ISSN 2527-5615
ISSN 2527-5607

Kalamatika : Jurnal Pendidikan Matematika
Volume 9, No. 2, November 2024 , pages 213-224

CHALLENGES IN LEARNING MULTIPLICATION: A STUDY ON ELEMENTARY SCHOOL STUDENTS

Siti Maryam Rohimah[1], Sarah Anida Putri[2], Yusup Nurdiansah[3], Salma Nur Anaya[4]

[1]Universitas Pasundan, Jl. Tamansari No. 6-8, Bandung, Indonesia.
sitimaryamrohimah@unpas.ac.id
[2] Universitas Pasundan, Jl. Tamansari No. 6-8, Bandung, Indonesia.
sarahanidaputri@gmail.com
[3] Universitas Pasundan, Jl. Tamansari No. 6-8, Bandung, Indonesia.
yusupnurdiansyah99@gmail.com
[4] Universitas Pasundan, Jl. Tamansari No. 6-8, Bandung, Indonesia.
salmanuranaya06@gmail.com

ABSTRACT

This study aims to identify the learning obstacles encountered by 3rd-grade elementary school students when learning the multiplication of natural numbers. These obstacles were examined through the Respondent Ability Test (RAT), administered to students who have already studied multiplication. The study uses a qualitative descriptive approach with 22 participants from a 3rd-grade class at an elementary school in Bandung, Indonesia. Data were collected through tests and interviews and were then analyzed using data reduction, data presentation, and conclusion-drawing techniques. The analysis results indicate that learning obstacles can be classified into three categories: ontogenic, epistemological, and didactical. Ontogenic obstacles arise when students struggle to transition from concrete understanding to abstract concepts. Epistemological obstacles occur when students are unable to apply learned concepts in word problem contexts. Didactical obstacles emerge when the instructional approach is overly procedural, leading students to memorize multiplication results without grasping the underlying concepts. Analyzing these obstacles is essential for identifying their causes and designing more effective teaching strategies in the future.

ARTICLE INFORMATION

Keywords

Learning obstacles
Multiplication
Natural number
Elementary school

Article History

Submitted *Aug 3, 2024*
Revised *Oct 10, 2024*
Accepted *Oct 11, 2024*

Corresponding Author

Siti Maryam Rohimah
Universitas Pasundan
Jl. Tamansari No. 6-8, Bandung, Indonesia
Email: sitimaryamrohimah@unpas.ac.id

How to Cite

Rohimah, S. M., et. al. (2024). Challenges in Learning Multiplication: A Study on Elementary School Students. *Kalamatika: Jurnal Pendidikan Matematika*, *9*(2), 213-224.

https://doi.org/10.22236/KALAMATIKA.vo9Xno2.2024pp213-224

INTRODUCTION

Elementary school is the first formal educational institution that individuals attend (Kenedi et al., 2019). It plays a crucial role in early learning development by introducing foundational knowledge, concepts, and values related to the environment and life (Maryono, 2017). Among the subjects studied in elementary school, mathematics is essential and taught at every educational level, including elementary school. However, learning mathematics can be challenging, as it contains fundamental concepts that require a deep understanding, aligning with the opinion of Syahrul and Nur'aeni (2018) who emphasize the importance of comprehending 'mathematical concepts.' Mathematics is inherently abstract, involving ideas used to classify specific objects and develop students' mathematical skills.

Arithmetic, a branch of mathematics that has long existed, is commonly known as the study of numbers. It plays a crucial role in all aspects of life and is a fundamental skill that everyone should master. Arithmetic includes the four basic operations: addition, subtraction, multiplication, and division. Among these, multiplication is a fundamental skill that students need to master, serving as a foundation for understanding further material and concepts across various fields of study. Multiplication, as a basic arithmetic operation, is also described by Fatimah et al., (2021) as a process of repeated addition, where a number is multiplied by a specific multiplier. In lower grades, multiplication builds upon addition concepts, requiring students to master it to develop a solid foundation for advanced mathematics.

