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Improving Math Skills of Special Education Students

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Abstract
Education curricula have not fully captured the needs of students with special needs and disabilities. The articleoffersunderstandings into the pivotal factors delignating the poor academic performance in mathematics subjects by the special needs group. The article goes further to propose how stakeholders in education sectors, especially teachers, can help improve math skills of special education students based on literature reviews of other publications addressing this concern, providing evidence of the success of some of the proposed strategies. The key proposals include;enhanced collaboration between mathematics and other teachers,employment of technology, multiple instructional methods, formation of peer groups, curriculum adjustment, verbalizationof mathematics procedures and creation of a conducive environment to facilitate learning. In the long run, the implementation of the highlighted proposals is likely to help education stakeholders improve mathematics skills amongst students with special needs.

Keywords
Special, Students, Mathematics, Skills,Technology, Curriculum, Methods, Cognitive, Accommodation, Modification, Peer, Challenges, Collaboration

I. Introduction

From a historical overview, the mode of delivering mathematics instructions to students with special needs and learning disabilities has not received the same level of attention and examination by researchers, policy maker and educators (Owen & Fuchs, 2002). While the subject of mathematics remains an important element to learners across institutions, the situation is nonetheless grimmer for students with special needs. 'Students with special needs' is a term used to describe learners with persistent and significant personal differences and scholastic needs that regular education systems cannot meet, or are unable to accommodate fully. These individual distinctions exhibit themselves over a wide range of medical and physical conditions to maladaptive behavior. Such unique conditions affect learners' ability to acquire knowledge and skills in the classroom environment and elsewhere. In striving to provide equal opportunity for learners, education systems have not been entirely successful in fulfilling the legitimate needs of special needs students.

Against this background, this paper will examine the factors contributing to poor academic performance in mathematics towards presenting practical solutions for improving math skills of special education students.

II. Factorscontributing to Poor Performance

(i). Disability-Oriented Challenges

Physical, biological and mental challenges constitute the most important factor explaining poor performance in mathematics by special needs learners. Categories of disabilities that qualifyfor this category includes autism, audio-visual impairments, emotional instability and mental illnesses, to mention a few. For instance, Autism affects performance in mathematics due to the affected person's inability to understand language and communicate. The condition affects the learner's ability to understand instructions in the classroom setup, be they auditory instructions from the teacher or symbolic mathematical symbols. The affected finds it more challenging compared to ideally normal learners to understand the sentential meaning, requirements of a mathematical problem and recognizing external information that is irrelevant to the problem.

Another important special challenge is dyscalculia (Butterworth, 2003). The condition is especially important in understanding why some special needs students perform poorly in mathematics. Its defining characteristic is that children find it extremely difficult to grasp basic number concepts, numerical facts, and procedures. While the affected learner is entirely capable of generating correct solutions to mathematical problems, it is a laboriously mechanical process for them which they do with little confidence. Furthermore, the learner struggles with recall, identification and reorganization of mathematical symbols, and the formulation of a problem-solving plan.

(ii). Attention Problems

Berch and Mazzocco (2007) pose that learners with attention problems perform poorly in mathematics because they either fail to capture critical information during a classroom session or are unable to recognize meaningful signals during problem-solving. Learners with attention problem are misunderstood for a total lack of concentration on anything. In fact, the opposite is true; they direct a lot of energy to anything and everything that stimulates their senses. Because of their abnormally high attention to external stimuli, the student is repeatedly distracted from the learning process. This is especially important in learning mathematical skills since the subject requires a concentration of cognitive energy every step of the way.

(iii). Cognitive-Processing Challenges

Although learners may be well equipped in the visual and auditory senses, they still may be incapable of interpreting audio-visual stimuli. For example, a student may accurately perceive mathematical formulae written on paper, and may be perfectly capable of scribbling mathematical symbols from memory. They, however, might be incapable of transferring what they see on the paper to the chalkboard, writing inaccurately. Such erroneous

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transcription, according to Berch (2004), is the result of disturbances in the body's nervous system; disruptions cause an alteration of visual percepts as they move to the motor system that controls limb movement necessary for writing. Illustratively, a learner might read something like a+2b-3c+34, but upon attempting to transfer what they have read elsewhere, end up writing something like a-3b+3c+43. The unknowing teacher might cite this as a concentration issue. The student might understand how to solve a+2b-3c+34, but their mind processed a-3b+3c+43.

