

ANALYSIS OF ELEMENTARY SCHOOL STUDENTS' UNDERSTANDING OF ARITHMETIC CONCEPTS THROUGH A JUMPING ROPE GAME

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ABSTRACT

Arithmetic instruction in elementary school is often presented abstractly, making it difficult for students to understand the concepts meaningfully. One alternative contextual learning approach that aligns with the concrete operational stage is the use of local games. This study aims to describe the implementation of the jumping rope game as a medium for arithmetic learning and to measure students' understanding of the arithmetic concepts that arise during the game. This study uses a quantitative, survey-based approach with a sample of 56 grade III students from an elementary school in East Java, Indonesia. Data were collected through structured observation and guided oral tests, then analyzed using descriptive statistics in the form of frequency and percentage. The results, based on frequency and percentage analysis (n = 56), show that all students (100%) understood the concepts of counting and units of length. In contrast, 28 students (50%) understood simple counting operations, while 14 students (25%) understood the concept of time, indicating a decline in understanding as abstraction increased.

These findings confirm that jumping rope is an effective context-based learning medium for supporting students' understanding of concrete arithmetic concepts. However, teacher guidance remains essential to help students connect game experiences with more abstract concepts, particularly in operations and time. This implies that integrating traditional games into mathematics instruction should be accompanied by structured reflection and guided discussion to optimize conceptual understanding while also preserving local cultural practices.

Keywords: *Arithmetic; contextual learning; elementary school; jumping rope games; survey design*

ANALISIS PEMAHAMAN SISWA SEKOLAH DASAR TENTANG KONSEP ARITMETIKA MELALUI PERMAINAN LOMPAT TALI

ABSTRAK

Instruksi aritmetika di Sekolah Dasar sering disajikan secara abstrak, sehingga sulit bagi siswa untuk memahami konsep secara bermakna. Salah satu pendekatan pembelajaran kontekstual alternatif yang selaras dengan tahap operasional konkret adalah penggunaan permainan lokal. Penelitian ini bertujuan untuk mendeskripsikan implementasi permainan lompat tali sebagai media pembelajaran aritmetika dan untuk mengukur pemahaman siswa terhadap konsep aritmetika yang muncul selama permainan. Penelitian ini menggunakan pendekatan kuantitatif desain survei dengan sampel 56 siswa kelas III dari sebuah Sekolah Dasar di Jawa Timur, Indonesia. Data dikumpulkan melalui observasi terstruktur dan tes oral terbimbing, kemudian dianalisis menggunakan statistik deskriptif berupa frekuensi dan persentase. Hasil penelitian berdasarkan analisis frekuensi dan persentase (n= 56) menunjukkan bahwa seluruh siswa (100%) memahami konsep penghitungan dan satuan panjang. Sebaliknya, 28 siswa (50%) memahami operasi penghitungan sederhana, sementara 14 siswa (25%) memahami konsep waktu, menunjukkan penurunan pemahaman seiring dengan meningkatnya abstraksi. Temuan ini menegaskan bahwa lompat tali adalah media pembelajaran berbasis konteks yang efektif untuk mendukung pemahaman siswa tentang konsep aritmetika konkret. Namun, bimbingan guru tetap penting untuk membantu siswa menghubungkan pengalaman permainan dengan konsep yang lebih abstrak, terutama dalam operasi dan waktu. Hal

tersebut menegaskan bahwa mengintegrasikan permainan tradisional ke dalam pengajaran matematika harus disertai dengan refleksi terstruktur dan diskusi terpandu untuk mengoptimalkan pemahaman konseptual sekaligus melestarikan praktik budaya lokal.

Kata Kunci: *Aritmetika; desain survei, pembelajaran kontekstual; permainan lompat tali; sekolah dasar*

INTRODUCTION

Arithmetic is one of the basic competencies that plays an important role in learning mathematics in elementary school because it is directly related to the numeracy skills students need in daily life (Girard et al., 2021). The ability to count, perform basic calculations, understand sequences, and measure and compare quantities is the foundation for the development of logical and problem-solving skills at the next level of education (Dierckx et al., 2025). Furthermore, arithmetic not only functions as a counting skill, but also forms the thinking structure of students in understanding the relationship between numbers or number sense (Adamuz-povedano et al., 2021)), making estimates (Chan & Mazzocco, 2024) and making quantity-based decisions in various real-world situations, such as counting money, measuring lengths, comparing many objects, and determining the length of an activity (Pickering et al., 2025). If the concept of arithmetic is learned only as a mechanical procedure without understanding its meaning, students are at risk of misconceptions and difficulty transferring knowledge to different contexts, especially in non-routine problems (All-Mutawah et al., 2019; Braithwaite & Sprague, 2021). Therefore, learning arithmetic from an early age needs to be designed in a meaningful way so that students are not only able to do calculations, but also understand the underlying concepts.

