

The Use of Graphical Teaching Strategies to Enhance the Arithmetic Skills of Pupils with Dyscalculia.

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Abstract

Difficulties in arithmetic are often major obstacles in the academic paths of pupils with learning disability, as they frequently continue to cause problems throughout the schooling stage. This challenge is worse off for pupils with dyscalculia. Given these difficulties, a teaching strategy that provides improvement in arithmetic skills and improves the self-confidence of pupils with dyscalculia is desirable. Graphical teaching strategy has emerged as a promising method for enhancing arithmetic skills in pupils with dyscalculia. Thus, this paper was designed to review the relevance of graphical teaching strategies to enhance the arithmetic skills of pupils with dyscalculia. The exploratory paper revealed that graphical teaching strategies significantly enhance the arithmetic skills of pupils with dyscalculia. Therefore, it was concluded that the implementation of graphical teaching strategies in arithmetic instruction represents a promising avenue for addressing the challenges faced by pupils with this physical condition. The study, among others, suggested that educational institutions at the basic level should integrate graphical teaching tools into their classrooms, providing pupils with interactive and graphical learning opportunities.

KEYWORDS: Arithmetic Skills, Dyscalculia, Graphical Teaching Strategies, Pupils

Introduction

For ages, mathematics teachers have been interested in discovering more effective methods to support their pupils' comprehension and retention of the content they come across in the classroom. The best teaching strategy has to be used to enhance effective teaching (Garba, 2020). Graphical teaching strategy has emerged as a promising method for enhancing arithmetic skills in pupils with dyscalculia.

Graphical teaching strategy is a teaching strategy where ideas, abstract concepts, data, and other kinds of information are associated with images and diverse techniques related to them (Pena, 2011). It utilizes graphical tools and graphical representations like diagrams, flashcards, number lines, pictures, charts, graphs, and mind maps to convey complex information and concepts. This strategy can clarify complex concepts, aid problem-solving, and assist with decision-making. This approach leverages graphical stimuli to bridge gaps in comprehension.

According to Garba (2020), the materials used by teachers to teach and drive home their subject points at the primary and secondary school levels of the educational system is incontrovertibly a paramount issue in practical classroom interaction and successful transfer of knowledge from the teacher to the pupils. The use of graphical teaching strategies in arithmetic instruction can help pupils with dyscalculia visualize mathematical concepts, making them more accessible and understandable. Graphical representations can also aid in building connections between numbers and concepts, facilitating a deeper understanding of arithmetic operations.

The relevance of the graphical teaching strategy lies in its ability to cater to different learning styles, enhance creativity, develop problem-solving skills, and promote critical thinking skills leading to improved retention. Therefore, the influence of a graphical teaching strategy on enhancing arithmetic skills cannot be overemphasized. This is because mathematics by its nature is abstract, and thus requires additional effort to bring pupils to an understanding

of concepts, principles, and applications.

Arithmetic skill is the ability to apply basic math operations, analyze, and solve math problems. Arithmetic skills cover addition (+), subtraction (-), multiplication ($\times$), division ($\div$), etc. Despite the importance of arithmetic skills in an individual's life, some pupils still fail in mastering such basic skills leading to inadequate performance in both school internal and external examinations. According to National Key Result Area (2010), if the problems of grasping arithmetic skills in primary schools are ignored continuously, cumulative academic challenge will be difficult to be improved when the pupil enters a higher schooling stage. This challenge is worse off for pupils with dyscalculia.

Dyscalculia is a term used to describe a learning disorder that affects a person's ability to understand and manipulate numbers. It is a neurological disorder that affects the brain's ability to process mathematical information, making it difficult to understand basic number concepts. The American Psychiatric Association (2015) describes dyscalculia as the specific learning disabilities in mathematics (arithmetic) presented with difficulties in areas such as number knowledge and process, learning and memorizing arithmetic facts, executing arithmetic calculations fluently and accurately, as well as mathematics mental reasoning. It hinders pupils' ability to grasp arithmetic skills.