(iv). Negative Instructor Attitudes

Special needs students face poor perceptions amongst teachers and instructors that further make it difficult for them to learn mathematics. In most cases, teachers in the mathematics field have confessed to perceiving students with special needs as being lazy or dumb (Berch, 2004). While they may be oblivious to the students' situation when using such negative language when referring to special needs learners, the effects have been worrisome. Students who are constantly remindedthat they are different from their peers in the classroom environment tend to adopt such attitudes and internalize them. Over the course of their student life, they tend to develop a lower academic expectation for themselves in a similar manner since it is what they have been taught Berch (2004); a 'lazy', 'dumb' or 'incapable' student's efforts may not surmount to anything academically worthwhile.

A student with visual challenges such as spatial learning issues might be described as a 'struggler' in interpreting graphs. Another with conceptual issues may be deemed competent in pattern identification, but incapable of generalizing it. Such language might be entirely okay to a medical practitioner or psychologist. However, when used by teachers to describe students, its users subconsciously develop negative attitude unconducive for instruction. On the other hand, the recipient of such language develops low self-esteem, becoming overly dependent on teachers in their learning process, in a similar fashion to Markey's (2009) conceptualization of 'learned helplessness'. The effect is that students, special needs learners inclusive, refuse to solve mathematical problems independently until someone helps at every step.

III. Solutions to Improving Math Skills

A. Collaboration Between Mathematics and Special Education Teachers

Part of the reason why students perform poorly in mathematics is the negative attribution they receive from their mathematics instructors who might be unaware of their special needs. While these teachers might be committed to ensuring that their students learn mathematics and perform well, they lack the conceptual framework requisite for understanding why learners struggle with math (Mutch, 2004). They may also lack the instruction sets that cater to student learning needs. This is where special education teachers come in. Research conducted by Rea et al. (2002) demonstrates that student with disabilities can benefit in academic and social aspects when placed in a general education classroom.

Furthermore, Henderson (2002), showed the effectiveness of co-teaching models for all learners, with or without special needs. The model promoted in the learner a wider scope of the understanding of mathematics, facilitated the development of superior questions regarding mathematical thinking for students, and widened thinking about the congruence between needs and abilities. In this inclusive program, the collaboration between mathematics teachers and a special education counterpart is a critical success factor.

B. Creating Conducive Learning Environment

Special needs students are referred so because of the unique challenges they face and their distinct traits. As such, there is a need for education stakeholders to appreciate student differences and dynamics of learners' participation in a mathematics classroom towards the design of favorable learning environments. For instance, Allsopp, Kyger andLovin (2007) propose a two-dimensional strategy for mathematical instruction; supporting learning experience by shifting focus from concrete learning stages to abstract comprehension and including receptive and expressive question formats. The two strategies work in unison as a method of evaluating students' mathematical understanding.

Additionally, instructional practices need to be customized to accommodate learners' special needs. Accommodations purpose to enable special needs students to show their mathematical understanding on assessments with minimal or no interference from their biophysical or mental challenges. This should make it possible for them to learn mathematics as their non-disabled classmates while being fair to both parties. For example, such accommodations typically include restructuring test directions, question formats and assessment schedules (Anstrom, 2006). The learning environment may also be made favorable by using manipulative instructional materials specific to mathematics (Moyer, 2001), such as visuals, models, and graphic organizers.

C. Technology

Poor performance in mathematics by special needs students relates to their specific impairments. Used effectively, information and communication technology can help enhance their learning process by reducing the influences of impairments. For example, challenges with learning basic math facts can be addressed through direct instruction by computers (Kroesbergen, 2003). Kroesbergen (2003) notes that computer programming can be used to enhance the learning of math facts by providing the learner with special needs with a mechanism to automate and practice math facts. Even though computers are incapable of remediating difficulties the learner experiences in the learning process, traditional intervention by teachers complements the computer. Such an approach may help improve understanding of basic mathematics for the dyscalculic learner, hence improve performance.

