

# Numeracy Literacy through Mystery Boxes: A Pedagogical Tool for Improving Multiplication Skills

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## Abstract

*Purpose:* This study aims to analyze the learning needs of fourth-grade elementary school students in multiplication and identify how the Mystery Box game can be used as a pedagogical tool to improve students' numeracy skills.

*Methodology:* This study uses a qualitative approach involving students and teachers as research subjects. Data collection was conducted through observation, interviews, and analysis of documents/learning needs questionnaires.

*Results:* The results showed that most students needed concrete learning support rather than just focusing on memorization. Teachers assessed that the Mystery Box game had great potential to help students build conceptual understanding through activities.

*Applications/Originality/Value:* This study provides practical contributions to the development of mathematics learning in elementary schools, especially in multiplication material. The use of Mystery Box is said to be able to provide a more concrete, interactive, and enjoyable learning experience so that it can be applied as an alternative learning strategy.

## Introduction Section

Numeracy skills are a fundamental component of basic education because they reflect students' ability to understand, interpret, and use mathematical concepts effectively in everyday life ([Chang, 2023](#); [Seitz & Weinert, 2022](#)). Numeracy is not only related to arithmetic skills, but also includes logical reasoning, problem solving, and understanding quantitative representations. These competencies are essential for elementary school students to face various real-life situations. However, learning mathematics, especially multiplication, remains a major challenge because some students tend to memorize procedures without understanding the concepts in depth. Learning that focuses too much on routine exercises results in fewer opportunities for students to think creatively and develop problem-solving strategies ([Kholid et al., 2024](#)). This situation contributes to low numeracy skills in various contexts of basic education ([Casado-vara & Canal-bedia, 2024](#); [Poltz et al., 2022](#)), which has a broad impact on students' academic abilities and life skills ([de Bruin & Slovic, 2021](#)). Various factors have been identified as influencing students' numeracy development, ranging from the family environment to the learning approach at school. Parental involvement in daily numerical activities and the availability of number-based learning resources have been shown to support children's numeracy achievement. In addition, meaningful, contextual, and experience-based learning approaches have a significant effect on improving student numeracy literacy ([Kholid et al., 2023](#)). Learning models that are integrated with real-life activities have also been proven to increase student engagement. ([Dewantara et al., 2023](#)), meanwhile, cooperative strategies such as Think Pair Share with portfolio assessment can increase interest and achievement in mathematics learning ([Kholid et al., 2019](#)).

One innovation that has been developed to strengthen numeracy skills is the use of game-based learning in mathematics education. The game-based approach not only increases student motivation and engagement, but also has a positive impact on their conceptual mastery and cognitive abilities ([Roshanpour & Nikroo, 2022](#)). Game-based learning creates a fun and challenging learning environment that encourages students to actively engage ([Dvoryatkina & Simonovskaya, 2021](#); [Lytvynova, 2019](#)). In this context, Mystery Box emerges as a potential learning tool for developing numeracy skills. Mystery Box is designed to stimulate curiosity, cooperation, and critical thinking skills in students. In mathematics learning, this tool can be used to explore numerical concepts, including multiplication, through an interactive and collaborative approach. In addition to serving as a learning tool, Mystery Box can also be an interesting formative assessment tool ([Setiyani et al., 2025](#)). This pedagogical approach is consistent with constructivist theory, which emphasizes that students build understanding through social interaction and direct experience, which has been shown to improve conceptual understanding and higher-order thinking skills ([Irshid et al., 2023](#); [Tolkacheva et al., 2022](#)).

Recent research also emphasizes the importance of developing creative thinking and mathematical problem-solving

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skills. Analyzing creative thinking skills in non-routine problems can help teachers design more adaptive learning ([Kholid et al., 2024](#)). In addition, problem-solving skills are closely related to reflective thinking skills, which are one of the indicators of 21st-century skills ([Kholid, 2025](#)). Reflection-based learning has also been shown to be important for improving the quality of student learning experiences in elementary schools ([Gyergyek et al., 2024](#); [Setiyani et al., 2025](#)).

The integration of game-based learning with modern pedagogical principles also supports the formation of horizontal connections between teachers and students, thereby improving the quality of interaction and learning experiences ([Irshid et al., 2023](#); [Machaba, 2018](#)). Without adequate exploration activities, students tend to have difficulty understanding symbols, patterns, and solving advanced numeracy problems ([Kholid, 2025](#)). Therefore, students need media that can activate reasoning, encourage interaction, and foster curiosity. Mystery Box is one such alternative because it has been proven to increase cognitive engagement, flexibility of thinking, and conceptual understanding, as well as providing space for students to discover the meaning of multiplication through direct experience ([Kholid et al., 2024](#)). Therefore, the use of *the Mystery Box* is not limited to teaching multiplication but can be developed more broadly in the context of cross-disciplinary numeracy learning. Recent studies also show that this approach can encourage collaboration among students and help teachers develop learning strategies that are responsive to students' needs ([Dewantara et al., 2023](#); [Virdinarti Putra et al., 2024](#)).