Implementing mathematics education in elementary school presents significant challenges, as many students still struggle with mathematical concepts (Mahmud et al., 2023; Rohimah et al., 2022). These learning obstacles impact students' outcomes in mathematics, highlighting the need for effective instructional strategies to support students in overcoming these challenges.

Based on the researcher's observations and interviews with an elementary school teacher, many third-grade students face challenges in mathematics, especially in multiplying natural numbers. These difficulties affect students' comprehension of the material and their ability to solve multiplication problems accurately. This material, taught in the second grade, serves as a foundation for future learning. In multiplication lessons, students are expected to grasp the concept of multiplication as repeated addition rather than relying on memorization. Consistent with findings by Putri et al. (2024), students often show reluctance to memorize

formulas, experience declining motivation, fear mathematics, lack interest, and struggle with understanding concepts.

Multiplication difficulties arise from both internal and external factors (Kusumasari, Kiswoyo, & Sary, 2021). Internal factors include students' attitudes toward learning, interest, motivation, and study habits. External factors involve parental involvement, discipline among students and teachers, learning media, and school conditions. According to Dwiyono and Tasik (2021) students struggle with multiplication due to misunderstandings of symbols, place values, processes, and calculation errors. Furthermore, research by Amalia et al. (2022) indicates that students need help in understanding concepts, memorizing facts, and differentiating arithmetic symbols. They also encounter challenges in solving multiplication within word problems (Putri et al., 2024; Rizqi et al., 2023). Data collected from test responses were reduced and categorized based on learning obstacles, as outlined by Brousseau and Balacheff (2002). Addressing these obstacles promptly is crucial, as failure to do so may hinder students' progress in learning outcomes. Ensuring that learning materials align with students' needs is essential to enhance their understanding.

Learning content is a vital component of the learning process, directing the instructional path. Learning content should be designed to support students' learning pathways, which help anticipate potential challenges. These pathways illustrate students' thought processes during instruction, representing hypotheses based on instructional designs that aim to develop students' thinking toward achieving learning objectives (Clements & Sarama, 2004). They offer insight into expected learning trajectories, informed by empirical experiences that identify the steps students may take in developing mathematical ideas while acknowledging that each student's path may differ (Sztajn et al., 2012). Learning pathways assist teachers in modeling student thinking, identifying the next steps in learning, and interacting effectively during instruction (Wilson et al., 2014). Consequently, designing and developing learning pathways is crucial for anticipating potential learning obstacles.

This study, therefore, aims to analyze the challenges students face in learning multiplication of natural numbers in elementary school. This analysis will serve as a reference for designing future instruction to anticipate and address learning challenges in teaching multiplication.

METHOD

This study employs a qualitative research approach with a descriptive method and a case study framework. The qualitative method is used to obtain in-depth data that reveals specific meanings (Nafi'an, 2015). The descriptive method aims to illustrate the learning obstacles students encounter in arithmetic operations, particularly in the multiplication of natural numbers, and to provide deeper insights into these challenges in unmanipulated, natural conditions. This research was conducted at an elementary school in Bandung during the 2023/2024 academic year.

The study subjects were 22 third-grade students selected through purposive sampling, which involved choosing a specific class as a representative sample. This method ensures that participants are aligned with the study's focus on developing early mathematical skills and have received similar educational interventions, facilitating a more controlled analysis of learning effectiveness. Data collection techniques included tests and interviews, with tests conducted using the Respondent Ability Test (RAT) instrument comprising four multiplication questions.

