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DEEP LEARNING APPROACH TO TEACHING MULTIPLICATION CONCEPTS USING COIN MEDIA: CLASSROOM ACTION RESEARCH IN ELEMENTARY SCHOOL

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ABSTRACT

This study is a Classroom Action Research (CAR) aimed at improving the understanding of multiplication concepts among Grade II A students of SD N Koroulon 2 Sleman through a Deep Learning approach assisted by coin-based media. The research was conducted in two cycles using the spiral model developed by Kemmis and McTaggart. In the Cycle I, the learning process focused on using coin games as a concrete medium to build conceptual understanding of multiplication. The results showed that only 68% of students achieved learning mastery. Discrepancies were still observed in the achievement indicators, particularly in converting repeated addition into multiplication sentences. Based on the reflection results, improvements were implemented in the Cycle II through strategies such as paired group work, varied learning activities, and the inclusion of a "semi-abstract" stage in the instructional process. The results of the second cycle showed a significant improvement: learning mastery reached 89%, and all learning achievement indicators exceeded 80%. This study demonstrates that the Deep Learning approach, supported by contextual media and adaptive teaching strategies, can meaningfully enhance students' conceptual understanding of multiplication. This success was also supported by effective classroom communication and the cultivation of reflective thinking habits throughout the learning process.

Keywords: *Deep Learning, Multiplication Concept, Coins, Elementary School Students.*

Abstrak

Penelitian ini merupakan Penelitian Tindakan Kelas (PTK) yang bertujuan untuk meningkatkan pemahaman konsep perkalian siswa kelas II A SD N Koroulon 2 Sleman melalui pendekatan Deep Learning dengan bantuan media koin. Penelitian ini dilaksanakan dalam dua siklus menggunakan model spiral dari Kemmis dan McTaggart. Pada Siklus I, pembelajaran difokuskan pada penggunaan permainan koin sebagai media konkret untuk membangun pemahaman konsep perkalian. Hasilnya menunjukkan bahwa hanya 68% siswa yang mencapai ketuntasan belajar. Kesenjangan masih ditemukan pada indikator Capaian Pembelajaran, terutama dalam mengubah bentuk penjumlahan berulang menjadi kalimat perkalian. Berdasarkan hasil refleksi, dilakukan perbaikan pada Siklus II melalui strategi seperti kerja kelompok berpasangan, variasi aktivitas, serta penambahan tahapan "semi-abstrak" dalam pembelajaran. Hasil Siklus II menunjukkan peningkatan signifikan: ketuntasan belajar mencapai 89%, dan seluruh indikator capaian pembelajaran melampaui angka 80%. Penelitian ini menunjukkan bahwa pendekatan Deep Learning yang didukung media kontekstual dan strategi pembelajaran adaptif dapat meningkatkan pemahaman konseptual siswa secara bermakna. Keberhasilan ini turut ditunjang oleh komunikasi kelas yang efektif serta pembiasaan berpikir reflektif dalam proses belajar mengajar.

Kata Kunci: Deep Learning, Konsep perkalian, Koin, Siswa Sekolah Dasar.

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1. INTRODUCTION

Elementary education is a crucial stage in establishing the foundation of students' knowledge, including the mastery of basic mathematical concepts [1]. One such concept that should be well understood from an early age is multiplication [2]. Multiplication is not merely an arithmetic operation but also serves as a basis for understanding more advanced mathematical concepts such as division, fractions, and exponents [3]. However, field observations reveal that many second-grade elementary school students still struggle to fully grasp the concept of multiplication. This difficulty is largely due to the learning methods employed, which tend to be mechanistic and rely heavily on memorization [4]. Therefore, a more profound and meaningful learning approach is required.

One approach that can be applied is deep learning. This method emphasizes students' active engagement in the learning process and a comprehensive understanding of concepts, rather than mere memorization [5]. Through deep learning, students are encouraged to understand the meaning of a concept through exploration, reasoning, and real-life experiences. This is highly relevant to learning multiplication, where students need to comprehend the process of grouping and repeated addition [6]. This approach aligns with constructivist theory, which emphasizes the importance of building knowledge through concrete experiences. Consequently, it is essential to develop learning strategies that integrate deep learning with the use of concrete media.