The research questions in this study are: how does the multiplication ability of elementary school students change before and after working on problems using the Mystery Box game as a learning medium? How can the Mystery Box game help improve multiplication skills in elementary school students? What challenges do students face while using the Mystery Box in the process of learning multiplication? as well as what aspects of student motivation and engagement are supported by the use of the Mystery Box as a pedagogical tool in mathematics learning.

## Method

This study uses a descriptive qualitative approach to describe in depth the process, experiences, and development of students' multiplication skills through the use of the Mystery Box game. The qualitative approach was chosen because it is able to reveal how students think, respond, and build their understanding of mathematical concepts through direct interaction with learning activities ([Kholid, 2025](#)). This method is relevant for understanding the dynamics of student learning behavior in a real context, especially when they are engaged in educational games that encourage exploration, discussion, and independent problem solving. Direct observation in the classroom provides an authentic picture of students' basic abilities and learning characteristics, making it ideal for examining children's mathematical thinking processes ([Debrenti, 2024](#)).

This study was conducted at a private elementary school in Surakarta, Central Java, Indonesia. The research data was sourced from primary and secondary data. Primary data was obtained from fourth-grade students as the main subjects, while secondary data came from classroom teachers, field notes, and documentation of learning activities. Data collection was carried out using three main techniques, namely: (1) observation of the learning process, (2) interviews, (3) document collection. The instruments used included observation guidelines, interview guidelines, and learning needs analysis questionnaires. Data analysis used the Miles and Huberman model, which consists of three stages: data reduction, data presentation, and conclusion drawing ([Abdussamad, 2021](#)). The analysis was conducted continuously from the time the data was collected until the final interpretation was compiled. To ensure the validity of the data, this study used triangulation, which involves comparing and examining findings from various sources and techniques, including observations, interviews, and documentation.

## Figures and Tables

This section discusses the findings of the learning needs analysis conducted by 19 fourth-grade students and fourth-grade teachers at SD Muhammadiyah PK Kotta Barat. The researcher used a questionnaire to measure the needs of teachers and students for innovative culture-based learning media and to identify the need to develop numeracy skills (the aspect of using various numbers or symbols related to basic mathematics in solving everyday problems, interpreting analysis results to predict and make decisions, analyzing information presented in various forms (graphs, tables, charts, etc.)).



**Figures 1.** Mystery Boxes

Tables 1 and 2 below show the percentage scores obtained based on the findings.

**Table 1.** Percentage of Student Learning Needs Analysis

Statement	Answer Options			
	STS	TS	S	SS
I want multiplication practice problems that are easy to understand.	0	0	53	47
I want fun multiplication practice problems.	0	0	58	42
I want the teacher to give examples before practice so that it is easier to understand.	0	0	63	37
I want to learn multiplication using teaching aids or learning media such as cards, objects, or Mystery Boxes.	0	5	16	79
I find it easier to understand multiplication when using pictures or real objects.	0	16	47	37
I want teachers to use games or interesting media when teaching multiplication.	0	0	32	68
I want to learn multiplication so that I can calculate faster in everyday life.	0	0	37	63
I prefer to learn multiplication by studying with friends or in a group.	0	10	37%	53%
I enjoy learning multiplication if there are challenges or small games.	0	16	31	53
I want the teacher to explain the multiplication steps in an easy-to-follow manner.	0	0	32	68
I want to learn multiplication with examples from everyday life.	0	21	32	47
I want the teacher to give me exercises gradually so that I don't get confused.	0	0	68	32
I want the teacher to explain how to evaluate answers so that I know whether they are right or wrong.	0	0	58	42
I want the teacher to give feedback or comments after doing multiplication problems.	0	21	32	47
I want exercises that assess my abilities, but are still fun.	0	0	58	42

