and one including performance of academically gifted, exceptional, limited English proficient, and Title I students. As shown in Table 1, the sixth grade results showed that 112 students with autism were tested in mathematics with accommodations: twenty-eight had standard administration with

Participation of Students with Autism		
	Test	Mathematics Tested
Grade 6	Standard Administration with Accommodations	28
	Alternate Assessments NCAAAI Pilot	10
	Alternate Assessments NCAAP	74
Grade 7	Standard Administration with Accommodations	32
	Alternate Assessments NCAAAI Pilot	18
	Alternate Assessments NCAAP	58
Grade 8	Standard Administration with Accommodations	17
	Alternate Assessments NCAAAI Pilot	6
	Alternate Assessments NCAAP	92

Table 1; Participation of Students with Autism in NC EOG. This figure illustrates the number of students with autism tested in mathematics with accommodations ("End-of grade multiple," 2001) accommodations using the North Carolina Computerized Adaptive Testing System (NCCAS Accommodation Pilot), 10 had alternate assessments using the North Carolina Alternate Assessment Academic Inventory (NCAAAI Pilot), and 74 had alternate assessments using the North Carolina Alternate Assessment Portfolio (NCAAP) ("End-of grade multiple," 2001). Table 2 shows where the sixth grade also had 68 students with autism included in the performance of academically gifted, exceptional, limited English proficient, and Title I students scoring a 259.5 average math score, compared to the average 263.2 of all students ("End-of grade multiple," 2001).

The seventh grade results showed that 108 students with autism were tested in mathematics with accommodations, as seen in Table 1: 32 had standard administration with accommodations using the North Carolina Computerized Adaptive Testing System (NCCAS Accommodation Pilot), 18 had alternate assessments using the North Carolina Alternate Assessment Academic Inventory (NCAAAI Pilot), and 58 had alternate assessments using the North Carolina Alternate Assessment Portfolio (NCAAP) ("End-of grade multiple," 2001). The seventh grade also had 36 students with autism included in the performance of academically gifted, exceptional, limited English proficient, and Title I students scoring a 267.4 average math score, compared to the average 267.1 of all students, as shown in Table 2. ("End-of grade multiple," 2001).

Performance of Academically Gifted, Exceptional, Limited English Proficient and Title I Students Grade 6-8

	Category	Number Tested	Percent at or Above Level III	Average Scale Score Mathematics
Grade 6	All Students	100,079	67.6	263.2
	Autistic	68	48.4	259.5
Grade 7	All Students	96945	70.4	267.1
	Autistic	36	58.8	267.4
Grade 8	All Students	93305	74.4	270
	Autistic	68	48.4	259.5

Table 2; Performance of Middle School students in NC EOG. This figure illustrates the scores of students with & without autism tested in mathematics ("End-of grade multiple," 2001).

The eight grade results showed that 115 students with autism were tested in mathematics with accommodations: 17 had standard administration with accommodations using the North Carolina Computerized Adaptive Testing System (NCCAS Accommodation Pilot), 6 had alternate assessments using the North Carolina Alternate Assessment Academic Inventory (NCAAAI Pilot), and 92 had alternate assessments using the North Carolina Alternate Assessment Portfolio (NCAAP), as shown in Table 1 ("End-of grade multiple," 2001). The eight grade also had 32 students with autism included in the performance of academically gifted, exceptional, limited English proficient, and Title I students scoring a 267.7 average math score, compared to the average 270.0 of all students as shown in Table 2 ("End-of grade multiple," 2001).

Conclusion

These results show that within the appropriate teaching methods and necessary modifications of testing students with autism have the ability to succeed equivalent to the average student regardless of placement. The scores discussed above show that the differences are not as significant as one might think. There is not much research on comparing students with autism across settings, inclusion and self-contained, but from what was found there are differing opinions. Many researchers believe that inclusion is the place for students with autism, as they tend to perform at a level near to that of their peers, but the testing results, though limited, do not indicate that there is a significant difference between IQ or mathematical ability across settings. The choice of setting can differ between schools and parents' opinions but the best location for students with autism is the one where they can thrive and be most successful with their education.

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