The use of concrete media is particularly important in mathematics education at the elementary level [7]. Concrete tools such as coins can help students connect abstract concepts with real-life experiences. Coins, as instructional aids, have a physical form that is easily recognizable and manipulable by students [8]. With this medium, students can practice multiplication through direct grouping and counting activities. The use of such media is expected to strengthen students' conceptual understanding [9]. Additionally, learning activities become more enjoyable and encourage students to actively participate in the learning process.

Based on preliminary observations conducted at SD N Koroulon 2, particularly in second grade, it was found that many students did not properly understand the concept of multiplication. Some students still perceived multiplication merely as ordinary addition, without grasping the context of grouping. Teachers often continued to rely on lectures and drill exercises without incorporating concrete learning media. As a result, students showed low enthusiasm and faced difficulties in solving multiplication problems. This highlights the need for innovation in multiplication teaching methods. Therefore, the use of a deep learning approach assisted by metal coin media presents a viable alternative.

This approach is not only aimed at improving students' learning outcomes quantitatively but also at shaping a deeper and more meaningful way of thinking. Through manipulative activities with coins, students are guided to independently discover patterns and the meaning behind multiplication processes. This active learning approach is believed to improve students' retention of the material [10]. The teacher acts as a facilitator, guiding and providing direction throughout the exploration process. Students take the central role in the learning process, rather than being passive recipients of information. In this way, learning becomes more interactive and fosters a stronger conceptual understanding.

Research Rahim et al. [11] has shown that concrete media-based learning can have a positive impact on students' understanding of mathematical concepts. For instance, the use of real objects in multiplication lessons has been proven to enhance both comprehension and motivation among elementary students [12]. This supports the hypothesis that metal coin media also holds similar potential, particularly when combined with the deep learning approach. Moreover, this medium is easy to obtain, cost-effective, and does not require advanced technology [13]. As such, teachers can implement it widely without significant obstacles. This is also in line with the principles of contextual learning, which emphasize utilizing the surrounding environment as a learning resource.

In conclusion, a solid understanding of multiplication concepts is essential for second-grade students. To achieve this, a deep learning approach combined with concrete media such as coins offers a promising instructional alternative. This approach is expected to enhance students' conceptual understanding while also increasing their interest in mathematics [14], [15]. Therefore, this study is conducted to examine the effectiveness of the deep learning approach assisted by metal coin media in improving the understanding of multiplication among second-grade students at SD N Koroulon 2. The findings are expected to serve as a reference for teachers in designing innovative and effective instructional practices.

2. LITERATURE REVIEW

2.1. Deep Learning Approach

Deep learning in education refers to an instructional approach that emphasizes students' ability to understand, analyze, and apply knowledge meaningfully rather than relying solely on rote memorization. According to Choudhary et al. [16], deep learning fosters critical thinking, creativity, communication, and collaboration through student-centered activities. This approach allows learners to construct their understanding through exploration and problem-solving experiences that connect with real-world contexts. Deep learning engages students cognitively, emotionally, and socially, promoting long-term retention of concepts. It requires instructional designs that support inquiry, reflection, and meaningful interactions. Teachers act as facilitators who guide students through the process of discovery and knowledge construction.

Implementing deep learning in mathematics can help students develop a more profound comprehension of mathematical concepts, including multiplication. Instead of memorizing multiplication tables, students are encouraged to understand the reasoning behind repeated addition and grouping. Research by (Hattie & Donoghue [17] indicates that deep learning strategies, such as manipulatives and active learning tasks, significantly enhance student achievement in mathematics. This approach aligns with constructivist theory, which posits that knowledge is actively built by learners through experience. By engaging in deep learning, students become more autonomous and responsible for their learning processes. Consequently, deep learning is considered a powerful framework for fostering meaningful mathematics education at the elementary level.

2.2. Multiplication Concept

Multiplication is a fundamental arithmetic operation that involves repeated addition and plays a key role in students' mathematical development. It forms the basis for more complex topics such as division, fractions, ratios, and algebra. Early understanding of multiplication helps students make connections between numbers and enhances their number sense. According to Wardat et al. [14], effective teaching of multiplication should go beyond memorization and focus on conceptual understanding. This includes recognizing patterns, understanding arrays, and visualizing grouping structures. The National Council of Teachers of Mathematics ((NCTM [18]) also advocates for conceptual approaches that make multiplication meaningful to students.