Tabel 1. Respondent Ability Test (RAT)

Code	Questions (in English)
Q1	Andi has 8 chicken coops, with 10 chickens in each coop. Write the total number of Andi's chickens as a multiplication expression. ....
Q2	$12 + 12 + 12 + 12 + 12 + 12 + 12 = 84$ The addition above, when written as a multiplication expression, becomes: .....
Q3	There are 7 days in one week. How many days are there in 3 weeks? ....
Q4	There is going to be a birthday party tonight. Each child will receive 3 candies, 2 oranges, and a slice of cake. How many candies, oranges, and slices of cake will four children receive in total? ....

Subsequently, interviews were conducted to clarify and enhance understanding of the students' responses to the Respondent Ability Test (RAT). During these interviews, students were asked to explain their thought processes while solving multiplication problems, which allowed them to articulate the concepts they understood or the mistakes they made. Thus, the interviews gave the researcher further insights into students' understanding and difficulties in solving multiplication problems.

Data analysis techniques employed included data collection, reduction, presentation, and conclusion drawing. Miles et al. (2014) describe a case study as an in-depth investigation of a

specific example within a real-life context. Case studies focus on understanding complex dynamics within one or more cases, mainly when the distinctions between the phenomenon and its context are unclear, allowing the researcher to explore how and why specific outcomes occur. The data collected from the test responses were reduced and categorized according to learning obstacles based on Brousseau and Balacheff (2002). The data were then presented and concluded as the findings of this research. The results will be classified into ontogenic, epistemological, and didactical categories.

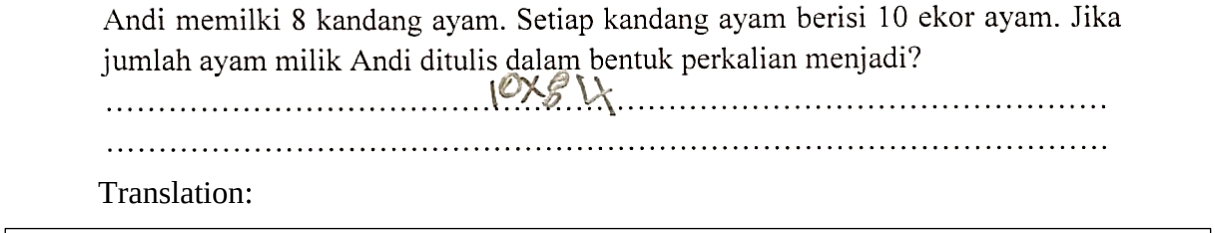
Students experience ontogenic obstacles when they struggle to transition from concrete to abstract concepts. They encounter epistemological obstacles when they cannot apply the ideas they have learned in the context of word problems. Additionally, didactical obstacles arise when the instructional approach is procedural, causing students to memorize multiplication results without fully understanding the underlying concepts.

RESULT AND DISCUSSION

Based on the research findings, the researcher identified several obstacles classified into three categories: ontogenic, epistemological, and didactical.

Ontogenic Obstacles

The researcher found that students experienced ontogenic obstacles related to multiplication. These obstacles indicate a gap in students' thinking as they struggle to transition from concrete to abstract concepts. This suggests that students have not yet fully grasped the fundamental concepts of multiplying natural numbers, as illustrated in Figure 1.


Andi memilki 8 kandang ayam. Setiap kandang ayam berisi 10 ekor ayam. Jika jumlah ayam milik Andi ditulis dalam bentuk perkalian menjadi?

……10x84……

……

Translation:

Andi has 8 chicken coops. Each coop has 10 chickens. Write the number of Andi's chickens in the form of multiplication: 10x84

Figure 1. Q1 Answer S13 Ontogenic Obstacle from the Respondent Ability Test (RAT)