From a cognitive development perspective, elementary school students are at the concrete operational stage, when conceptual understanding is most optimal when obtained through direct experience, real activities, and interaction with the surrounding environment (D. Ondog & T. Kilag, 2024). However, in practice, arithmetic learning in schools is still

often presented in the abstract by emphasizing the use of symbols, formulas, and calculation procedures without adequately associating them with students' daily experiences (Girard et al., 2021; Listiawati et al., 2023; Liu et al., 2024; Samritin et al., 2023; Susanto et al., 2022; Wilkie & Hopkins, 2024). The mismatch between students' cognitive development and the learning strategies leads students to memorize formulas rather than build a complete conceptual understanding (All-Mutawah et al., 2019; Uegatani et al., 2024). As a result, students' arithmetic knowledge is superficial, easily forgotten, and difficult to apply in situations beyond the examples given by the teacher, leading to a low level of conceptual understanding and a lack of interest in learning mathematics (Aye, 2025; Braithwaite & Sprague, 2021; Thomas et al., 2024). This condition indicates a gap between the learning needs of elementary school students and the predominantly abstract arithmetic approach still used in the classroom. Ideally, arithmetic learning at the elementary level should support students in developing conceptual understanding through meaningful, concrete, and context-based experiences aligned with their cognitive development. However, in practice, instruction often emphasizes abstract procedures, symbolic manipulation, and rote memorization, with limited connection to students' real-life contexts (Nahdi & Jatisunda, 2020). This situation results in students being able to perform calculations mechanically but experiencing difficulties in understanding underlying concepts and applying them in different situations (Listiani et al., 2026; Walid et al., 2025). Furthermore, the lack of concrete and interactive learning experiences contributes to low conceptual understanding of arithmetic among students,

as they struggle to relate numbers and operations meaningfully (Sello et al., 2024). This discrepancy between the expected learning outcomes and actual classroom practices highlights a significant and urgent gap that needs to be addressed.

To address this gap, a learning approach is needed that not only presents arithmetic as a set of procedures but also connects mathematical concepts to meaningful, concrete experiences relevant to students' daily lives, thereby supporting the development of deeper conceptual understanding.

One relevant approach is game-based learning. Game-based learning allows students to actively engage in the learning process by trying, experiencing, and reflecting on concepts directly (Adipat et al., 2021; Debrenti, 2023; Pratama & Setyaningrum, 2018). Several studies show that game-based learning can increase active engagement, learning motivation, and understanding of elementary school students' mathematical concepts (Debrenti, 2023; Mu'jizah & Ahsani, 2025). Through games, students not only process arithmetic concepts symbolically but also build understanding through sensorimotor experiences and social interactions, making learning more meaningful and lasting in memory (Debrenti, 2023).

In the context of education in Indonesia, regional games have great potential as a context-based learning medium because they are closely tied to students' culture and daily lives. The game not only serves as entertainment but also contains educational, social, and cognitive values that can be applied in mathematics learning (Rimayasi et al., 2025). The use of regional games in mathematics learning aligns with the ethnomathematical approach, which seeks to connect mathematical concepts with local cultural practices, making learning more relevant and meaningful for students (D'Ambrosio, 1985). In addition, integrating regional games into learning also helps preserve local culture amid the growing dominance of digital games among children.

One of these games still known to Indonesian children is jumping rope (Latama et al., 2025). The game of jumping rope in various regions in Indonesia involves physical activity, social interaction, and mathematical thinking processes related to counting, measuring, determining sequence, and comparison (Magistro et al., 2022; Ramos et al., 2024; Way & Ginns, 2024). In the jumping rope activity, students indirectly engage in activities to count jumps, determine the turn of play, estimate the length and height of the rope, and understand the sequence of game stages relevant to arithmetic concepts in elementary school (Anam et al., 2022). With these characteristics, the game of jumping rope has the potential to serve as a bridge between abstract arithmetic concepts and concrete learning experiences appropriate to the developmental stage of elementary school students.

Several studies show that jumping rope games have potential as a medium for learning mathematics. Research (Nur & Nurhafidzah, 2025) indicates that jumping rope games can contain non-standard concepts of counting, addition, and measurement. Research (Russo et al., 2024) also shows that the concepts of numbers, sequences, and simple counting operations arise naturally during jumping rope. However, most research still focuses on descriptive concept identification, so it does not provide a comprehensive picture of students' understanding of the arithmetic concepts that arise during the game.