Many students face difficulties in learning multiplication due to the abstract nature of the concept when taught through traditional methods. Repeated drills without conceptual grounding can lead to misconceptions and hinder mathematical reasoning. Teachers are encouraged to use visual models, real-life contexts, and manipulatives to help bridge the gap between abstract ideas and students' concrete experiences [19]. Research has shown that students who understand multiplication conceptually are more likely to apply it correctly in problem-solving situations [20]. By internalizing the meaning of multiplication, students develop flexibility and fluency in computation. Hence, meaningful and interactive teaching strategies are essential in building a strong foundation in multiplication.

2.3. Coin Media

Concrete learning media, such as coins, provide tactile and visual experiences that support the development of abstract mathematical thinking [21]. Coins are familiar, tangible objects that can be used to demonstrate mathematical concepts like grouping, repeated addition, and place value [22]. According to Piaget's theory of cognitive development, young learners in the concrete operational stage benefit from hands-on materials that help them visualize and manipulate ideas. Using coin media in multiplication lessons allows students to experience the concept of equal groups and total values in a real-world context. This method encourages active engagement and improves students' conceptual understanding. Furthermore, it provides opportunities for students to make meaningful connections between mathematics and their everyday lives.

Several studies have highlighted the effectiveness of concrete manipulatives in improving mathematics achievement, particularly in early grades. For example, Diandaru [23] found that students who used manipulatives such as coins performed better in understanding number operations. Coin media not only supports cognitive development but also increases student motivation and participation in learning activities. Its low cost and easy accessibility make it a practical tool for classroom use. Teachers can integrate coin activities into various learning scenarios to foster exploration and reasoning [24]. Overall, coin media serves as an effective bridge between abstract mathematical concepts and students' lived experiences.

3. METHOD

This research is included in the type of Classroom Action Research (CAR). The subjects in this study were students of Class II A of SD N Koroulon 2 in Sleman Regency. This study uses the spiral model from Kemmis and McTaggart, which describes the classroom action process as a series of continuous and interconnected cycles [25].

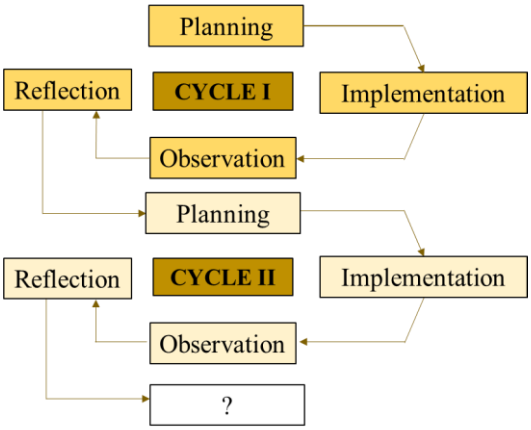

Figure 1. Research Cycle

Based on the image above, this study was conducted in two cycles. Prior to the first cycle, students were given a pre-test to assess their initial understanding of the multiplication concept. In the first cycle, the learning process was carried out using a Deep Learning approach combined with the use of coins to help enhance students' conceptual understanding of multiplication. After the learning activities were completed, a post-test was administered to measure the improvement in students' understanding, and the results were used as a basis for reflection and improvement in the next cycle. In the second cycle, the instructional approach was refined based on the reflections from the first cycle, and a follow-up test was given to compare the results with those of the previous cycle. Data in this study were collected through two techniques: observation and testing. Observation was used to monitor the activities of both teacher and students during the learning process, while the test was used to evaluate students' conceptual understanding.

Data collection was conducted by administering a test consisting of 15 items covering five indicators of Learning Outcomes Achievement, namely: (1) writing multiplication sentences based on the arrangement of provided coins, (2) arranging coins based on given multiplication sentences, (3) completing coin arrangements based on given multiplication sentences, (4) converting multiplication sentences into repeated addition forms, and (5) converting repeated addition into multiplication sentences. The data were analyzed using a descriptive percentage method, which aimed to calculate the percentage of overall learning outcomes achievement as well as the percentage of each individual indicator.

