

## Dyscalculia: Mathematical Difficulties in the Concept of Multiplication Using Word Problems

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### ABSTRAK

Penelitian ini bertujuan untuk menganalisis kesulitan matematika yang terjadi pada anak dengan kasus diskalkulia untuk konsep perkalian yang difokuskan pada aplikasi soal cerita. Menggunakan metode kualitatif dengan pemilihan jenis penelitian studi kasus dan pemilihan instrument penelitian berupa instrument tes dan lembar wawancara sesuai dengan alur penelitian. Subjek penelitian adalah satu orang anak usia kelas IV Sekolah Dasar yang memiliki kasus diskalkulia berdasarkan hasil analisis dokter dan ahli terapi khusus. Penggunaan teknik random sampling untuk memilih subjek penelitian di dua klinik tumbuh kembang anak merupakan kesesuaian dengan tujuan penelitian. Hasil penelitian menyimpulkan bahwa subjek memiliki kesulitan dalam pemahaman mengenai konsep perkalian, tidak hanya sekedar prosedur rutin, namun fokus kepada merepresentasikan perkalian secara fungsional. Selain itu adanya penemuan lain bahwa terdapat kesulitan pada anak mengenali simbol bilangan dan menghubungkan bilangan dengan situasi nyata. Untuk itu perlu adanya terapi khusus pada anak sehingga meminimalkan gangguan belajar yang timbul pada anak.

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### ABSTRACT

This study aims to analyse the mathematical difficulties that occur in children with dyscalculia cases in the concept of multiplication which focused on the application of word problems. We used qualitative methods by selecting the type of case study research and selecting research instruments in the form of test instruments and interview sheets according to the research flow. The subject of the study was one child in the fourth grade of elementary school who had a case of dyscalculia based on the analysis of doctors and exceptional therapists. The use of random sampling technique to select research subjects in two child development clinics is under the research objectives. The results of the study concluded that subject has difficulty understanding the concept of multiplication, not just a routine procedure, but focus on representing multiplication functionally. In addition, there are other findings that there are difficulties in student recognizing number symbols and connecting numbers with real situations. Therefore, we need special therapy to minimize learning disorders that occur in this student

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**Keywords:**

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## Introduction

When we talk about a special case in children related to their psychological condition, one that has an important portion is the case of dyscalculia. Dyscalculia is a mathematics

learning disorder where the mathematical ability is far below the age level and the level of mathematical ability that should be (Khing, 2016; Pandey, 2014). Children who tend to have dyscalculia tend to have normal intelligence (Kaufmann & Von Aster, 2012; Zygouris et al., 2016). For this reason, many parents feel that their children do not have special cases, because they attend normal schools, but it turns out that as time goes by, there are conditions that show disturbance when they learn. Children with dyscalculia are not children who are “lazy or stupid” and are in normal intelligence patterns, but their brains process information in different ways (Geary, 2012).

Based on the literature obtained, as many as 4% - 8% of school-age children have a potential for dyscalculia and experience chronic difficulties learning mathematics ((De Castro et al., 2014). Meanwhile, another study stated that 3%-14% of school-age students were diagnosed with dyscalculia (Afiati & Azwar, 2016). The large percentage of dyscalculia cases requires special attention from many parties. In the case of dyscalculia, learning difficulties that occur are disorders of brain development due to problems in the information processing phase or weaknesses of several types of cognitive functions (Iuculano, 2016; Szucs & Goswami, 2013). However, in some cases, dyscalculia is caused by brain dysfunction, a mild diagnosis of the brain (Djamrah, 2011). This condition can affect the ability of children to have numeracy skills (Emerson & Babbie, 2010). In general, memory disturbances in the brain cause difficulty when it comes to distinguishing symbols, geometric shapes, the concept of numbers, memorizing addition, difference, multiplication, and division correctly (Suharmini, 2005).