Based on this description, this research is important for examining the implementation of the jumping rope game as a medium for learning arithmetic and for describing students' knowledge of arithmetic concepts that arise during the game. This research empirically enriches regional game-based arithmetic learning strategies to support the preservation of local culture in elementary schools.

METHOD

This study uses a quantitative, survey-based approach. This design was chosen to describe the student's level of understanding

of arithmetic concepts that emerge through the implementation of the jumping rope game. The quantitative approach enables the objective analysis of student comprehension data using descriptive statistics (Loeb et al., 2017).

Population and Sample

The study population was drawn from an elementary school in East Java, Indonesia. The research sample consisted of 56 Grade III students, selected through purposive sampling. Grade III was chosen because it represents a transitional stage in which students have acquired basic arithmetic skills while still relying on concrete experiences for conceptual understanding. Compared to Grade II, their numerical abilities are more stable, enabling more meaningful assessment. Compared to Grade IV, they remain highly engaged in physical and play-based activities, making jumping rope developmentally and culturally appropriate for this age group. The research was conducted in the school field, which naturally facilitated the implementation of the jump rope game.

Research Variables and Data Collection Techniques

The independent variable in this study was the use of the jumping rope game as a medium for learning arithmetic, while the dependent variable was students' understanding of arithmetic concepts. Data were collected through structured observation and guided oral tests. Structured observation was employed to capture students' arithmetic-related activities during the game, including stages of play, turn-taking, and numerical processes such as counting, measuring, comparing, and simple operations.

The guided oral test was conducted after the game to explore students' conceptual understanding further and involved four purposively selected students as supporting data. A scoring guideline was developed based on indicators of conceptual understanding to assess students' responses for accuracy and clarity of explanation. This scoring guideline was applied consistently across all students ($n = 56$) to ensure that the percentage results (e.g., 25%, 50%, and 100%)

were calculated in a standardized and reliable manner. All tests were administered and evaluated by the researcher to maintain consistency in scoring.

The data were analyzed using descriptive statistics in the form of frequency and percentage. Percentage results were derived from observation data involving all students, while the oral test results provided qualitative support for interpreting students' conceptual understanding.

1. Structured Observation

Observations are made to identify arithmetic activities that arise during the game. Observations focus on indicators such as counting jumps, understanding the game's order, and making non-standard measurements of rope height.

2. Guided oral test

The guided oral test is used to measure students' understanding of arithmetic concepts arising in the game, including counting, units of length, basic counting operations, and time.

Data Analysis Techniques

Data analysis employed descriptive statistics to examine students' understanding of arithmetic concepts. Microsoft Excel was used to calculate frequencies and percentages, with results presented in tables and graphs.

RESULTS AND DISCUSSION

RESULTS

Observations during game preparation indicate that most students do not understand how to jump rope with rubber bands or how to make the rope, so they require assistance from the teacher. This finding indicates that traditional games are no longer commonly practiced among students. Nevertheless, students still demonstrate active involvement through counting activities and collaboratively arranging the rubber bands. These preparatory activities implicitly involve basic arithmetic processes, particularly counting and sequencing, before the core game begins. Such engagement illustrates how numeracy skills can naturally emerge

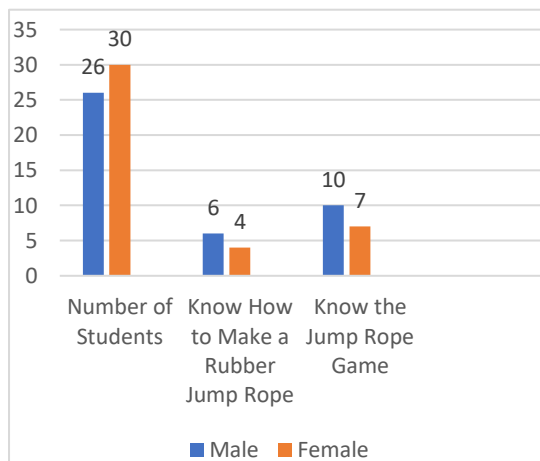
even in the initial stage of play, as shown in Figure 1.

Figure 1. Student involvement in the preparatory stage



To understand students' baseline familiarity with the jumping rope game, an initial survey was conducted prior to the learning activity. This information is important to determine whether the game is still commonly known and practiced among students. The data on students' initial knowledge of jumping rope are presented in Figure 2 below.