The percentage of learning achievement was calculated based on the number of students who scored a minimum of 70 on the test. Meanwhile, the percentage of achievement for each sub-indicator was calculated by summing all correct responses, dividing by the number of students, and averaging based on the number of items in each sub-indicator. The success of the action in this study was determined by two main indicators. The first indicator stated that at least 80% of the students must achieve the minimum mastery criteria (MMC) of 70. The second indicator emphasized that all Learning Outcomes Indicators must reach a success rate of 80.

4. RESULTS AND DISCUSSION

4.1. Results

4.1.1 Description of Cycle I Research Results

Cycle I was carried out by implementing multiplication learning using the help of coin media. The first indicator of success is seen from the learning outcomes in Cycle I as follows.

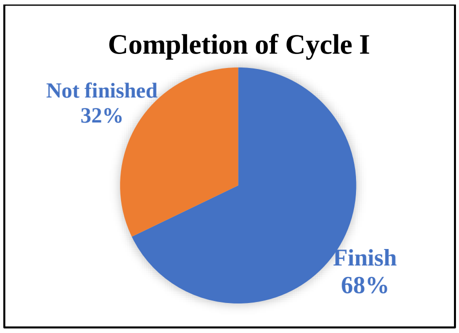

Figure 2. Completion of Learning Outcomes in Cycle I

Based on table 1, it shows that the learning outcomes of class II A students on multiplication material that are completed are 68% and those that are not completed are 32%. This means that the learning outcomes on the first success indicator are below 80%. The second success indicator is seen from the average achievement of each learning achievement indicator in Cycle 1 as follows.

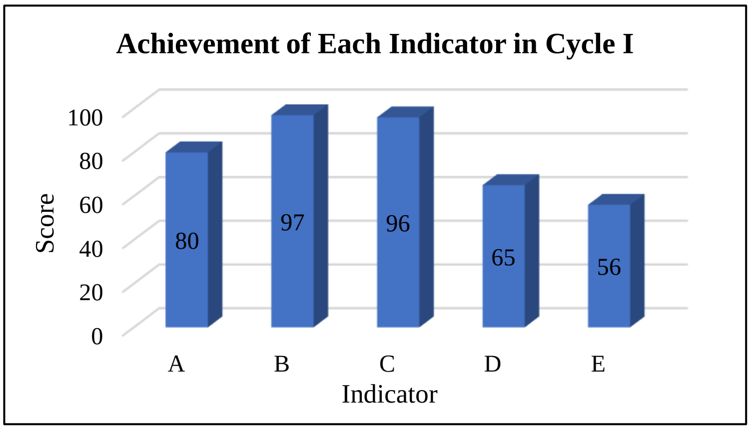

Figure 3. Achievement of Each Indicator in Cycle I

Based on the results of each indicator in the Learning Outcomes Achievement, the highest score was obtained in indicator (B), which involved arranging coins based on prepared multiplication sentences, with a score of 97. This was followed by indicator (C), completing the coin arrangement based on given multiplication sentences, with a score of 96. Next, indicator (A), writing multiplication sentences from the prepared coin arrangements, achieved a score of 80. Meanwhile, indicator (D), writing multiplication sentences from repeated addition, showed a lower result with a score of 65. The lowest score was found in indicator (E), converting repeated addition into multiplication sentences, with a score of 56, indicating that students still experienced difficulties in connecting the concept of repeated addition to its multiplication form.

During the learning process, the teacher identified five issues that affected the effectiveness of the learning activities. The first issue was group division, which consisted of four students per group but lacked equitable task distribution. This resulted in one or two students dominating the use of the metal coin aids, while others were less actively involved. The second issue stemmed from the repetitive nature of the activities in each session, which led to boredom and reduced learning motivation. Additionally, students' lack of accuracy in summing numbers indicated that their conceptual understanding remained superficial and had not yet reached meaningful learning.

Another problem was the weak communication between teacher and students. The teacher's instructions were often not clearly heard due to the absence of an initial agreement, such as using a "single clap" signal to indicate silence and focus. As a result, the learning process became less conducive because students did not respond appropriately to instructions. Moreover, there was no transitional phase to bridge students' thinking from semi-concrete to abstract stages. In a deep learning approach, this kind of cognitive transition is crucial so that students do not merely memorize procedures but truly understand the meaning and interconnectedness of the concepts being studied [26].