The characteristics that are clearly visible in dyscalculia students are (Mutiani & Suyadi, 2020). Disturbance in spatial concepts. Students will find it difficult to distinguish front - back, top - bottom, beginning - end, up - bottom, far - near, and high - low; 2) Abnormalities in visual perception. Students have difficulty seeing a group of objects in group; 3) Association in visual motor. Students have difficulty counting objects in sequence while mentioning the number. Students seem to be able to memorize numbers only without understanding the meaning of these numbers; 4) Perseveration. Student attention attached to a particular object for a long period of time, therefore it is difficult to focus on the work that is being done; 5) Difficulty in reading and speaking. When a student has mathematical difficulties, complete with symbols, the first thing to look for is his ability in reading and speech (language), because these two abilities are closely related to the prerequisites for learning mathematics.

Math difficulties is a problem that never ends in learning process, for students as learners and teachers as facilitators of learning. In general, the term math difficulty refers to children with poor math performance caused by a variety of factors ranging from poor teaching to environmental factors. Students with math difficulties have insufficient performance in math caused by cognitive weaknesses, not because of sociocultural environment, called mathematical disabilities (Crooks & Alibali, 2014). It is associated with dyscalculia as a learning difficulty or disorder in mathematics.

Learning mathematics is certainly closely related to the concept and ability to understand various symbols. One of the mathematical concepts that students at the elementary school level must understand is the concept of multiplication. The concept of multiplication is one of the four main concepts in algebra operations to comprehend by the student, and a prerequisite for developing students' mathematical skills (Bahadir, 2017). The concept of multiplication is also one of the success factors in solving various mathematical problems (Brendefur et al., 2015). However, students with math difficulties, often fail to reach academic standards in solving multiplication problems (Zhang et al., 2015). Where the standard is, the third-grade elementary school students have been able to develop the concept of multiplication

and division, while fifth grade elementary school students are expected to have mastered multiplication reasoning with various semantic structures.

The development of the concept of multiplication in word problems leads students who have math difficulties to experience disturbance in the learning process, especially for children with math disabilities or dyscalculia. Therapy or special monitoring in learning is needed, so that long-term memory that is difficult to reach by dyscalculia children can find a solution through periodic assistance. For this reason, this study was conducted with the aim of analysing the math difficulties that occur in a student with dyscalculia case for the concept of multiplication which is focused on the application of word problems. The study is different with another previous studies, because this research is based on the doctors' and special children therapists' analysis with disability case that obtained from a child who was educated in normal schools.

Several studies related to children with dyscalculia disorders already exist with various problems that arise. Research by Azhari, Yacoeb and Irfan (Azhari et al., 2020) succeeded in compiling learning tools for children with dyscalculia cases to help them overcome learning difficulties. Another study from Chideridou-Mandari, Padeliahu, Karamatsouki, Sandravelis, and Karagiannidis (Chideridou-Mandari et al., 2016) stated that there needs to be special knowledge for mathematics teachers to understand the unique characteristics of students with dyscalculia disorders to choose the suitable learning model. The appropriate treatment provides flexibility in selecting actions for children with dyscalculia cases who are weak in basic math skills and cannot count correctly (Amimul & Aquil, 2020). Further research regarding children with dyscalculia cases needs special attention because many dyscalculia cases have not found solutions to their problems (Dharma Raja & Kumar, 2012). For this reason, there is a need for research that analyzes from an early age the mastery of basic mathematical concepts for elementary school-age children, especially the concept of multiplication. For research for children with dyscalculia symptoms to be well-conditioned, research must also obtain assistance from therapists and child psychologists.

## Method

This study uses a qualitative method, with a case study on one research subject: fourth-grade elementary school students. The selection of research subjects went through several stages of analysis and tracing in several child development clinics. The difficulty in finding research subjects is more focused on parents who have not provided information regarding their child's condition. Some parents think that their children only have ordinary learning difficulties experienced by normal children because mathematics is complex. After a long search, a child development clinic was finally chosen, which usually provides unique explorations to dyslexic children with various symptoms of learning difficulties, attention deficit disorders, and hyperactive children.

Choosing qualitative research methods relates to the interpretive paradigm, which emphasizes the researcher's experience of the research subject (Starman, 2013). While the choice of case study type, because the research deals with real-time phenomena that explore various contexts that occur naturally (Rashid et al., 2019). It collected research data through multiplication material tests in story questions, observations, and interviews. The research implementation is during November – December 2020.