Figure 2. Students' initial knowledge data



As illustrated in Figure 2, only 17 students were familiar with the jumping rope game, and only 10 could make a rope from rubber bands, indicating limited practical and experiential knowledge. While all students were recorded in the data, the low number of students who understood and engaged with the game suggests a decline in its use as a play activity. This finding highlights the need to reintroduce jumping rope as a context-based learning medium to support arithmetic

understanding while preserving local cultural practices.

Results of Structured Observation of Arithmetic Activities

Observations were conducted using structured observation sheets that included arithmetic concept variables, including counting, sequencing, non-standard measurements, and comparison. Observation focuses on student activities throughout all stages of the jumping rope game.

The initial observations showed that most students needed an introduction to the jumping rope game before the core activity began. In the early stages of observation, students appear to gather and wait for the teacher's direction regarding the rules and stages of the game, as shown in Figure 3.

Figure 3. The initial observation situation shows that students need to be introduced to the jumping rope game before the implementation of the activity



The results of observations in Team A (Group 1 and Group 2) showed that students were able to follow the early stages of the game with a very high success rate. At the ground level to the ankles, all students managed to play the game without errors, indicating their ability to count and understand the game's optimal order. This success is also evident at the stage of large snakes still at low altitudes, as shown in Figure 4.

Figure 4. Stages of the big snake



However, as the rope height increases during the knee-to-shoulder stage, students' success rate begins to decrease. This decrease indicates that students face challenges in estimating jump heights and making gesture adjustments, which are related to the concepts of non-standard measurements and high-to-low ratios. The initial decline becomes apparent at the knee stage, as shown in Figure 5.

Figure 5. The level of the jumping rope game at knee height indicates the beginning of a decline in student success



To provide a clearer description of students' achievement during the game, the structured observation data were analyzed based on each stage of the activity. The findings reveal differences in the level of success between Group 1 and Group 2 within Team A. The results of observations on Team A are presented in Figure 6 below.

Figure 6. Observation results of the success of Team A jumping rope game (Group 1 and Group 2)

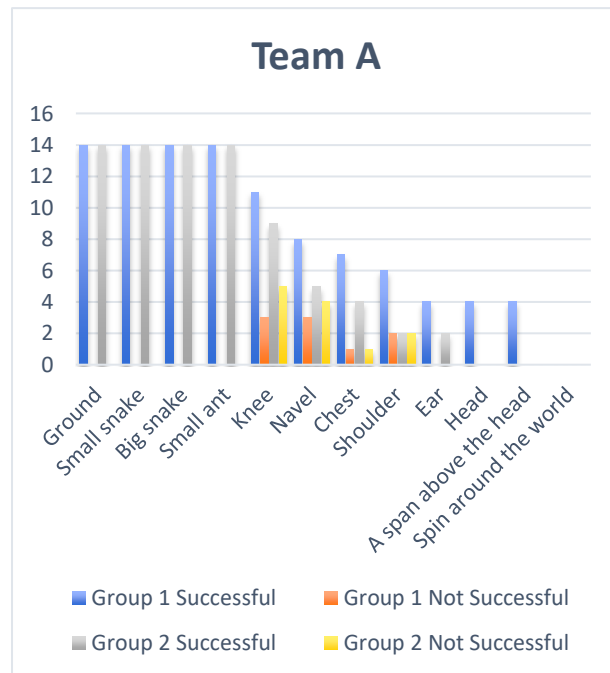


Figure 6 shows that both Group 1 and Group 2 in Team A demonstrate a similar overall pattern of success in the jumping rope game. However, Group 1 consistently achieves slightly higher success rates than Group 2 across most stages. In both groups, students perform well in the early stages, but their success decreases as the rope height increases. This comparison indicates that while both groups follow a similar performance trend, Group 1 shows better adaptability in maintaining performance at higher difficulty levels.

It turns out that the results of the observations in Team B (Groups 3 and 4) show a relatively similar pattern. Student success remains high in the early stages of the game, but decreases in the later stages as the rope height increases. The variation in success between groups in Team B shows that students differ in their ability to adjust movement strategies and estimate height at each stage of the game. The results of observations on team B are presented in Figure 7.