To address these issues, the implementation of the deep learning approach is highly necessary. This approach emphasizes in-depth learning through exploration, reflection, and active student engagement in knowledge construction. Teachers need to design learning activities that go beyond mechanical repetition and challenge students to think critically and relate the material to real-life experiences. Furthermore, effective communication and agreed-upon classroom strategies from the outset will foster a more structured and interactive learning environment [27], [28]. By considering students' thinking stages and encouraging active participation of every group member, the learning process will become more inclusive, meaningful, and profound.

4.1.2 Description of Research Results Cycle 2

The Cycle 2 was conducted to optimize multiplication learning using the help of metal coin media. The success indicators of the second cycle can be seen from the learning outcomes in the following figure.

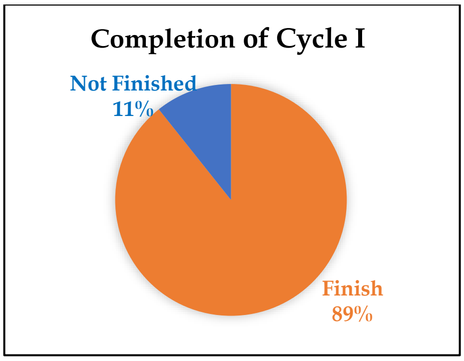

Figure 4. Completion of Cycle I

Based on the picture above, the learning outcomes of class II A students on multiplication material that were completed were 89% and those that were not completed were 11%. This means that the learning outcomes on the first success indicator were below 80%. The second success indicator is seen from the average achievement of each learning achievement indicator in the following Cycle II.

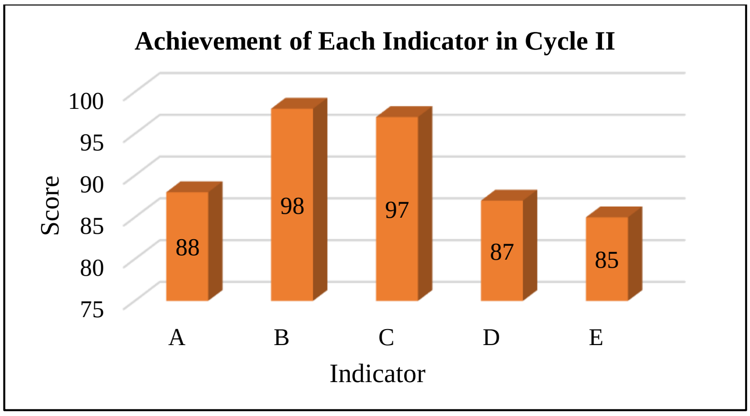

Figure 5. Achievement of Each Indicator in Cycle II

Based on the figure, it is evident that students demonstrated a relatively high level of understanding of multiplication concepts. For indicator (A), which involved writing multiplication sentences from prepared coin arrangements, a score of 88 was achieved. The highest score was recorded in indicator (B), arranging coins based on given multiplication sentences, with a score of 98, followed by indicator (C), completing the coin arrangements based on multiplication sentences, with a score of 97. Meanwhile, indicator (D), writing multiplication sentences from repeated addition, obtained a score of 87, and indicator (E), converting repeated addition into multiplication sentences, scored 85. Overall, these results indicate that students have begun to understand the connection between concrete and symbolic representations in the concept of multiplication.

In the second cycle of learning, all basic competency indicators successfully reached the minimum achievement threshold of 80%. This success was largely due to several strategic actions implemented by the teacher to address the issues encountered in the previous cycle. One key adjustment was the shift in learning technique from large group work to paired learning. This approach was chosen to allow a more balanced task distribution, ensuring that each student had equal opportunities to actively participate, thus preventing passive engagement in the learning process. The deep learning approach was also gradually implemented by encouraging students' active involvement and metacognitive awareness of their roles in the learning process.

Another important action was reducing repetitive activities to avoid student boredom, as well as offering varied strategies for summing a set of numbers. This allowed students to choose methods that aligned with their individual learning styles, thereby fostering deeper and more meaningful cognitive engagement. This aligns with the principles of the deep learning approach, which emphasizes deep conceptual understanding rather than mere procedural memorization [29], [30]. The teacher also aimed to develop students' cognitive flexibility by encouraging them to discover their own problem-solving strategies.