**Table 2.** Percentage of Teacher Learning Needs Analysis

Statement	Answer Options			
	STS	TS	S	SS
Do you need engaging learning materials to teach multiplication?	0	0	✓	0
Do you need teaching materials that are appropriate for the abilities of my students?	0	0	✓	0
Do you need examples of contextual multiplication problems (closely related to students' lives)?	0	0	✓	0
Do you need multiplication teaching strategies that are easier for students to understand ?	0	0	0	✓
Do you need a way to help students who have difficulty	0	0	0	✓

understanding the concept of multiplication)?				
The school provides concrete learning media for teaching multiplication.	0	0	0	✓
Do you have access to sufficient teaching aids or media in the classroom?	0	0	✓	0
Do you need additional creative media to help with multiplication learning?	0	0	✓	0
Do you need training on how to use math learning media?	0	0	✓	0
Do you need game-based media to teach multiplication?	0	0	0	✓
Do you need media that can increase students' interest in learning multiplication?	0	0	✓	0
Do you need media that helps students understand groups of objects in multiplication?	0	0	✓	0
Would you like to use Mystery Box or similar surprise media in your teaching?	0	0	✓	0
Do you often find students who have difficulty understanding the basic concepts of multiplication?	0	0	✓	0
The media available at school is not very helpful in teaching multiplication.	0	✓	0	0
Do you need new ideas to make multiplication learning more interesting?	0	0	✓	0
There is often not enough time in class to provide adequate multiplication practice.	0	0	✓	0
Do you need worksheets that help students understand the steps of multiplication?	0	0	0	✓
Do you need examples of evaluation tools or worksheets that can help assess students' understanding easily and interestingly?	0	0	0	✓
Do you need a simple yet effective assessment method to <u>determine each student's multiplication skills?</u>	0	0	✓	0

Based on [Table 1](#), the questionnaire analysis results show that students have a strong learning need for multiplication learning that is easy to understand, enjoyable, and supported by concrete media. As many as 53% of students agreed and 47% strongly agreed that they needed multiplication exercises that were easy to understand. This is reinforced by the third statement, namely that 63% of students agree and 37% strongly agree that teachers need to provide examples before practice so that students can understand the material more easily. Students' need for enjoyable learning is also clear. A total of 58% agree and 42% strongly agree that they want enjoyable multiplication exercises. In addition, the majority of students like the use of games or interesting media when learning; 32% agree and 68% strongly agree with this statement. In fact, 53% agree and 31% strongly agree that they enjoy learning multiplication when it is accompanied by challenges or small games. In terms of concrete learning media, students showed a very strong positive response. When asked to learn using teaching aids such as cards, objects, or Mystery Boxes, 79% of students strongly agreed and 16% agreed. Similarly, 47% of students agreed and 37% strongly agreed that they find it easier to understand multiplication when using pictures or real objects. This data confirms that a concrete approach provides important support in the process of students' understanding of multiplication. In terms of independence and clarity of strategy, students also showed a great need. A total of 32% agreed and 68% strongly agreed that they wanted teachers to provide easy-to-follow explanations of the steps of multiplication. In addition, 58% agreed and 42% strongly agreed that they wanted teachers to explain how to assess answers so that they would know whether they were right or wrong. The need for contextual learning was also high. A total of 47% strongly agreed and 32% agreed that they wanted to learn multiplication using examples from everyday life. In addition, 63% of students strongly agreed and 37% agreed that they wanted to learn multiplication so they could calculate faster in everyday life. In terms of evaluation and feedback, students expressed a need for clear guidance. A total of 58% agree and 42% strongly agree that they need exercises that assess their abilities but are still enjoyable. In addition, 47% strongly agree and 32% agree that they want teachers to provide feedback or comments after completing the exercises. Overall, the survey results show that students need concrete, enjoyable multiplication learning, using interesting media, accompanied by clear step-by-step explanations, and providing feedback that helps their understanding develop. This combination of needs can be an important basis for designing more effective multiplication learning that suits students' needs ([Murtafiah et al., 2024](#)). The results of the learning needs questionnaire were reinforced using the following interview data with students.

*P1: What do you think multiplication*

*is? S1: Repeated addition.*

*S2: Arranged addition.*

*P2: What symbol do you usually see to indicate multiplication?*

*S2: A cross.*

*S3: Like the letter ×.*

*P3: Have you ever used multiplication while playing or helping your parents at home?*