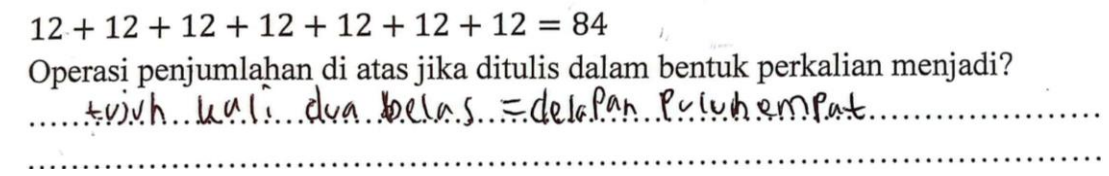
Based on the student's responses in Figure 1, the student attempted to solve the multiplication problem, but the provided answer did not correspond to the question. The student

recognized that the question involved multiplication but did not understand the specific form of multiplication being asked. In interviews, Researcher (R) spoke with Student (S), who answered 10 x 84 because they did not grasp the fundamental concept of multiplication involving the number 10.

R : *How did you arrive at the answer for the multiplication problem in question number 1?*
S13 : *I saw that the question was about multiplication, but I thought the answer was 10 times 84. However, I do not understand multiplication involving 10.*
R : *Where did the number 84 come from?*
S13 : *10 times 84 is 10 times 8, and the result is 4.*

Additionally, the student provided another reason, stating that 10 x 84 is 10 x 8 and that the result is 4. This misunderstanding stems from the instructional content used as a reference for the student when learning multiplication, which focuses on memorizing multiplication facts and symbols without engaging students in constructing meaning from the multiplication symbols. This aligns with findings emphasizing the importance of understanding concepts rather than rote memorization in mathematics education (Putri et al., 2024). Students are often required to memorize multiplication facts, leading to a gap in thinking. This gap occurs because there are no stages in the learning process that facilitate the transition in students' thought patterns (Rohimah, 2017). As a result, students only memorize each multiplication fact presented in the instructional content.

Furthermore, ontogenic obstacles arise when students cannot convert addition into multiplication, as illustrated in Figure 2.


12 + 12 + 12 + 12 + 12 + 12 + 12 = 84
Operasi penjumlahan di atas jika ditulis dalam bentuk perkalian menjadi?
tujuh kali dua belas = delapan puluh empat

Translation:

12 + 12 + 12 + 12 + 12 + 12 + 12 = 84
The addition above when written in the form of multiplication becomes:
seven times twelve = eighty four

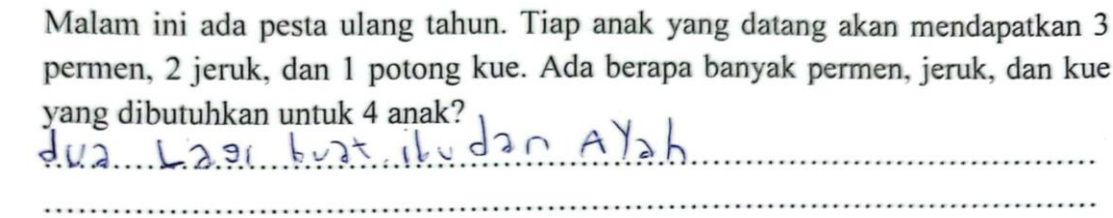
Figure 2. Q2 Answer S5: Ontogenic Obstacle from the Respondent Ability Test (RAT)

The student's response in Figure 2 indicates that they wrote their answer as a

multiplication sentence rather than using the multiplication symbol. The student's answer, “seven times twelve = eighty-four,” reflects confusion about whether to respond with a sentence or numbers. The student’s thinking process in solving the problem has not yet reached the stage where they can properly write the multiplication symbol. This is because the student is still at a concrete thinking stage. Although arriving at the answer was correct, the final result did not meet expectations. Therefore, teachers need to ensure that students have sufficient foundational skills before progressing to the following stages of learning (Yuliyanto et al., 2021).

Epistemological Obstacles

Epistemological obstacles can occur when students are unable to apply the concepts they have learned in the context of word problems. While students may be able to solve simple multiplication operations, they may struggle to use these skills in more complex situations. According to Moru (2007) epistemological obstacles arise from a limited understanding of the nature of mathematical concepts themselves. This limitation in context is caused by instructional content that presents problems in a less varied manner (Rohimah, 2017). The limitations experienced by students in the context can be observed in Figure 3.