Additionally, a classroom agreement was established between the teacher and students as a means of strengthening classroom communication. For instance, when the teacher signals a "single clap," students are expected to be silent and pay attention, allowing the next learning instructions to be delivered clearly. Another significant measure was the addition of a "semi-abstract" stage following the "semi-concrete" stage. This phase allowed students to transition from concrete to symbolic representation, which is at the core of the deep learning approach: gradually and deeply building conceptual understanding from concrete experiences.

4.1.3. Comparison of Improvement Between Cycle I and Cycle II

A comparison of learning achievement results between Cycle I and Cycle II can be seen in the following figure.

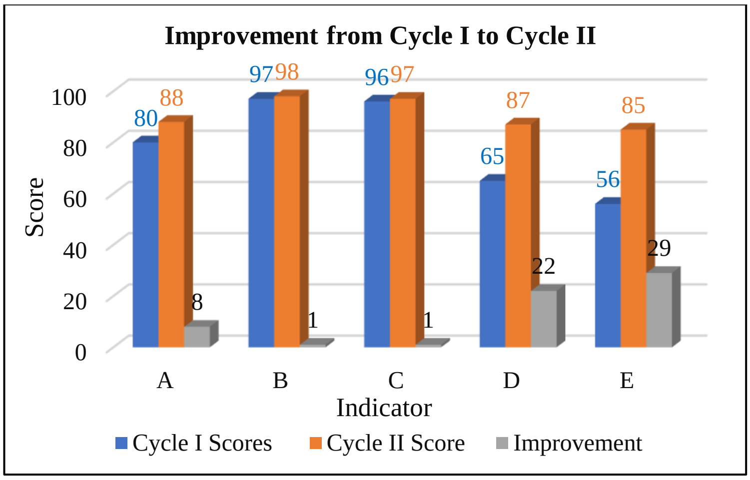

Figure 6. Improvement from Cycle I to Cycle II

Learning outcomes in cycle II showed a significant increase compared to cycle I. In indicator (A), namely writing multiplication sentences from prepared coin arrangements, the score increased from 80 to 88 or increased by 8 points. Indicator (B) arranging coins from prepared multiplication sentences experienced a slight increase from 97 to 98, and indicator (C) completing coins from prepared multiplication sentences increased from 96 to 97, each increasing by 1 point. Meanwhile, a striking increase was seen in indicator (D) writing multiplication sentences from repeated addition, which increased from 65 to 87 with an increase of 22 points, and indicator (E) writing repeated addition into multiplication sentences experienced the highest spike from 56 to 85 or increased by 29 points. This shows that the improvement efforts made in cycle II have a positive impact on students' understanding, especially in the transition from concrete to abstract concepts.

4.1.4. Discussion

The results of the research in Cycle I indicated that the learning process of multiplication using coin media was not yet fully optimal. The mastery learning rate reached only 68%, while 32% of the students had not yet achieved the minimum standard. Learning achievement data showed that students found it easier to understand concrete activities, such as arranging or completing coin sets (indicators B and C), but still encountered difficulties with symbolic aspects, such as converting repeated addition into multiplication sentences (indicator E). This suggests that students' thinking processes were still at the concrete operational stage and had not yet fully reached the stage of symbolic representation. These findings are supported by

Susanti [31] and Hatmoko et al. [32], who stated that elementary school students require a strong bridge between concrete experiences and symbolic understanding in order to grasp mathematical concepts effectively.

Several challenges that emerged during the learning process also served as barriers to achieving comprehensive competency [33]. These included ineffective group divisions, unclear communication, and the absence of a structured thinking progression from concrete to abstract. The deep learning approach had not been fully implemented, as learning activities remained largely procedural and repetitive. Instruction that focused too heavily on technical drills failed to encourage students to develop a deep understanding of conceptual relationships. This aligns with the findings of Fitriana et al. [34] and Sukmanasa et al. [35], who noted that learning approaches that emphasize outcomes without fostering deep cognitive processes result in students struggling to apply concepts in new situations.

In the second cycle, various instructional improvements were implemented to align with the deep learning approach. Strategies such as paired learning, varied activities, and enhanced communication through classroom agreements contributed to a more structured and interactive learning environment. The addition of a semi-abstract stage also facilitated students' transition from concrete to symbolic understanding, which lies at the core of deep learning. As a result, the mastery learning rate increased significantly to 89%, with all learning indicators scoring above 80%. This strategy is consistent with the findings of Sugrah [36] and Siswanto [33], who emphasized that deep learning enhances the quality of conceptual understanding through reflective and collaborative, student-centered learning processes.