Figure 7. Observation results of the success of the Team B jump rope game (Group 3 and Group 4)

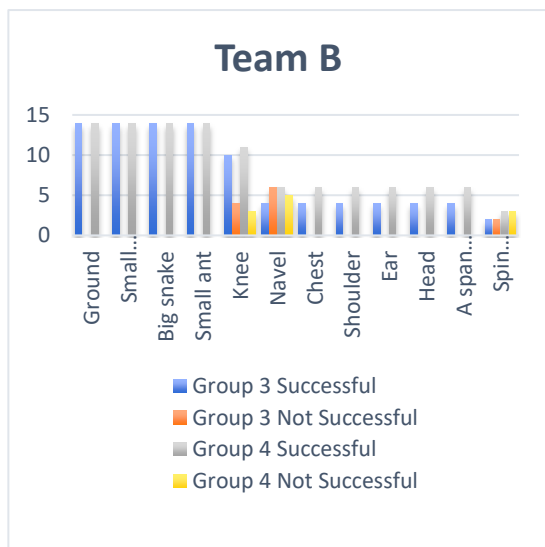


Figure 7 shows that both Group 3 and Group 4 in Team B demonstrate a similar overall pattern of success in the jumping rope game. However, Group 4 consistently achieves higher success rates than Group 3 across most stages. In both groups, students perform well in the early stages, but their success decreases as the rope height increases. This comparison indicates that while both groups follow a similar performance trend, Group 4 shows better adaptability in maintaining performance at higher difficulty levels.

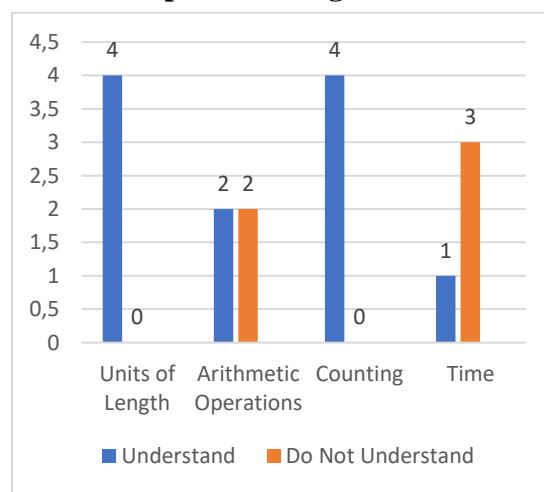
Overall, the difference in success rates between the two teams' groups showed variation in students' ability to perform high-low comparisons and non-standard measurements. These findings confirm that the game of jumping rope not only involves motor activity but also facilitates the emergence of mathematical cognitive processes, particularly in understanding the concepts of measurement and magnitude comparison in context.

Results of the Guided Oral Test

To assess students' understanding of arithmetic concepts that arise during the game, guided oral tests were conducted with four students. The selection of students is purposive because the oral test serves as supporting data to deepen the observation results. Test questions include: the concept of

long units, counting operations, counting, and time. The results of the oral test are presented in Figure 8.

Figure 8. Results of students' arithmetic concepts knowledge verbal test



Based on Figure 8, all students (100%) understand the concept of long units and counting. The findings indicate that the concept of concrete arithmetic, which can be observed directly, is easier for students to understand through play activities. Meanwhile, understanding the basic calculation operations is in the medium category, with two students able to explain the concept and the other two not fully understanding.

The concept of time is the least understood, because only one student can explain the relationship between time and the jumping rope game. These findings suggest that concepts that require higher levels of abstraction tend to require additional mentoring and teacher reinforcement to be optimally understood by elementary school students. Overall, the results of the oral test reinforced the observational findings that the traditional game of jumping rope has the potential to facilitate understanding of basic arithmetic concepts, especially concrete ones.

Discussion

The low level of knowledge among elementary school students indicates that jumping rope is no longer a common play activity in the school environment. These findings reflect a shift in children's play culture, with non-physical activities and technology-based games dominating. As a result, students' opportunities to gain learning

experiences through physical activities and meaningful social interactions are becoming increasingly rare. This shift not only affects students' physical development but also reduces opportunities for experiential learning that naturally integrates cognitive, social, and motor skills. When traditional games are replaced by predominantly digital interactions, the embodied aspects of learning, such as estimating distance, coordinating movement, and negotiating turns, become less frequently practiced. However, the limited initial understanding of jumping rope actually underscores the urgency of using it in learning at school. The implementation of jumping rope games in the context of learning not only serves as a medium for learning arithmetic but also reintroduces regional games with educational and cultural value. Thus, the game of jumping rope can play a dual role: as a context for learning and as an effort to preserve local culture in the elementary school environment.