Additionally, the research evidence indicates that technology has the potential to facilitate the implementation of other strategies geared towards the effective teaching of mathematics to impaired learners. These strategies include the provision of basic computational competency and the provision of manipulatives that enhance conceptual understanding. For instance, technology can be used to represent the mathematical concepts in varied ways (Hasselbring, Lott &Zydney, 2005). This ability helps the learner formulate mental images of mathematical concepts, in ways themselves best understand.

Thirdly, technology offers a better means of customizing learning experiences to suit the impaired learner. Math games are one approach, as exemplified by the Math Matrix computer program owned by techmatrix.org. Such games are designed in such a manner that they are as interesting as they can get to capture the undivided attention of the participant. They also go on further

to use programming techniques that evaluate the concentration levels of the math gamer by analyzing their responses to interactive questions, capturing signals of inattention that the human instructor might miss (Stanberry &Raskind, 2009). The results of the analysis can be used to customize more lessons for the learner automatically, ensuring as much effort as possible is directed towards ensuring the learner grasps concepts despite their special challenges. Moreover, computer programs are devoid of subjective bias, and may not label the learner dumb, among other demeaning labels.

Technology also helps improve the math skills of special education students through the use of virtual manipulatives. These are alternative to concrete learning materials. Virtual manipulates ensure this by availing sequences of concrete, representational and abstract instructional materials to teachers on an online platform. These can then be accessed over the internet by instructors for demonstrating concepts to a class in interactive and comprehensible means. For example, such manipulatives may be used by the physically handicapped learner with poor motor skills to move virtual objects (Hasselbring, Lott &Zydney, 2005). Through this form of engagement, they can focus on concepts of representation rather than divert significant mental resources for locomotion.

Video technology can also be used to enhance the instruction of mathematical concepts. With traditional instruction, mathematics is taught through textual communication. This may not fit into the requirements of learners with language disorders such as autism. Video technology offers a way out – real world scenarios can be presented in video format, ensuring the student does not struggle with textual information (Hasselbring, Lott &Zydney, 2005).

D. Explicit Instruction

Also termed direct instruction, explicit instruction refers to an instructional method that constructs interactions between the student and the teacher. The practice involves the teacher guiding the student through predefined instructional sequences to instill strategies used by effective learners to master concepts (Kroesbergen& Van Luit, 2003). The instructor begins by stating the learning objective, after which follows the sequence of instructions. Though each step of the sequence, an evaluation is performed to assess what the learner already know about the subject. Information obtained from these analyses is used to customize subsequent instructions, which may involve repetitive practicing of the skills learned in the curriculum. Importantly, the pace of the sequence and associated repetitive task must be determined by students' progress and how they understand each phase. With this approach, instructional sequences involve allocating enough time for the learner to process what has been taught so that they may provide feedback on the same. Responses are frequently solicited as a means of monitoring the effectiveness of the specific strategy chosen by the instructor.

E. Multiple Instructional Methodologies

The use of instructions in teaching new mathematical skills and concepts has been a mainstay in effective instruction literature. Teachers need to ensure that they spend enough time in planning mathematics instruction. While so doing, much emphasis should be placed on the selection and sequential organization of instructions. The intention is to expose students to variations in mathematical problems while also highlighting common features of seemingly unrelated problems. The teacher can present numerous examples through specific sequences. For instance, from concrete instruction to more abstract forms and simplistic examples to more complex forms (Owen & Fuchs, 2002).

In the context of the mathematical application, this can be achieved through a variety of ways. Fractional and algebraic mathematics can be initially instructed with concrete samples. The sequence may then proceed with visual representations and culminate with abstract representations. Sequencing examples as an instructional methodology may be most important during the early learning stages where the impaired student acquires new skills. With multiple examples, the result is that the learner gains the ability to apply learned skills to a wider range of mathematical problem types.

