



Analysis of Learning Difficulties of Multiplication Calculation Operations and the Potential of Educational Games Loaded with Local Wisdom as Learning Media for Grade III Elementary/MI Students in Temanggung Regency, Central Java

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Abstract. This study aims to analyze the learning difficulties of multiplication calculation operations and examine the potential use of educational games containing local wisdom as a learning medium for grade III elementary school students in Temanggung Regency, Central Java. This study uses a quantitative approach with descriptive types and survey methods. Data was collected through student and teacher questionnaires, observations, and documentation of learning outcomes. The results of the study show that students' ability to understand multiplication is still low, characterized by an average score that has not reached completion and a high percentage of students who experience difficulties. The learning that takes place is still dominated by conventional methods and the limited use of learning media. On the other hand, students have a high level of familiarity with digital games and show an interest in game-based learning. In addition, local wisdom in Temanggung Regency has potential that can be integrated in learning, but has not been utilized optimally. Therefore, the development of educational games based on local wisdom is a relevant solution to improve understanding of the concept of multiplication and create more interactive, contextual, and meaningful learning.

Keywords: Learning difficulties, Multiplication calculation operations,, educational games, local wisdom

1. INTRODUCTION

Mathematics learning in elementary school has an important role in shaping students' logical, analytical, and systematic thinking skills [1]. One of the fundamental materials taught at this level is multiplication calculation operations [2]. However, in practice, multiplication learning is often still a challenge for grade III students because of its nature that begins to shift from concrete to abstract [3]. This causes students to have difficulty in understanding the basic concept of multiplication in its entirety.

The phenomenon that occurs in the field shows that students tend to only memorize the results of multiplication without understanding the meaning behind the process [4]. As a result, when faced with slightly different or context-based questions, students experience confusion and mistakes [5]. This condition shows that there is a gap between

the learning objectives of mathematics and the learning practices that take place in the classroom.

Theoretically, mathematics learning in elementary school students must be adjusted to the stage of cognitive development that is in the concrete operational phase [6]. At this stage, students will more easily understand concepts through hands-on experience and the use of concrete media [6]. Therefore, multiplication learning should not only focus on memorization, but also on understanding concepts as repetitive summation.

In the perspective of constructivism, students build knowledge through active interaction with the learning environment [7]. However, if learning is only procedure-oriented without involving meaningful experiences, then students' conceptual understanding will not develop optimally [8]. This is what causes misconceptions in understanding multiplication operations.

Current national education policies emphasize the importance of student-centered and context-based learning. Permendikdasmen Number 12 of 2025 concerning Content Standards directs learning to integrate digital technology and local content as part of a meaningful learning process. This shows that learning is not only material-oriented, but also on relevance to students' lives.

In addition, the regulation also encourages the use of innovative learning media that can increase student involvement. In this context, teachers are required to be able to develop learning strategies that are creative and adaptive to technological developments. Therefore, the use of digital-based media is one of the relevant solutions in mathematics learning.

Globally, the mathematical ability of Indonesian students is still relatively low when compared to other countries [9]. The results of the Programme for International Student Assessment (PISA) in 2022 show that most Indonesian students have not reached the minimum level of competence in numeracy [9]. This shows that mathematical problem-solving skills still need to be improved.

The low achievement indicates that there are problems that do not only occur at the secondary level, but also are rooted in basic education [10]. The numeracy skills measured in PISA are the result of accumulated learning since elementary school, so improvement must start from the early stages of learning, including in basic materials such as multiplication.

Based on the results of observations and teacher questionnaires contained in the research proposal, mathematics learning, especially multiplication materials, is still dominated by conventional methods such as memorization and practice routine questions. Teachers tend to use a drilling approach without the support of interactive and contextual learning media, which causes students to be less actively involved in the learning process.

The increase in the number of internet users globally and nationally shows that digital technology has become part of daily life, including for school-age children. The We Are Social report in 2025 notes that the number of world internet users reaches 5.56 billion out of a total global population of 8.2 billion people, while in Indonesia the number of internet users reaches 221 million or equivalent to 79.5% of the total population [11]. Data from the Central Statistics Agency in 2024 also shows that 39.71% of early childhood children have used mobile phones and 35.57% have accessed the internet, even in the age group of 5-6 years as many as 58.25% have used gadgets and 51.19% have accessed the internet [11].