The results of the structured observation showed that jumping rope facilitated the emergence of various basic arithmetic concepts through students' direct play activities. The high success rate of students in the early stages of the game, from the ground stage to the ankle, shows that students can perform counting activities and understand the game's order very well. The complete success at this early stage indicates that the basic concrete numeracy concepts are easier for students to grasp through hands-on play experiences. Conversely, the decrease in success rates at the higher rope levels reflects the increased cognitive and motor demands of students, especially in estimating jump heights and making non-standard high-to-low comparisons. The variation in success levels across groups also shows that students differ in their ability to adjust movement strategies and estimate magnitudes. These findings are in line with Piaget's theory of cognitive development which states that elementary school students are at a concrete operational stage (D. Ondog & T. Kilag, 2024; Juárez-ruiz et al., 2025), where conceptual understanding is built through direct

experience and interaction with real objects (Piaget, 1970).

The results of the guided oral test reinforced the observation that students' understanding of concrete arithmetic concepts was higher than that of more abstract concepts. All students showed a very high understanding of the concept of counting and long units (100%). Meanwhile, understanding basic calculation operations is in the medium category, while understanding the concept of time is in the low category. These findings suggest that not all arithmetic concepts arise explicitly through play activities without a process of reflection and reinforcement. Therefore, although jumping rope games are effective as a context-rich and fun medium for arithmetic learning, the role of the teacher is still necessary to help students relate the experience of play to formal arithmetic concepts, especially those that require a higher level of abstraction, such as calculation and time operations. With the right mentoring, jumping rope games have the potential not only to increase students' active engagement but also to deepen their conceptual understanding of arithmetic. Ultimately, combining experiential play with structured pedagogical reflection may lead to more durable and transferable mathematical learning outcomes.

CONCLUSION

The study's results show that the traditional game of jumping rope can serve as a context-based arithmetic learning medium for elementary school students. Through play activities, students naturally develop and understand basic arithmetic concepts, such as counting, sequence comprehension, non-standard measurements, and comparisons, through hands-on experience during the game. Students' understanding of concrete concepts, such as counting and units of length, is in the very high category, while their understanding of counting operations is in the medium category, and their understanding of time is in the low category.

The game of jumping rope can be a means of learning concrete arithmetic concepts. As for concepts that require abstraction, teacher

assistance is needed to help students associate the experience of playing with the concept of arithmetic, especially in the material of calculation and time operations. Therefore, the integration of traditional games into mathematics instruction should be accompanied by reflective discussion and guided questioning to bridge informal mathematical experiences with formal symbolic representations. Overall, jumping rope has the potential to be an alternative to learning arithmetic that is fun, meaningful, and supports the preservation of local culture in the elementary school environment.

In addition, this study contributes to the growing body of research on ethnomathematics and game-based learning by providing empirical evidence that culturally rooted play activities can enhance conceptual understanding in arithmetic. Future research is recommended to involve a larger sample size, apply experimental designs to measure learning gains more rigorously, and explore the integration of other traditional games as context-based mathematics learning media.

REFERENCES

- Adamuz-povedano, N., Fernández-Ahumada, E., García-Pérez, M. T., & Montejo-Gámez, J. (2021). Developing Number Sense: An Approach to Initiate Algebraic Thinking in Primary Education. *Mathematics*, 9(5), 1–25. <https://www.mdpi.com/2227-7390/9/5/518>
- Adipat, S., Laksana, K., Busayanon, K., Asawasowan, A., & Adipat, B. (2021). Engaging Students in the Learning Process with Game-Based Learning: The Fundamental Concepts. *International Journal of Technology in Education*, 4(3), 542–552.
- All-Mutawah, M., Thomas, R., Eid, A., Mahmoud, E. Y., Jaafar, M., & Fateel. (2019). Conceptual Understanding, Procedural Knowledge and Problem-Solving Skills in Mathematics: High School Graduates Work Analysis and Standpoints. *International Journal of Education and Practice*, 7(3), 258–273. <https://doi.org/10.18488/journal.61.2019.73.258.273>
- Anam, N., Maghfirah, N. I., & Saiyenah. (2022). Play and Learn with Tradisional Local Wisdom Game in School. *Indonesian Journal of Education and Social Studies (IJESS)*, 01(01), 28–39.
- Ayeh, I. G. (2025). Students' mathematics conceptual challenges: Exploring students' thinking, understanding, and misconceptions in functions and graphs. *European Journal of Science and Mathematics Education*, 13(3), 191–206. <https://doi.org/https://doi.org/10.30935/s-cimath/16596>
- Braithwaite, D. W., & Sprague, L. (2021). Conceptual Knowledge, Procedural Knowledge, and Metacognition in Routine and Nonroutine Problem Solving. *Cognitive Science A Multidisciplinary Journal*, 45(10), 1–28. <https://doi.org/10.1111/cogs.13048>
- Chan, J. Y., & Mazzocco, M. M. M. (2024). New measures of number line estimation performance reveal children's ordinal understanding of numbers. *Journal of Experimental Child Psychology*, 245, 105965. <https://doi.org/10.1016/j.jecp.2024.105965>
- D. Ondog, J., & T. Kilag, O. K. (2024). A Constructivist Framework for Early Grade Numeracy: Drawing on Jean Piaget's Cognitive Development Theory. *International Multidisciplinary Journal Of Research For Innovation, Sustainability, And Excellence*, 1(5), 456–463. <https://doi.org/orcid.org/0009-0007-8568-6257>
- D'Ambrosio, U. (1985). Ethnomathematics and Its Place in the History and Pedagogy of Mathematics. *For the Learning of Mathematics*, 5(1), 44–48. <http://www.jstor.org/stable/40247876%0A%0A>
- Debrenti, E. (2023). Game-Based Learning experiences in primary mathematics education. *Frontiers in Education*, 9, 1–8. <https://doi.org/10.3389/feduc.2024.1331312>