Translation:

There is going to be a birthday tonight. Every child will get 3 candies, 2 oranges, and a slice of cake. How many candies, oranges, and slices of cake that four kids will get?

Two more for Mom and Dad

Figure 3. Q4 Answer S10: Epistemological Obstacle from the Respondent Ability Test (RAT)

Based on the response from S10 in Figure 3, the student demonstrated a lack of understanding of the question's intent and did not answer correctly. The student's answer is outside the context of what was asked in the problem. The results from the interview indicate that:

R : *Why did you answer, "two more for Mom and Dad"?*
S10 : *Oh, for this one, it is because usually when it is a birthday, the cake is always given to*

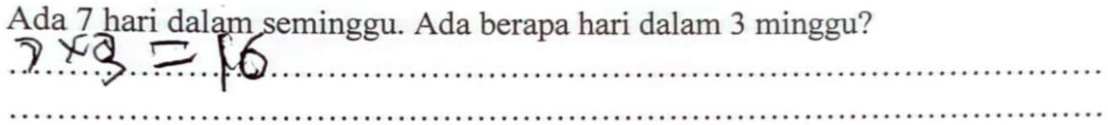
my mom and dad, so I answered "two" for them.

This misunderstanding is due to a misconception experienced by the student (Job & Schneider, 2014). In the learning process, when students merely imitate the procedures demonstrated by the teacher, they may struggle to answer or solve problems when faced with different situations (Fuadiah et al., 2016). This limitation in context is what is referred to as an epistemological obstacle. In the context of multiplication, students are constrained in applying the concept to word problems.

Didactic Obstacles

Didactic obstacles occur when the instruction provided by the teacher is purely procedural. According to Brousseau and Balacheff (2002), didactics emphasize the importance of learning that occurs through the interaction between the teacher, students, and mathematical tasks. When the instruction is procedural, and the teacher believes that the most important aspect of mathematics education is obtaining correct answers, it can lead to ineffective didactical transposition (Sbaragli et al., 2011). Learning obstacles arise because teachers inappropriately present instructional materials and use methods and approaches that are not suitable (Firdaus et al., 2022).

In Figure 4, one of the findings related to didactic obstacles occurs in the concept of multiplication.



Translation:

There are 7 days in a week. How many days are in 3 weeks? 7 x 3 = 16

Figure 4. Q3 Answer S9: Didactic Obstacle from the Respondent Ability Test (RAT)

In Figure 4, the student answered the problem with 7 x 3 = 16 when it should have been 7 x 3 = 21. This error occurred because the student memorized the multiplication facts; when they forgot the memorized information, the answer provided was incorrect. The results from the interview with the student are as follows:

R : *For question number 3, what did you answer, dear?*
S9 : *I answered 7 x 3 = 16, ma'am.*
R : *May I ask how many days there are in a week?*

S9 : *7 days, ma'am.*
R : *Now, how many days are there in 3 weeks?*
S9 : *Hmm, according to the problem, it is 7 x 3, ma'am.*
R : *Try calculating the total. What is it?*
S9 : *16, ma'am.*
R : *Why 16?*
S9 : *Because there are three sevens, ma'am.*
R : *Oh, so there are three sevens, huh?*
S9 : *Yes, ma'am.*

Procedures typically modeled by teachers should be reinforced with an understanding of multiplication concepts. Flores et al. (2014) further emphasize that conceptual knowledge is crucial for students to grasp well, as it strengthens procedural knowledge. This way, students develop comprehensive mathematical competence.