In line with this data, the results of the initial questionnaire of 28 grade III students at MI Al Ikhlas Parakan Kauman showed that all students (100%) had played digital games, with a fairly high frequency of use, namely 39.3% played 3–5 times per week, 28.6% played 1–2 times per week, and 32.1% played every day. In addition, as many as 96.4% of students use mobile phones as their main device, 96.4% understand the rules of the game, and 96.4% say it is easier to understand learning through game media. These findings show that students are familiar with digital games and have readiness to accept game-based learning, so that the use of digital board game media becomes relevant to the learning characteristics of students in the digital era.

In addition, student learning outcome data shows that most students have not achieved completeness in multiplication material. The low average score and high percentage of students who have not completed are indicators that the learning carried out is not effective. This condition reinforces the existence of real problems that need to be addressed immediately through learning innovation.

Several previous studies have shown that the use of digital-based learning media and educational games can improve student learning outcomes [12]. Interactive media is able to provide a more interesting learning experience and make it easier for students to understand abstract concepts [13]. However, most of the research still focuses on technological aspects without integrating the local cultural context.

On the other hand, research that specifically examines the relationship between students' learning difficulties and the development of local wisdom-based media is still limited. In fact, the integration of local culture in learning can increase the relevance and closeness of the material to students' lives [14]. Therefore, research that combines the analysis of learning difficulties with the development of local culture-based media is needed.

Based on existing research phenomena and gaps, the development of innovative learning media is very important. The media developed must be able to bridge the gap between abstract concepts and students' concrete experiences [15]. One potential approach is the use of digital-based educational games that are able to increase student learning engagement [16].

In addition, the integration of local wisdom such as Temanggung coffee and the art of Jaran Kepang can provide a context closer to students' lives. Learning based on local wisdom is important because it is able to relate learning materials to the cultural context and environment of students so that learning becomes more meaningful and relevant to students' daily lives [17]. Thus, learning becomes more meaningful and relevant.

Based on this description, this study aims to analyze the difficulty of learning multiplication operations in grade III elementary school/mi students in Temanggung Regency. This analysis was carried out to identify the factors that cause students' learning difficulties both from conceptual and learning aspects.

In addition, this study also aims to examine the potential use of educational games based on local wisdom as an innovative learning medium. Thus, it is hoped that this research can contribute to the development of learning media that is effective, contextual, and in accordance with the characteristics of elementary school students.

2. METHOD

This study uses a quantitative approach with descriptive research types and survey methods. A quantitative approach is used to obtain numerical data that describes real

conditions related to learning difficulties in learning multiplication operations and the potential use of educational games as a learning medium. This type of descriptive research aims to describe phenomena that occur in the field systematically and factually, without giving specific treatment to the research subject [18]. Meanwhile, the survey method was used to collect data directly from respondents through questionnaires to obtain information about learning conditions, student learning difficulties, and students' familiarity with the use of digital games.

This research was carried out in the Temanggung Regency area, Central Java, with research subjects consisting of students and teachers of elementary schools/madrasah ibtidaiyah. The sampling technique was carried out using a combination of several sampling techniques that were adjusted to the characteristics of the data. Data on the habit of using digital games was obtained from 28 grade III students who were taken using the total sampling technique, because all class members were used as respondents. Teacher questionnaire data was obtained from 10 teachers from private MI, public MI, and public elementary schools using purposive sampling techniques, namely the selection of respondents based on certain criteria relevant to the research. Meanwhile, student learning outcome data on multiplication material was obtained from 50 students through a documentation technique with a total sampling approach, which is using all available value data. The use of this combination of sampling techniques aims to obtain comprehensive and representative data.

The data used in this study consisted of primary data and secondary data. Primary data was obtained through student and teacher questionnaires and learning observation results, while secondary data was obtained from curriculum documents, PISA 2022 data, and literature relevant to mathematics learning, educational games, and local wisdom. The use of these two types of data aims to strengthen the analysis and provide a more comprehensive picture of the problems being studied.