- Dierkx, V., Rijt, B. Van De, Hessen, D., & Luit, H. Van. (2025). Early numeracy development as a foundation of mathematics achievement in primary education. *Learning and Individual Differences*, 121(June 2024), 102706. <https://doi.org/10.1016/j.lindif.2025.102706>
- Girard, C., Bastelica, T., Leone, J., Epinat-Duclos, J., Longo, L., & Prado, J. (2021). The relation between home numeracy practices and a variety of math skills in elementary school children. *Plos One*, 16(9), 1-25. <https://doi.org/10.1371/journal.pone.0255400>
- Juárez-ruiz, E., Flores-medrano, E., Otero-valega, K., & Tascón-cardona, L. (2025). Levels of Complexity in Mathematics Teachers' Knowledge Connections: An Approach Based on MTSK and Piaget's Schemas. *Education Sciences*, 15(6), 1-20. <https://doi.org/10.3390/educsci15060641>
- Latama, R., Atuna, L., Nur, S., Kantoli, A., & Abaidata, R. (2025). Peran Permainan Tradisional Lompat Tali dalam Menstimulasi Perkembangan Motorik Kasar Anak Usia Dini. *Jurnal Pendidikan Anak Usia Dini Dan Kewarganegaraan*, 2(3), 132-142. <https://doi.org/https://doi.org/10.61132/paud.v2i3.498>
- Listiani, T., Wutsqa, D. U., Hernawati, K., Saragih, M. J., Soesanto, R. H., Martha, K., Dirgantoro, K. P. S., Setyaningrum, W., & Retnawati, H. (2026). Analysis of learning obstacles in grade 1 elementary mathematics using the concrete-pictorial-abstract (CPA) approach. *Multidisciplinary Science Journal*, 8(4), 1-16. <https://doi.org/10.31893/multiscience.2026226>
- Listiawati, N., Sabon, S. S., Siswantari, Subijanto, Wibowo, S., Zulkardi, & Riyanto, B. (2023). Analysis of implementing Realistic Mathematics Education principles to enhance mathematics competence of slow learner students. *Journal on Mathematics Education*, 14(4), 683-700. eric.ed.gov/?id=EJ1408894
- Liu, D., Tan, X., Yan, H., & Li, W. (2024). Improving mental arithmetic ability of primary school students with schema teaching method: An experimental study. *Plos One*, 19(4), 1-17. <https://doi.org/10.1371/journal.pone.0297013>
- Loeb, S., Dynarski, S., Mcfarland, D., Morris, P., Reardon, S., & Reber, S. (2017). *Descriptive analysis in education: A guide for researchers* (Issue March). National Center for Education Evaluation and Regional Assistance.
- Magistro, D., Cooper, S. B., Carlevaro, F., Marchetti, I., Magno, F., Bardaglio, G., & Musella, G. (2022). Two years of physically active mathematics lessons enhance cognitive function and gross motor skills in primary school children. *Psychology of Sport & Exercise*, 63, 102254. <https://doi.org/10.1016/j.psychsport.2022.102254>
- Mu'jizah, U., & Ahsani, E. L. F. (2025). Penerapan Game Based Learning Berbantuan Permainan Market Class untuk Mengembangkan Literasi Numerasi Siswa Kelas V MI Nabaul Ulum. *Jurnal Riset Pembelajaran Matematika Sekolah*, 9(1), 86-96. https://doi.org/https://doi.org/10.21009/jr_pms.091.10
- Nahdi, D. S., & Jatisunda, M. G. (2020). Conceptual Understanding And Procedural Knowledge : A Case Study on Learning Mathematics of Fractional Material in Elementary Conceptual. *Journal of Physics: Conference Series*, 1-5. <https://doi.org/10.1088/1742-6596/1477/4/042037>
- Nur, M. A., & Nurhafidzah. (2025). Efektivitas Permainan Tradisional terhadap Hasil Belajar Matematika SD: Literature Review. *Jurnal Bersama Ilmu Pendidikan*, 1(4), 182-192. <https://doi.org/10.55123/didik.v1i4.315>