CONCLUSION

There are three characteristics of learning obstacles faced by students when solving problems related to the concept of multiplication of natural numbers: ontogenic, epistemological, and didactic obstacles. Ontogenic obstacles arise when there is a gap in the thinking process of multiplication, as students transition from concrete to abstract thinking, necessitating instruction that helps them understand the origin of the concept. Epistemological obstacles occur due to students limited contextual understanding, such as when they cannot apply the concept in word problems. Didactic obstacles involve misconceptions related to fundamental concepts, which affect the formulation of concepts related to the multiplication of natural numbers due to procedural methods and rote memorization techniques instilled by the teacher. The recommendations based on the conclusions and discussions of this research are teachers should ensure students have mastered prerequisite material, such as addition and multiplication operations; and the need for further research in developing a teaching device for multiplication material that considers the learning obstacles identified in this study, allowing the obstacles to be addressed in subsequent learning processes.

ACKNOWLEDGMENTS

The researchers would like to thank the principal, teachers, and all participants in this study.

REFERENCE

Amalia, D. R., Chan, F., & Sholeh, M. (2022). Analisis Kesulitan Siswa Belajar Operasi Hitung Perkalian Pada Pembelajaran Matematika di Kelas IV. *Jurnal Pendidikan Dan Konseling*, *4*(3), 945–957.

Brousseau, Guy., & Balacheff, Nicolas. (2002). *Theory of Didactical Situations in Mathematics*. Kluwer Academic Publishers.

Clements, D. H., & Sarama, J. (2004). Learning Trajectories in Mathematics Education. *Mathematical Thinking and Learning*, *6*(2), 81–89. https://doi.org/10.1207/s15327833mtl0602_1

Dwiyono, Y., & Tasik, H. K. (2021). Analisis Kesulitan Belajar Operasi Hitung Perkalian Matematika Siswa Kelas IB SD Negeri 019 Samarinda Ulu. *Borneo: Jurnal Ilmu Pendidikan LPMP Kalimantan Timur*, *1*, 1–15.

Fatimah, D., Murtono, & Su'ad. (2021). Katela Media Technology for Multiplication Count Operations. *Journal of Physics: Conference Series*, *1823*(1). https://doi.org/10.1088/1742-6596/1823/1/012107

Firdaus, R., Sa'ud, U. S., & Arisetyawan, A. (2022). Desain Didaktis untuk Mengatasi Hambatan Belajar pada Materi Keliling dan Luas Persegi serta Persegi Panjang. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(4), 3632–3645. https://doi.org/10.24127/ajpm.v11i4.5592

Flores, M. M., Hinton, V., & Strozier, S. D. (2014). Teaching Subtraction and Multiplication with Regrouping Using the Concrete-Representational-Abstract Sequence and Strategic Instruction Model. *Learning Disabilities Research & Practice*, *29*(2), 75–88.

Fuadiah, N. F., Suryadi, D., & Turmudi, T. (2016). Some Difficulties in Understanding Negative Numbers Faced by Students: A Qualitative Study Applied at Secondary Schools in Indonesia. *International Education Studies*, *10*(1), 24. https://doi.org/10.5539/ies.v10n1p24

Kusumasari, D. A., Kiswoyo, & Sary, R. M. (2021). Analisis Kesulitan Belajar Perkalian Pada Siswa Sekolah Dasar. *Jurnal Gentala Pendidikan Dasar*, *6*(1), 104–117. https://doi.org/10.22437/gentala.v6i1.12560

Job, P., & Schneider, M. (2014). Empirical Positivism, an Epistemological Obstacle in the Learning of Calculus. *ZDM - International Journal on Mathematics Education*, *46*(4), 635–646. https://doi.org/10.1007/s11858-014-0604-0

Kenedi, A. K., Helsa, Y., Ariani, Y., Zainil, M., & Hendri, S. (2019). Mathematical Connection of Elementary School Students to Solve Mathematical Problems. *Journal on Mathematics Education*, *10*(1), 69–80.