The study began with interviews conducted with the guardians of the research subjects to obtain factual data regarding the identification of the guardians on the subject's initial condition after receiving the results of the paediatrician's post-mortem. Then the following interview is with a therapist who specializes in dealing with issues at the Child Development

Clinic. Observations were made by looking at some of the results of practice questions done by the subject to see further analysis. After analyzing several answers to the subject matter, the conclusion that students experience dyscalculia symptoms finally emerged. Then the detailed analysis continued for multiplication in the form of story questions by distributing several advanced test questions to students. After completing the multiplication material test, the interview applies by focusing on the answer to clarify the analysis of student answers.

## Result and Discussion

Based on the results of the initial interviews with the guardians of the subject, it was concluded that the subject was a child with early identification by the paediatrician, the subject had learning difficulties that should not be found in his age. According to the results of analysis that then discussed further with psychologist at Child Development Clinic, the subject identified as Attention Deficit Disorder and Learning Disabilities. Children with Attention Deficit Disorder have high creativity by diverting attention from external tasks to the inner imagination and audiation or sound predictions (Serrallach et al., 2016). For the case of children with learning ability disorders, it is marked as children with normal IQ, but has poor performance at school and certain neuropsychological disorders in their emotions and cognitive (Fernández-Alcántara et al., 2017). The two disorders that were identified earlier in the subject led to further analysis based on the thinking of the therapist who specifically treated the subject.

Analysis therapists conducted on the subject, after several exercises of several meetings which adapted material content with the applicable curriculum at the school, because the subject attend formal schools in general, it was found that long-term memory of the subject cannot be withdrawn well, just a short-term memory that is running normal. The subject was unable to operationalize mathematical operation symbols functionally. The age of the subject is at the fourth-grade level of elementary school who should be able to understand the basic concept of multiplication and implement it in the development of learning the form of word problems. Finally, the subject was categorized into dyscalculia. The research of Soares, Evans, and Patel (Soares et al., 2018) created a synonym for dyscalculia as a mathematical disability.

Subject has difficulty interpreting the multiplication symbol in mathematical problems. The test given by the researcher is not in the form and atmosphere in general, but the test is still providing directions to provide solutions. When the subject is given a problem: "write down the result of  $4 \times 3$ ." Then the subject can immediately write down the result and the answer is correct. The next problem, "write the multiplication of  $4 \times 3$  into a repeated addition." The subject did not give any answers. Then the subject was guided by the researcher to write down the result in the form  $3 + 3 + 3 + 3$ . Seeing this result, the subject was confused, then the question arose, "Why can it be changed like that? Why is the result the same?" When do the researchers give an explanation with a rather long time and a question of the same form as the example given, the subject can comprehend it.

At the next meeting, when the subject was given a similar question as in the previous meeting, like the example above, the subject was unable to write down the answer. When the researchers asked whether he could not remember the explanation at the previous meeting, the subject answered that he could not. Even the subject had to repeat memorizing the multiplication back from simple numbers. The subject has difficulty "calling" the long-term memory he has, therefore, the understanding given in the past becomes meaningless. The concepts of multiplication that given earlier get in the memory of the subject, but the quantity was only about 10%. If the subject is given 10 questions without explanation repetition of the material, only 1 question can be answered, and the rest goes wrong. This initial conclusion also has similarities with research from Mandari, Padeliadu, Karamatsouki, Sandravelis, and

Karagiannidis (Chideridou-Mandari et al., 2016), which states that students have difficulties in multiplication. Students give answers without thinking, so the solutions that appear are what they were thinking at the time.

Then the researcher tried to develop a simple word problem for the concept of addition as the basic concept of multiplication. "Ani bought 11 packs of candy, then Mother bought 23 packs of candy for Ani, how many packs of candy is Ani's now?" The subject can immediately answer with the correct result, but when asked the reason, he answered that he heard the mention of the numbers and directly adding it up, but the value and symbol of the results he conveyed, he did not understand. The meaning of giving the answer is to make it easier for the subject to understand the material, and when given an explanation the subject accepts it well and is able to restate the meaning of the results of the problems given. Even when given the next word problems in the same form he was able to answer.