- Piaget, J. (1970). *Piaget's Theory*. Wiley.
- Pickering, J., Attridge, N., Inglis, M., & Morsanyi, K. (2025). Numeracy, logical reasoning and real-world decision making. *Research in Mathematics Education*, 48(2), 1–17. <https://doi.org/10.1080/14794802.2025.2472675>
- Pratama, L. D., & Setyaningrum, W. (2018). GBL in math problem solving: Is it effective? In ... *Journal of Interactive Mobile ...* staffnew.uny.ac.id. [http://staffnew.uny.ac.id/upload/132306621/penelitian/C5_GBL_is_it_effective Loviga Wahyu.pdf](http://staffnew.uny.ac.id/upload/132306621/penelitian/C5_GBL_is_it_effective_Loviga_Wahyu.pdf)
- Ramos, L., Simoes, V., & Franco, S. (2024). "Active Mathematics"—A Classroom-Based Physical Active Learning Intervention in an Elementary School: An Experimental Pilot Study. *Education Sciences*, 14(6), 1–11. <https://doi.org/10.3390/educsci14060637>
- Rimayasi, Rizkayati, A., Sari, E. R., & Onde, M. K. L. O. (2025). Makna Belajar Matematika melalui Permainan Tradisional sebagai Kajian Kualitatif terhadap Peningkatan Literasi Numerasi Siswa Sekolah Dasar. *Edukatif: Jurnal Ilmu Pendidikan*, 7(4), 1069–1078.
- Russo, J., Kalogeropoulos, P., Bragg, L. A., & Heyeres, M. (2024). Non-Digital Games That Promote Mathematical Learning in Primary Years Students: A Systematic Review. *Education Sciences*, 14(2), 1–19.
- Samritin, Natsir, S. R., Manaf, A., & Sari, E. R. (2023). The Effect of Realistic Mathematics Education Implementation in Mathematics Learning in Elementary School. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 13(1), 81–88. <https://doi.org/10.30998/formatif.v13i1.16522>
- Sello, L., Kgaladi, M., & Paul, M. (2024). The Use of Concrete-Pictorial-Abstract Approach to Enhance Learners' Conceptual Understanding of Fractions. *Edumatica: Jurnal Pendidikan Matematika*, 14(03), 186–198. <https://doi.org/10.22437/edumatica.v14i3.37168>
- Susanto, N. C. P., Hartati, S. J., & Setiawan, W. (2022). Peningkatan literasi numerasi dan karakter berpikir kritis siswa SD berbasis etnomatematika. *Jurnal Ilmiah Pendidikan Matematika*, 7(2), 48–69. <https://doi.org/https://doi.org/10.26877/jipmat.v7i2.12534>
- Thomas, C. A., Berry, R. Q., & Sebastian, R. (2024). Examining the elements of culturally relevant pedagogy captured and missed in a measure of high-quality mathematics instruction. *ZDM - Mathematics Education*, 56(5), 953–964. <https://doi.org/10.1007/s11858-024-01595-7>
- Uegatani, Y., Otani, H., Shirakawa, S., & Ito, R. (2024). Real and illusionary difficulties in conceptual learning in mathematics: comparison between constructivist and inferentialist perspectives. *Mathematics Education Research Journal*, 36(4), 895–915. <https://doi.org/10.1007/s13394-023-00478-6>
- Walid, A., Tan, E., & Teo, R. (2025). The Effectiveness of the Use of Learning Videos on the Understanding of Mathematics Concepts in Elementary Schools. *International Journal of Educatio Elementaria and Psychologia*, 2(3), 142–154. <https://doi.org/10.70177/ijeeep.vxix.xxx>
- Way, J., & Ginns, P. (2024). Embodied Learning in Early Mathematics Education: Translating Research into Principles to Inform Teaching. *Education Sciences*, 14(7), 1–18. <https://doi.org/10.3390/educsci14070696>
- Wilkie, K. J., & Hopkins, S. (2024). Primary students' relational thinking and computation strategies with concrete-to-symbolic representations of subtraction as difference. *Journal of Mathematical Behavior*, 73(January), 101121. <https://doi.org/10.1016/j.jmathb.2023.101121>