F. Verbalization of Mathematical Procedures

Instructors should encourage their students to speak out their decision and the results of each decision at every problem-solving step. A student should say out loud what they think, for example 'I need to multiply by 4 to get a sixteenth). They might even verbalize the very steps they take during calculations, for example, 'I need to confirm whether the outcome is valid'. According to (Tournaki, 2003), verbalization can be performed during the first stages of learning, during problem-solving or upon completion of a mathematical task. Students with learning disabilities who are behaviorally impulsive may find it difficult to solve problems because they tend to disregard stepwise approaches, instead attempting to find the solution by combining numbers randomly. Verbalization might be the right solution, since speaking out thoughts at each computational step ensures that they control their impulsive behavior as a form of self-control.

G. Peer Help Groups

Including peer support in the classroom, setup may be vital for the learning processes for all special students. Peer support groups usually take the format of one-on-one mentoring in which students from higher grades tutor a lower grade counterpart. The groups may also be constituted within the same classroom, whereby higher performing students tutor their colleagues whose performance starkly contrasts theirs (Baker, Gersten, & Lee, 2002). Ideally, they should be strategically paired in two's either as desk mates, or otherwise, to ensure that the low achiever gets help as and when they need it. Additional support and aid from their regular education learners might prove crucial towards empowering the impaired with confidence that they too can achieve the same academic milestones in mathematics in spite of the challenges they face.

H. Curriculum Adjustments

The learning curriculum is important in the process of education. Most curriculums do not adequately cover the needs of students with special needs. As such, it is important that necessary modifications be made to existing curricula to absorb the emerging concerns of special needs education. It is vital that the curriculum is structured in such a manner that allows every student to participate actively at their levels to achieve their goals since, according to Allinder et al. (2000), the current educational structure is more favorable to students without disabilities. For example, it is should be mandatory that different learning materials are provided for the same topics on any given subject. While so doing, the curriculum goals as pertains to qualifications and grading should be applied consistently to all students, with or without a disability. The focus here should be on ensuring that the system offers equal opportunity

for all learners

VI. Supportive Evidence

An everyday application of how technology can be used to enhance the teaching of mathematics to special needs students can be seen at the University Of North Carolina Of Chapel Hill. Through the institution's Centre for Literacy and Disability Studies, the university envisions to address literacy needs of persons with severe speech and physical disabilities, of whom 70-90% possess significantly inferior literacy skills (Med.unc.edu, 2016). The organization has developed substitute pencils through their project dubbed "Writing With Alternative Pencils". The tools are designed to assist learners who are incapable of holding traditional writing tools due to anatomical motor challenges or are incapable of using keyed input devices such as the keyboard.

The product uses eye-tracking technologies to help as an alternative to writing as an input mechanism. With this technology, special lenses are attached to the eye's cornea. These work in combination with electromechanical transducers to track the movement of the eye. The physically handicapped users who cannot use their arms to write can instead use the technology to point to objects on a screen by gazing momentarily on an object of interest. In the context of a math class, the quadriplegic learner can stare at mathematical symbols momentarily, and the eye-gaze input system interprets the gesture and responds accordingly by inputting the symbol to a virtual calculator.

In New Zealand, assistive technology has demonstrated positive outcomes for disabled learners. A study conducted by the New Zealand Ministry of Education attempting to examine how technology influences learning for the disabled, specifically covering special needs students suffering from dyslexia, hearing challenges, autism, and visual impairments (Education Zealand, 2016). Their study followed the progress of a 13-year-old student with autistic spectrum disorder; he had difficulty learning, communicating while maintaining eye contact and most importantly, would not participate in any learning activity that required writing. The assistive technology employed was an iPad. Through time, the student was able to write using on-screen keyboard offered by the iPad and concentrated more with minimal disruptions from constantly erasing writing he did not like. Such technologies can be applying to learners with similar issues, ensuring autistic students focus and communicate with mathematics instructors effectively.