Difficulties in mathematics (arithmetic) are often major obstacles in the academic paths of pupils with learning disabilities, as they frequently continue to cause problems throughout the schooling stage. Though researchers have not been able to identify the precise cause of dyscalculia, however, Nfon (2016) identified genes and heredity, brain development, environment, and brain injury as possible causes of dyscalculia.

Further research on difficulties with arithmetic and on effective instruction for pupils who encounter such problems has become more

important as such young people seek to achieve more challenging educational goals. This condition affects a significant portion of the pupil population, impacting their ability to perform basic arithmetic operations, recognize numerical patterns, and grasp mathematical relationships. Traditional pedagogical approaches may not always be effective for these pupils, leading teachers and researchers to explore alternative strategies to improve mathematical understanding.

Given these difficulties, a teaching strategy that provides improvement in arithmetic skills and improving self-confidence of pupils with dyscalculia is desirable. Educators, researchers, and policy-makers worldwide continue to struggle to understand the strategies to improve educational outcomes and educational attainment for pupils with dyscalculia. Graphical teaching strategies offer a means to make abstract numerical concepts more tangible for pupils with dyscalculia. Traditional arithmetic instruction often relies heavily on abstract symbols and formulas, which can be particularly challenging for pupils who struggle with numerical cognition.

Graphical representations, such as number lines, pictures, charts, diagrams, flashcards, graphs, and mind maps, can significantly improve pupils' grasp of arithmetic relationships and concepts as well as increase engagement. Additionally, graphical tools facilitate a deeper understanding of difficult concepts by catering to a variety of learning demands and styles.

Number lines is a pictorial representation of numbers on a line, showing their correlations and order. It is an essential tool in graphical teaching strategies that improves problem-solving skills and nurtures critical thinking and problem-solving strategies. For example, it serves as a fundamental tool for illustrating the sequence of numbers and the concept of magnitude. By visualizing numbers in a linear format, pupils can better understand addition and subtraction operations as movements along the line. This graphical approach simplifies the concept of numerical operations by depicting them as spatial movements rather than abstract calculations (Klein, 2020).

The use of these graphical tools not only aids in comprehension but also provides a reference point for pupils to check their work and verify their understanding for example, flowchart. Bahtaji (2020) revealed that the use of the supportive graphical intervention improved the conceptual understanding of pupils. The study explained that pupils benefit greatly from explicit graphical interventions because they are life skills that are necessary for both studying Mathematics and other subjects.

Additionally, they help pupils visualize and analyze data, which helps them develop critical thinking and problem-solving abilities. Teachers and parents can use digital software to generate dynamic and interesting representations of graphical tools, which will help to make learning more applicable and meaningful. Teachers can offer a holistic and inclusive learning experience that equips pupils for success in Mathematics, and beyond, by utilizing graphical teaching strategies to improve the arithmetic skills of pupils with dyscalculia. Hence, the efficacy of graphical teaching strategies in supporting pupils with dyscalculia is a topic of growing interest.

The Thesis Statement of this discussion is to explore the benefits of using graphical teaching strategies to enhance arithmetic skills in pupils with dyscalculia. These were captured in four domains: a) enhancing the creativity of pupils, b) fostering engagement and motivation, c) reducing mathematics anxiety in pupils, and d) supporting differentiated instruction.

Enhancing Creativity of Pupils

According to Bagila, *et. al.* (2019), contemporary education requires teachers to organize activities that ensure the development of individual abilities and creative attitude of each pupil in the classroom through the introduction of activities, and the implementation of the principles of moral communication with children. Zbuzant (2024) affirmed that teachers should try to strengthen the creativity of pupils. Hence, teachers must develop different arsenals in combination with pedagogical approaches to use all the possibilities of the teaching strategy (Bagila, *et. al.*, 2019).

Graphical teaching strategies can play a significant role in enhancing the creativity of children with dyscalculia. By using graphical representations, teachers can help pupils with dyscalculia to better understand and internalize mathematical concepts, which can lead to increased creativity and problem solving skills. Graphical teaching strategies can enhance creativity in children with dyscalculia in several ways, viz:

Improving Problem-Solving Abilities: Pupils with dyscalculia might benefit from graphic teaching strategies to improve problem-solving abilities, which are crucial for innovative thought. Pupils can investigate various approaches and answers to mathematical issues by utilizing graphical representations, which encourages creativity and critical thinking.