S2: Yes, when playing with friends.  
 S4: When my mom asked me to count items.  
 P4: If you have 4 bags of candy and each bag contains 5 candies, how would you find the total number of candies?  
 S4: I would calculate it using multiplication:  $4 \times 5 = 20$ .  
 P5: In your opinion, is it easier to understand multiplication with pictures, tables, or memorization? S6: Memorization.  
 S7: Use memorization.  
 P6: If  $2 \times 5$  is 10, do you think  $2 \times 6$  is bigger or smaller?  
 S8: Larger.  
 Follow-up Question: Why is it larger?  
 S8: Because  $2 \times 6$  equals 12.  
 P7: If you have 5 friends and each friend needs 2 pencils, how many pencils do you need to buy?  
 buy?  
 S1: You have to buy 10 pencils, because you use the multiplication  $5 \times 2$ .  
 P8: If you have to choose the fastest way to calculate, which method would you choose?  
 S1: Multiplication.  
 S10: Addition.  
 Follow-up question: Why?  
 S10: Because addition is easier.  
 S1: Use multiplication so it's faster.  
 P10: Do you think that using learning media such as Mystery Box can help you to memorize multiplication?  
 S9: I think it can.  
 S3: I don't know yet.  
 P9: Have you ever seen graphs, tables, or charts at school? What do they look like?  
 S6: Just tables.  
 S7: Tables and charts are square-shaped.  
 P12: There are 3 groups of marbles, each group contains 4 marbles. How do you calculate it if using repeated addition.  
 S8:  $3+3+3+3$ .  
 S9:  $4+4+4$ .  
 P10: Do you think that using game-based learning makes it easier for you to memorize multiplication?  
 S5: Yes.  
 S6: Yes.  
 S10:  
 Yes.

Based on [Table 2](#). Based on the results of the questionnaire given to teachers. Analysis of Teachers' Learning Needs shows that teachers have a high need for the provision of interesting learning media, teaching materials that are appropriate to students' abilities, contextual example questions, easy-to-understand multiplication learning strategies, and more effective evaluation tools. All responses in the Agree and Strongly Agree categories indicate that teachers need increased pedagogical support, especially in teaching multiplication concepts. Multiplicative thinking requires a provocative and contextual task approach to help students move from additive strategies to more efficient multiplication strategies ([Cheeseman et al., 2023](#)). This shows the relevance of teachers' needs for contextual examples and learning strategies that are easier for students to understand. In addition, teachers also stated that they need ways to help students who have difficulty understanding basic multiplication concepts. The conceptual model problem-solving approach is very effective in helping students, including those with special needs, understand the structure of multiplication. This shows that teachers need conceptual models and concrete media that facilitate the visual understanding of multiplication concepts ([Bruno et al., 2024](#)). Teachers also emphasized the importance of concrete and creative media. Consistent, non-digital game-based learning has been proven to increase student motivation and perseverance in learning mathematics in elementary school ([Russo et al., 2024](#)). Therefore, teachers' need for game media, including media such as Mystery Box, is very relevant to modern learning approaches. In addition, the need for training in the use of mathematics learning media is also high, indicating that the mastery of TPACK (Technological Pedagogical and Content Knowledge) by elementary school teachers is still a global challenge, especially in integrating technology and mathematics learning media into the classroom ([Li et al., 2024](#)). Therefore, the need for teachers to obtain training in the use of media is not only valid but also very urgent. In terms of assessment, teachers need worksheets that make it easier for students to understand the steps of multiplication, as well as simple but effective evaluation tools ([Ishartono et al., 2024](#)). Assessment instruments that have clear procedures and support gradual numeracy development are important. Teachers need LKPD and evaluation tools that not only assess the final results but also the students' thinking process ([Outhwaite et al., 2024](#)). Teachers' need for game-based media and digital game-based learning can increase interest, participation,

and understanding of mathematical concepts in elementary school students. This reinforces teachers' need for interactive and enjoyable learning resources ([Debrenti, 2024](#)). Early numeracy skills greatly influence success in mathematics at subsequent levels, and early numeracy skills can predict long-term mathematical achievement ([Chan & Scalise, 2022](#); [Seitz & Weinert, 2022](#)). This indicates that teachers' need for media that helps students understand basic multiplication concepts is not only a local context need but also relates to the urgency of strengthening numeracy in primary education globally.

*P1: "How do you usually teach the concept of multiplication to fourth graders?"*

*A1: "I use teaching aids, abacus, and fingers."*

*P2: "In your opinion, what difficulties do students often experience in understanding the concept of multiplication?"*

*A2: "Students understand the concept, but they have difficulty memorizing it, so they continue to calculate."*

*P3: "How important is the use of learning media in helping students understand multiplication?"*

*J3: "It is very important, especially to help them understand the concept."*

*P4: "Have you ever used or heard of the Mystery Box learning media before?"*

*J4: "I have heard of it."*

*P5: "How do you relate the contents of the Mystery Box to everyday situations?"*

*J5: "Using real objects such as buttons or candies, grouped into several parts. Students observe and model multiplication, for example, 4 bags  $\times$  3 candies."*

*P6: "How do you explain the concept of multiplication so that students understand its meaning in everyday life?"*

*J6: "Using concrete objects and story problems that are relevant to students' lives."*

*P7: "How important is it to train students to interpret calculation results in a real context?"*