VII. Conclusion

Ultimately, educators and educational systems world over face increasing concerns over their dedication towards providing equal opportunities for all. The special needs concern continues to be the loudest, demanding more attention. With more concentration on the enhancement of the curriculum, effective teaching practices, communication tools and technologies, the collaboration between teachers and the special needs sector, the dream for equal opportunities might be realized. Specifically, special needs groups need to be empowered in the academic field of mathematics, as the subject is invaluable in scientific fields spurring unlimited economic opportunities for the qualified.

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References

[1] *Allinder, R. M., Bolling, R. M., Oats, R. G., & Gagnon, W. A. (2000). Effects of teacher self-monitoring on implementation of curriculum-based measurement and mathematics computation achievement of students with disabilities. Remedial and Special Education, 21(4), 219-226.*

[2] *Allsopp, D. H., Kyger, M. M., &Lovin, L. H. (2007). Teaching Mathematics Meaningfully: Solutions for Reaching Struggling Learners. Brookes Publishing Company. PO Box 10624, Baltimore, MD 21285.*

[3] *Allsopp, D., Lovin, L., Green, G., & Savage-Davis, E. (2003). Why students with special needs have difficulty learning mathematics and what teachers can do to help. Mathematics Teaching in the Middle School, 8(6), 308.*

[4] *Anstrom, T. (2006). Achieving mathematical literacy: Interventions for students with learning disabilities. Washington, DC: American Institutes of Research.*

[5] *Baker, S., Gersten, R., & Lee, D. S. (2002). A synthesis of empirical research on teaching mathematics to low-achieving students. The Elementary School Journal, 51-73.*

[6] *Berch, D. B., &Mazzocco, M. M. (2007). Why Is Math So Hard for Some Children? The Nature and Origins of Mathematical Learning Difficulties and Disabilities. Brookes Publishing Company. PO Box 10624, Baltimore, MD 21285.*

[7] *Butterworth, B. (2003). Dyscalculia screener. NferNelson Pub.*

[8] *Education Zealand,. (2016). Assistive technology. Education in New Zealand. Retrieved 19 May 2016, from http://www.education.govt.nz/school/student-support/special-education/assistive-technology/*

[9] *Hasselbring, T. S., Lott, A. C., &Zydney, J. M. (2005). Technology-supported math instruction for students with disabilities: Two decades of research and development. Retrieved December, 12, 2005.*

[10] *Henderson, K. (2002). Commentary: Collaboration to benefit children with disabilities: Incentives in IDEA. Journal of Educational and Psychological Consultation, 13(4), 383-391.*

[11] *Kroesbergen, E. H., & Van Luit, J. E. (2003). Mathematics interventions for children with special educational needs a meta-analysis. Remedial and special education, 24(2), 97-114.*

[12] *Markey, S. M. (2009). The Relationship between Visual-Spatial Reasoning Ability and Math and Geometry Problem-Solving. ProQuest LLC. 789 East Eisenhower Parkway, PO Box 1346, Ann Arbor, MI 48106.*

[13] *Med.unc.edu. (2016). About — clds. [online] Available at: http://www.med.unc.edu/ahs/clds/about-1. [Accessed 19 May 2016].*

[14] *Moyer, P. S. (2001). Are we having fun yet? How teachers use manipulatives to teach mathematics. Educational Studies in mathematics, 47(2), 175-197.*

[15] *Mutch-Jones, K. (2004). Collaborative insights: The work of general and special educator pairs in inclusive mathematics*

classrooms.

[16] Owen, R. L., & Fuchs, L. S. (2002). Mathematical problem-solving strategy instruction for third-grade students with learning disabilities. Remedial and Special Education, 23(5), 268-278.

[17] Rea, P. J., McLaughlin, V. L., & Walther-Thomas, C. (2002). Outcomes for students with learning disabilities in inclusive and pullout programs.Exceptional Children, 68(2), 203-222.

[18] Stanberry, K., &Raskind, M. H. (2009). Assistive technology for kids with learning disabilities: An overview. LD Online.

[19] Tournaki, N. (2003). The differential effects of teaching addition through strategy instruction versus drill and practice to students with and without learning disabilities. Journal of Learning Disabilities, 36(5), 449-458.

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