Conceptualizing Mathematics: Pupils with dyscalculia may find it simpler to envision and comprehend mathematical ideas with the use of graphic representations. Because they can think more abstractly and link disparate ideas, pupils may become more creative as a result.

Promoting exploration and experimentation: Pupils with dyscalculia can benefit from graphically taught methods by being encouraged to experiment and explore various mathematical ideas, which can boost their creativity and inventiveness. Pupils can test theories and investigate various circumstances by utilizing graphical tools, which enhances their critical thinking and problem-solving abilities.

Graphical teaching strategies can play a significant role in enhancing the creativity of children with dyscalculia. By using graphical representations, teachers can help pupils with dyscalculia to better understand and internalize mathematical concepts, leading to increased creativity and problem-solving skills. By incorporating graphical strategies into their teaching practices, teachers can help pupils with dyscalculia to develop their creative potential and achieve academic success

Fostering Engagement and Motivation

Engagement and motivation are critical factors in the learning process, particularly for pupils with dyscalculia, who may experience anxiety and a lack of confidence in their arithmetic abilities. Graphical teaching strategies have the potential to increase engagement and motivation by making learning more interactive and enjoyable.

Traditional arithmetic instruction can often be perceived as monotonous or frustrating for pupils who struggle with mathematical concepts. According to Embong (2019), traditional teaching methods have not proved to be effective in the teaching and learning of a practical subject like mathematics. In contrast, interactive graphical tools offer a dynamic and engaging learning experience that can capture pupils' interest and enthusiasm.

Interactive methods such as the graphical teaching strategy could provide opportunities for hands-on learning and exploration. This strategy often incorporates graphical elements that make learning more enjoyable and less intimidating for pupils with dyscalculia. Research shows that graphical teaching strategies can enhance motivation by creating a sense of achievement and encouraging active participation. When pupils are engaged and motivated, they are more likely to persevere through challenges and achieve better success in arithmetic.

Moreover, graphical tools and interactive activities can provide immediate feedback, allowing pupils to see the results of their efforts and adjust their strategies accordingly. This feedback loop is crucial for building confidence and promoting a positive attitude towards Mathematics (Schunk, 2003). By offering an engaging and supportive learning environment, graphical teaching strategies help pupils with dyscalculia develop a more positive relationship with arithmetic.

Graphical tools are instrumental in enhancing the retention of arithmetic concepts among pupils with dyscalculia. The cognitive load theory

posits that pupils have limited working memory capacity, and presenting information in a graphical format can reduce the cognitive burden associated with processing abstract numerical data (Sweller, 2011). By translating numerical information into graphical representations, teachers can alleviate some of the cognitive demands placed on pupils with dyscalculia. Graphical teaching strategy improves retention in diverse ways which include: graphical encoding (information is retained as graphical images, making it easier to recall); reinforcement (graphical tools reinforce learning, providing a graphical reminder of key concepts); and active learning (graphical tools encourage active engagement, promoting deeper understanding and retention).

By incorporating graphical tools, pupils are more likely to remember key concepts longer, make connections between ideas, apply learned information to new situations, and recall information accurately. For instance, the use of graphical tools such as pictorial representations and diagrams can help pupils retain information by linking mathematical concepts with graphical imagery. Research indicates that graphical tools facilitate long-term retention by creating mental images that pupils can recall when solving problems. In the context of arithmetic instruction, graphical tools like charts, flash cards, number line, pictures, etc. provide a graphical context that reinforces numerical relationships and operations.

Furthermore, graphical strategies can support memory retrieval by providing graphical cues that trigger recall. When pupils are familiar with the graphical representation of mathematical concepts, they are better equipped to access and apply their knowledge during problem-solving tasks. This enhanced retention contributes to a deeper understanding of arithmetic principles and improves overall academic performance.

Reduction of Mathematical Anxiety

Mathematical anxiety is seen as one of the emotional factors that causes dyscalculia. Mathematical anxiety is described as a fear of Mathematics or as a

negative emotional reaction to Mathematics. Mathematical anxiety is a common and significant hurdle for many pupils, especially those with dyscalculia, a learning disability that interferes with arithmetic comprehension, computation, and other functions.