The next problem is giving a simple word problem that contains the concept of multiplication. The results of the subject's answers are presented in Figure 1.

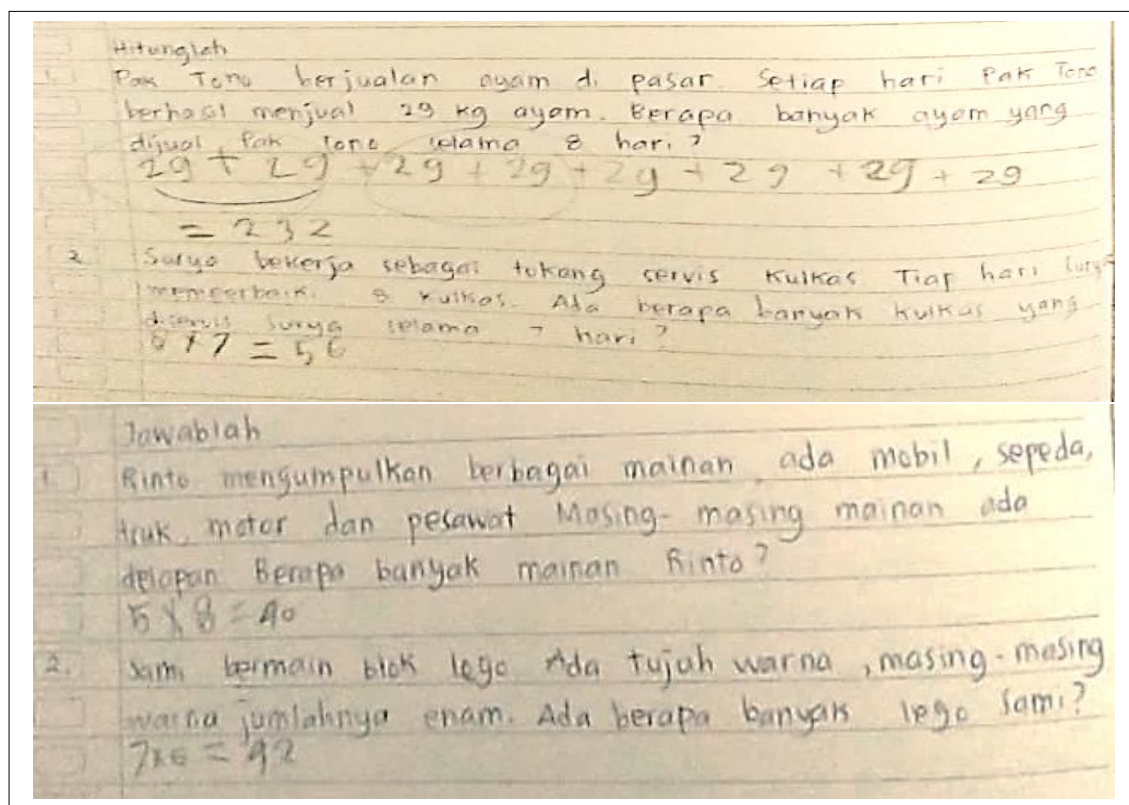


Figure 1. Subject's Answer Results

No.	Item
1.	Mr. Tono sells chicken in the market. Every day Mr. Tono sells 29 kg of chicken. How many chickens did Mr. Tono sell in 8 days?
2.	Surya works as a refrigerator repairman. Every day Surya repairs 8 refrigerators. How many refrigerators are there Surya serviced for 7 days?
3.	Rinto collects various toys, including cars, bicycles, trucks, motorbikes and planes. Each toy amounted 8. How many toys did Rinto has?
4.	Sami is playing Lego blocks. There are 7 colours, each colour amounted 6. How many Lego did Sami has?