Mahmud, M. R., Turmudi, T., Sopandi, W., Rohimah, S. M., & Pratiwi, I. M. (2023). Learning Obstacles Analysis of Lowest Common Multiple and Greatest Common Factor in Primary School. *Jurnal Elemen*, *9*(2), 440–449. https://doi.org/10.29408/jel.v9i2.12359

Maryono. (2017). Atmosfer Sekolah dasar dan Implikasinya Bagi Pendidikan Guru Sekolah Dasar. *Jurnal Ilmiah Universitas Batanghari Jambi*, *17*(1), 103–113.

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative Data Analysis: A Methods Sourcebook (3rd edition)*.

Moru, E. K. (2007). Talking With the Literature on Epistemological Obstacles. *FLM Publishing Association, Edmonton, Alberta, Canada*, *27*(3).

Nafi'an, M. I. (2015). Analisis Kemampuan Kognitif Siswa Dalam Memecahkan Masalah Matematika. *Jurnal Pendidikan Dan Pembelajaran Matematika (JP2M)*, *1*(1), 80–88.

Putri, S. A., Rohimah, S. M., & Nurhadi, M. (2024). Increasing the Ability to Understand Mathematical Concepts through the Team Games Tournament (TGT) Model Assisted by the PhET Application. *Jurnal Riset Pembelajaran Matematika Sekolah*, *8*(2), 38–47. https://phet.colorado.edu/in/

Rizqi, A. F., Adilla, B. L., & Sulistiyawati, E. (2023). Analisis Kesulitan Belajar Matematika pada Siswa Sekolah Dasar dan Alternatif Pemecahannya. *Jurnal Pendidikan Dasar Flobamorata*, *4*(1), 481–488. https://e-journal.unmuhkupang.ac.id/index.php/jpdf

Rohimah, S. M. (2017). Analisis Learning Obstacles Pada Materi Persamaan dan Pertidaksamaan Linear Satu Variabel. *JPPM (Jurnal Penelitian Dan Pembelajaran Matematika), 10*(1), 132–141.

Rohimah, S. M., Darta, D., & Anggraeni, R. I. (2022). Analisis Learning Obstacles Pada Materi Pecahan Siswa Kelas IV Sekolah Dasar. *Symmetry: Pasundan Journal of Research in Mathematics Learning and Education*, *7*(2), 171–180. https://doi.org/10.23969/symmetry.v7i2.6386

Sbaragli, S., Arrigo, G., & D'amore, B. (2011). Epistemological and Didactic Obstacles: The Influence of Teachers' Beliefs on the Conceptual Education of Students. *Mediterranean Journal for Research in Mathematics Education*, *10*, 61–102.

Syahrul, S., & L Nur'aeni, E. (2018). Desain Didaktis Pembelajaran Matematika Konsep Perkalian Berbasis Permainan Congkak di Sekolah Dasar. *PEDADIDAKTIKA: Jurnal Ilmiah Pendidikan Guru Sekolah Dasar*, *5*(4), 206–216. http://ejournal.upi.edu/index.php/pedadidaktika/index

Sztajn, P., Confrey, J., Wilson, P. H. H., & Edgington, C. P. (2012). *Learning Trajectory Based Instruction: Toward a Theory of Teaching*. *41*(5), 147–156.

Wilson, P. H., Sztajn, P., Edgington, & Confrey, J. (2014). Teachers' Use of Their Mathematical Knowledge for Teaching in Learning a Mathematics Learning Trajectory. *Journal of Mathematics Teacher Education, 17*(2), 149–175.

Yuliyanto, A., Turmudi, T., Syaodih, E., Saputra, D. R., Dharmawan, A., & Pertiwi, C. K. (2021). The Validity and Reliability of Instruments for Measuring Elementary School Students' Early Mathematical Ability. *Kalamatika: Jurnal Pendidikan Matematika*, *6*(2), 127–142. https://doi.org/10.22236/kalamatika.vol6no2.2021pp127-142