Though dyscalculia triggers mathematical anxiety and real, detrimental learning consequences, teachers, parents, and even pupils with dyscalculia seldom fully understand the nature and breadth of the condition. A study by Vintere (2021) disclosed that most teachers are unable or unaware of how to determine whether a pupil has dyscalculia or mathematical anxiety and do not have appropriate tools to help a pupil with such learning difficulty.

Baloğlu (2001) suggested developing arithmetic skills as one of the two ways to eliminate Mathematics anxiety. Graphical approaches can make math more accessible and enjoyable, reducing anxiety and increasing confidence (Ramirez, *et. al.*, 2013). Graphical teaching strategy can play a crucial role in reducing anxiety in children with dyscalculia. By providing a graphical and interactive approach to learning Mathematics, graphical tools can help alleviate anxiety and create a more positive learning experience.

Graphical teaching tools can reduce anxiety in children with dyscalculia in several ways: First, it helps in visualizing mathematical concepts. Graphical representations can help pupils with dyscalculia to visualize mathematical concepts, making them more accessible and easier to understand. This can reduce anxiety as pupils feel more confident and in control of their learning.

Secondly, by breaking down complex concepts: Graphical teaching strategy can break down complex mathematical concepts into smaller, more manageable parts, reducing feelings of overwhelm and anxious. By using graphical representations, pupils can focus on one step at a time, building their confidence and reducing anxiety.

Thirdly, it helps in providing a sense of control among pupils. Graphical teaching strategies can provide pupils with dyscalculia with a sense of control over their learning, reducing anxiety and increasing motivation. By using interactive graphical tools, pupils can explore and experiment with different mathematical concepts, developing their problem-solving skills and confidence.

Lastly, it creates a positive learning environment. Graphical teaching strategies can create a positive learning environment, reducing anxiety and increasing engagement. By using colorful and interactive graphical tools, teachers can create a fun and engaging learning experience, reducing anxiety and promoting a growth mindset.

Some examples of graphical teaching tools that can help reduce anxiety in children with dyscalculia include number lines, graph paper, etc. Number lines can help pupils visualize mathematical concepts, such as addition and subtraction, and provide a sense of control over their learning. Graph paper can help pupils to organize and visualize mathematical concepts, reducing anxiety and increasing understanding. By providing a graphical and interactive approach to learning Mathematics, graphical teaching strategy can help alleviate anxiety and create a more positive learning experience. By incorporating graphical tools into their teaching practices, teachers can help pupils with dyscalculia to reduce anxiety and achieve academic success.

Supporting Differentiated Instruction

Differentiated instruction can be attained through graphical teaching strategies, which cater for diverse learning styles and abilities. Graphical tools like diagrams, flashcards, charts, number lines, post cards, etc., simplify complex concepts, while multiple representations deepen understanding.

Pupils with dyscalculia benefit from a graphical teaching strategy, which provides temporary support and facilitates tiered tasks, promoting inclusive education. This approach ensures equal learning opportunities for

pupils with different needs. Effective graphical strategies, like concept pictures, number lines, charts, flashcards, and interactive whiteboards, create a supportive learning environment that empowers struggling pupils to succeed. With the use of these tools, teachers can overcome learning barriers and help pupils reach their full potential.

Graphical strategies provide a flexible framework for differentiation by offering multiple modes of representation and engagement. For instance, graphical teaching strategies can be adapted to suit various learning preferences, such as using color-coded diagrams for graphical learners or incorporating interactive digital tools for kinesthetic learners. This adaptability allows teachers to tailor instruction to meet the specific needs of each pupil.

Hence, a graphical teaching strategy supports differentiated instruction by accommodating diverse learning styles and needs, thus offering tailored interventions that address the unique challenges faced by pupils with dyscalculia and takes a more holistic and innovative approach incorporating graphical approach to help pupils with dyscalculia develop a deeper understanding of arithmetic concepts by using manipulative and real world examples to enable pupils to explore and interact with math in a more engaging and meaningful way. Mastering of fundamental quantitative concepts is vital to learning more abstract and complex Mathematics, a requirement for pupils who seek to complete high school and attend colleges or universities.