Based on the results of the answers above and a short interview at the location, the subject can correctly answer all questions at the same time after being given examples that have similarities in the previous answers. Same as the previous case, when the subject asked the meaning of the results written on the answer sheet, he only answered "do not understand". The subject only understands to write down the results of solving the problem given based on his memory at the beginning of the meeting is asked to say verbally the results from several simple multiplications. The range of multiplication of numbers is made not long, for example, it is only asked to say verbally at the beginning of the multiplication 7 and 8. Because if too much data is memorized, the subject will find it difficult to answer.

The description of the observations made on the subject shows that the subject has difficulty in understanding the concept of multiplication, not just a routine procedure, but a focus on representing multiplication functionally. Even though understanding concepts in learning mathematics must be deeply embedded (Mulyono & Hapizah, 2018). Detection through regular tests such as in this study is very important to do, thus, the strengths and weaknesses of children with math learning disabilities can be identified more clearly (Rajaie et al., 2011). Based on the results of the explanation from the therapist, children with dyscalculia characteristics cannot return to normal like children in general, but through continuous therapy, learning disorders will be minimized, hence, they are not too burdensome. For this reason, dyscalculia must be detected since the elementary school period (Mahesh, 2015).

The characteristics of a child suffering from dyscalculia tend to become more obvious as time goes by, but these characteristics are different for each child. On the advice of a therapist and paediatrician, it is better if parents who notice symptoms that are not usually experienced by children at a normal age in general, then immediately contact the expert. Based on research conducted by Nfon (Nfon & Ph, 2016), some of the characteristics seen in children with dyscalculia are shown in table 1.

**Table 1.** Characteristics of Children with Symptoms of Dyscalculia at School Level

School Level	Characteristic features
Kindergarten and Elementary School	<ul style="list-style-type: none"> <li>- Difficulty in number labelling of objects in groups.</li> <li>- Difficulty in recognizing number symbols.</li> <li>- Difficulty in connecting numbers to real situations.</li> <li>- Trouble in remembering numbers and sorting them correctly.</li> <li>- Difficulty in recognizing patterns and order of objects based on size, shape and colour.</li> <li>- Avoid games that involve numbers, calculations, and other math concepts.</li> </ul>

Based on table 1 above, the characteristics that appear in the same research subjects indicate similar things; this shows the difficulty children recognise number symbols and connect numbers with real situations. When the subject first arrives at the Child Development Clinic, the therapist states that the subject experiences various mathematical difficulties, especially those related to symbols and patterns, but along with regular therapy, these conditions can be minimized according to the subject's ability to understand each treatment given to him during therapy. For understanding multiplication concepts, especially story problems, the therapist stabilizes light mathematical concepts in counting and their

implementation in solving simple problems. Understanding multiplication through regular addition continues to drill common multiplication questions, then brings up story questions. This continuous strengthening can minimize student difficulties but is casuistic because it only applies when concentration appears in the learning environment. When children with dyscalculia symptoms return to a regular school, these difficulties reappear along with students' learning conditions that are difficult to concentrate.

This study obtained the basic conclusion that regular therapy and frequent practice of multiplication questions, especially those related to story problems, can remind various mathematical concepts to help children with dyscalculia symptoms in learning under normal conditions. This condition is essential not only in child development clinics but also must be a concern for teachers in public schools, where cases of dyscalculia in children occur a lot. The importance of children to draw long-term memory to interact wisely is something that the teacher must continuously do. In addition, various conditions observed by teachers and parents can detect cases of dyscalculia in children early on. However, it is still necessary to apply other tools to make it easier for students, especially at the elementary school level, to control the ability of mathematical concepts, one of which is through learning media (Sinaga & Simarmata, 2020). The development of this research will continue in the preparation of instructional media designs for students with dyscalculia symptoms to form aspects of communication, the interaction of past and present memories, and activeness during learning

### Conclusion

Children with dyscalculia symptoms have difficulty understanding the concept of multiplication, not just routine procedures, but focusing on representing multiplication functionally. In addition, there are other findings that there are difficulties in children recognizing number symbols and connecting numbers with real situations. For this reason, it is necessary to have unique therapy for children to minimize learning disorders that arise in children.

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