*J7: "It is very important because meaningful learning is learning that can be applied in real life."*

*P8: "How good are students at interpreting multiplication results?"*

*J8: "They still focus on memorization and have difficulty understanding story problems due to low literacy skills."*

*P9: "Are students able to make predictions or decisions in the Mystery Box activity?"*

*J9: "Possibly."*

*P10: "How does the Mystery Box activity change students' decision-making abilities?"*

*J10: "It is likely to be better."*

*P11: "Do you often use tables, charts, or graphs to help students understand multiplication?"*

*J11: "Yes. I create charts containing groups of objects so that students see multiplication as the number of groups  $\times$  the number of objects."*

*P12: "How do you integrate the Mystery Box with tables or charts?"*

*J12: "After opening the box, students count the objects, group them, and then transfer the data to a table."*

*P13: "Can students convert concrete information into tables or graphs?"*

*J13: "Yes."*

*P14: "How do you assess students' ability to draw conclusions from multiplication data?"*

*J14: "By looking at the accuracy of reading data and the ability to connect data with the multiplication model."*

*P15: "Does the Mystery Box help students analyze data more actively?"*

*J15: "Yes, because students collect, observe, discuss, and process the data themselves, making it more meaningful."*

The results of interviews with teachers show that mathematics learning in fourth grade has so far relied on conventional media such as number cards, abacuses, and simple concrete objects. Teachers said that they had never used game-based learning media or more creative manipulative media in teaching mathematics. Elementary school teachers often need concrete examples and conceptual models to integrate cultural contexts or real experiences into multiplication learning so that students can more easily understand abstract mathematical structures ([Bruno et al., 2024](#); [Asmawati et al., 2023](#)). In line with this, the results of interviews from pre-research teacher documents show that teachers actually understand the importance of concrete learning media to help students build multiplication concepts. Teachers emphasized that the use of media plays a significant role in facilitating concept understanding and increasing student engagement. Appropriate learning media can strengthen the relationship between conceptual meaning and mathematical symbols ([Irshid et al., 2023](#); [Li et al., 2024](#)). Teachers believe that concrete media can help students see multiplication as a grouping process, not just memorizing numbers. They need training in the use of mathematical learning media because learning has been more procedural in nature, not emphasizing reasoning and numeracy representation. Elementary school teachers still face major challenges in integrating technology, pedagogy, and content simultaneously. Therefore, teachers' need for media training is not only relevant but also crucial to improving the quality of numeracy learning ([Li et al., 2024](#)).

Most students prefer learning that uses concrete tools that can be touched, played with, or moved. They admit that it is easier to understand lessons when the media can be seen directly, because it makes learning more interesting and less boring. Game-based learning and manipulative media can increase motivation, conceptual understanding, and engagement among elementary school students ([Debrenti, 2024](#); [Hii Bii Hui & Muhammad Sofwan Mahmud, 2023](#)).

Similarly, manipulative media helps students concretize abstract concepts into understandable learning experiences (Dan et al., 2024; Faturrokhman, 2024). In the context of numeracy, it shows that elementary school students often have difficulty connecting symbols and story contexts because their literacy skills are not yet optimally developed (Chan & Scalise, 2022; Seitz & Weinert, 2022). This is in line with the interview results, which show that students still have difficulty understanding multiplication story problems because they are reluctant to read long texts, so they tend to resort to memorization. Teachers also see a need for media that not only teaches concepts but also helps students interpret information in the form of tables, charts, and pictures. Strengthening numeracy understanding requires visual data representations that are easy for students to interpret (Outhwaite et al., 2024).

Additionally, media such as the Mystery Box, as described in the teacher interviews, has the potential to help students analyze information and make predictions based on concrete data. Activities such as opening boxes, grouping objects, recording data in tables, and modeling multiplication can improve students' higher-order thinking skills. Manipulative tasks can improve students' data analysis and decision-making skills in the context of basic mathematics (Dvoryatkina & Simonovskaya, 2021).

## Conclusion

Interviews with students and teachers showed that learning multiplication in fourth grade requires concrete, interesting media that can help them really get the concept. Students still rely on repeating addition and have a hard time with word problems, so they need media that can really show them what multiplication is all about. In addition, students stated that they were more motivated when learning was packaged through games and fun activities, such as the use of Mystery Boxes. Teachers also emphasized the importance of creative learning media, teaching aids that suit student characteristics, and learning strategies that can bridge understanding from mere memorization to mastery of concepts. This study provides a theoretical contribution by reinforcing the view that constructivist-based and game-based learning approaches are capable of building mathematical concept understanding through direct experience and social interaction.

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