Furthermore, graphical teaching strategy can be used to scaffold learning, providing varying levels of support based on pupils' progress and proficiency. For instance, initially providing highly structured graphical teaching strategy and gradually transitioning to more open-ended graphical tasks can help pupils build confidence and independence. This approach ensures that all pupils, regardless of their starting point, can benefit from targeted support that aligns with their individual learning needs.

Summary

Based on the discussion in the paper, the findings of the paper are summarized as follows:

1. Graphical teaching strategies enhance the creativity of pupils by providing graphical representations that help pupils with dyscalculia grasp mathematical relationships more effectively.
2. The use of a graphical teaching strategy enhances the retention of arithmetic concepts in pupils with dyscalculia by reducing cognitive load and simplifying complex information. It also fosters greater engagement and motivation in pupils with dyscalculia, leading to improved retention and confidence in performing arithmetic tasks.
3. Graphical teaching tools can play a significant role in reducing anxiety in children with dyscalculia.
4. Graphical teaching strategies support differentiated instruction by accommodating diverse learning styles and needs, thus offering tailored interventions that address the unique challenges faced by pupils with dyscalculia.

Conclusion

Graphical teaching strategies significantly enhance the arithmetic skills of pupils with dyscalculia. By utilizing graphical tools, teachers create a conducive learning atmosphere that alleviates stress and fosters comprehension of pupils with dyscalculia. Tailored learning is achieved through graphical instruction methods, addressing individual knowledge gaps and strengths in pupils' dyscalculia. Interactive experiences and multiple representations build self-assurance and proficiency, enabling pupils to overcome learning obstacles. This approach empowers pupils to excel in arithmetic.

This paper concludes that the implementation of graphical teaching strategies in arithmetic instruction represents a promising avenue for addressing the challenges faced by pupils with dyscalculia. Graphical teaching strategies revolutionize the learning experience for pupils with dyscalculia. However, teachers need to consider the individual needs of their pupils and adapt graphical tools accordingly.

Suggestions

Educational institutions at basic level should integrate graphical teaching tools into their classrooms, providing pupils with interactive and graphical learning opportunities. Integrating graphical tools into classrooms can revolutionize the way pupils learn and practice arithmetic skills. It creates an immersive and engaging learning environment that caters for diverse learning styles. This approach can be particularly beneficial for pupils with dyscalculia, as graphical tools can help them better understand complex concepts and relationships.

Educational agencies should provide professional development for teachers: Empowering teachers through professional development is crucial to supporting pupils with dyscalculia. This initiative should focus on enhancing teachers' knowledge of dyscalculia and graphical teaching strategies, developing their skills to design engaging graphical lessons, and building their confidence in supporting pupils with dyscalculia. Improved teaching practices lead to increased pupil engagement and arithmetic skills, boosting teachers' confidence and pupils' outcomes. Empowering teachers could help to unlock the full potential of pupils with dyscalculia, providing them with the tools and resources needed to succeed in arithmetic and beyond.

Graphical tools should be tailored to the individual needs of pupils with dyscalculia: By assessing pupils' strengths, weaknesses, and learning preferences, teachers can create personalized learning plans that harness the power of graphical tools. This targeted strategy enables pupils to grasp arithmetic concepts more effectively, build confidence, and foster a deeper

understanding of complex ideas. Personalized graphical supports enhance engagement, retention, and academic achievement. It empowers when learning materials cater to their distinct learning style, pace, and interests. By embracing individuality and diversity, teachers can create a supportive learning environment that sets pupils up for success in arithmetic and beyond.

Suggestion for further research: In order to improve the understanding and support of pupils with dyscalculia, researchers are encouraged to conduct research in key areas. These include comparative analyses, which can assess the efficacy of various teaching approaches, longitudinal studies that look into the long-term effects of graphical teaching strategies on arithmetic outcomes, neuroimaging techniques that can shed light on the underlying mechanisms of dyscalculia, and personalized learning strategies that are suited to each pupil's unique learning profile and needs.

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