A particularly significant improvement was observed in indicators D and E, which assess students' ability to connect repeated addition with symbolic multiplication. The score for indicator E rose from 56 to 85, reflecting the success of the conceptual transition strategy, which had previously posed a major challenge. This confirms that learning which promotes exploration and meaningful understanding enables students to better develop their conceptual thinking. The deep learning approach also helps students become aware of their own thinking processes and build understanding through strong inter-conceptual connections. Research by Miterianifa et al. [37] and Alam et al. [38] supports these findings, stating that elementary students can enhance their conceptual thinking skills through concrete media followed by gradual symbolization.

The improvement in student learning outcomes between Cycle I and Cycle II occurred due to differences in the learning process stages. The stages in Cycle I were: concrete – semi-concrete – abstract. In Cycle II, the stages were: concrete – semi-concrete – semi-abstract – abstract. The following illustration presents this comparison.

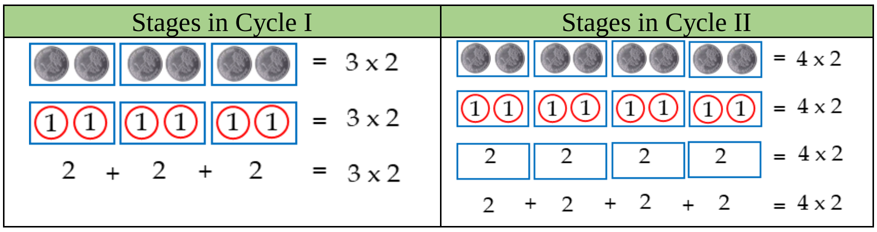

Figure 7. Illustration of the Stages in Cycle I and Cycle II

Based on the illustrated diagram, the process of understanding multiplication concepts through a concrete approach took place over two cycles. In the first cycle, students were introduced to three groups, each containing two coins. This concept was then translated into the multiplication form 3 × 2. Furthermore, the representation was explained using the number "1" appearing twice in each group, which was ultimately formulated as repeated addition: 2 + 2 + 2 = 3 × 2. In the second cycle, a similar pattern was developed by adding one more group, resulting in four groups with two coins in each, thus forming the multiplication expression 4 × 2.

This process reflects the development of multiplication concept understanding in accordance with Bruner's theory [39], which encompasses three stages: enactive (direct interaction with concrete objects), iconic (using images or visualizations), and symbolic (using numbers and mathematical operations). Additionally, these stages align with Piaget theory [40] on children's cognitive development, which states that children learn new concepts through the concrete operational stage before reaching abstract thinking abilities. The use of visual aids and manipulative tools proves to be crucial in instilling meaningful understanding of multiplication concepts for students.

Overall, the findings of this study confirm that the deep learning approach is highly appropriate and effective for teaching mathematics at the elementary level. The implementation of a structured thinking sequence beginning with the concrete stage, followed by semi-concrete, semi-abstract, and finally abstract combined with productive collaboration and strong classroom communication, are key factors in supporting improvements in student learning outcomes. This approach not only creates a more meaningful learning environment but also fosters students' metacognitive awareness. In other words, students are not merely solving problems, but also understanding the logic behind the problem-solving process. These results affirm the importance of designing instruction that emphasizes deep thinking as a fundamental basis for improving the quality of mathematics education at the primary school level.

5. CONCLUSIONS

Based on the findings from two learning cycles using coin media and coins, it can be concluded that the deep learning approach is effective in enhancing second-grade students' understanding of multiplication concepts. In the first cycle, learning outcomes did not meet the minimum mastery target (68%) and several issues emerged, such as group dominance, ineffective communication, monotonous activities, and the absence of a transition phase from concrete to abstract thinking. Improvements in the second cycle such as switching to pair-based learning, introducing varied activities, adding a semi-abstract phase, and improving classroom communication resulted in a significant increase in understanding and mastery, reaching 89%. The most notable progress occurred in students' ability to convert repeated addition into multiplication expressions. These results emphasize that gradual thinking stages, strengthened communication, and meaningful, varied activities play a crucial role in enhancing mathematics learning outcomes, especially in bridging concrete experiences and symbolic representations. Multiplication learning should consistently apply deep learning strategies to support this connection.

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