The data collection techniques in this study include questionnaires, observations, and documentation. Questionnaires are used as the main instrument in the survey method to collect data related to students' learning difficulties, learning methods used by teachers, the use of learning media, and students' experiences in playing digital games. Observation is carried out to directly observe learning activities in the classroom, while documentation is used to obtain data in the form of student learning outcomes on multiplication materials and other supporting data.

The research instrument is in the form of a closed questionnaire which is compiled based on research indicators, including aspects of learning difficulties, learning methods, media use, and the level of familiarity of students with digital games. In addition, observation sheets are used to record learning activities systematically. To improve the quality of the instruments, questionnaires were compiled based on indicators relevant to the research objectives.

The data obtained was analyzed using quantitative descriptive analysis techniques by calculating the percentage of each response obtained. The results of the analysis are then categorized and presented in the form of a table to make it easier to understand. The percentage calculation is carried out using a formula where P is the percentage, f is the frequency, and N is the number of respondents. This approach allows researchers to objectively describe learning conditions and identify patterns of student learning difficulties and the potential use of educational games in learning. $P = \frac{f}{N} \times 100\%$

3. RESULTS

This section presents the results of research obtained through data collection using questionnaires, documentation, and observations. The data analyzed included student learning outcomes in multiplication operation materials, the level of familiarity of students with the use of digital games, and learning conditions based on the teacher's perspective. The presentation of results was carried out in the form of a table accompanied by quantitative descriptive analysis to provide a systematic and factual picture of the learning conditions that occurred in the field.

The results of the research were compiled based on the data sources obtained, namely student score documentation data, student questionnaire data, and teacher questionnaire data. Each data is analyzed to identify patterns of student learning difficulties, characteristics of digital media use, and ongoing learning conditions. Through the presentation of this data, it is hoped that a comprehensive picture can be obtained as a basis for formulating the discussion and implications of the research.

Table 1. Results of Student Value Analysis on Multiplication Material

Indicator	Value
Number of students	50
Average	62
Highest score	85
Lowest value	40

Based on Table 1, the results of the analysis of student scores on the multiplication operation material in grade III MI Al Ikhlas Parakan Kauman show that students' abilities are still relatively low. This is shown by the average grade point average of 62 which is below the expected standard of completeness. This condition indicates that most students are not able to understand the concept of multiplication optimally.

The wide range of scores between the highest score (85) and the lowest score (40) shows that there is a significant ability gap between students. Some students have been able to understand the material well, but others still experience quite basic difficulties. This difference indicates that the ongoing learning process has not been able to accommodate differences in students' abilities equally.

In addition, the low average score also indicates that students' understanding still tends to be procedural, namely memorizing the results of multiplication without understanding the basic concept of repeated addition. This condition has an impact on students' difficulties in solving problems that are contextual or require understanding of concepts. Thus, efforts are needed to improve the learning process through the use of more interactive and contextual media in order to improve students' overall understanding.

Table 2. Characteristics of Digital Game Use

Aspects	Percentage
Have played games	100%
1–2 times/week	28,6%

3–5 times/week	39,3%
Every day	32,1%
Using a cellphone	96,4%
Understanding the rules of the game	96,4%
Easier to learn with games	96,4%

The results in Table 2 show that all students (100%) have had experience in using digital games, which indicates that digital technology has become a part of students' daily lives. The high frequency of use, where more than 70% of students play games more than three times a week, shows that gaming is not just an entertainment activity, but has become an inherent habit.

In addition, the dominance of mobile phone use (96.4%) shows that access to digital media is very high, so that technically students are ready to receive technology-based learning. The high percentage of students who understand the rules of the game and find it easier to learn through games (96.4%) shows that games have the potential to be an effective learning medium, because they are able to increase engagement and make it easier to understand concepts. This indicates that the learning characteristics of students today are more in line with an interactive and experiential learning approach.

Table 3. Results of Questionnaire for Elementary / MI Teachers (Public and Private) on Multiplication Learning

Aspects	Category	Jml	Percentage
Learning methods	Conventional (memorization, drilling, routine exercises)	8	80%
	Varied (props/games)	2	20%
Use of educational games	Not yet using	6	60%
	Already using	4	40%
Type of media used	Conventional	6	60%
	Educational Games	2	20%
	Kombinasi	1	10%
	Props	1	10%

Based on Table 3, it can be seen that most teachers still use conventional learning methods in teaching multiplication operations, such as memorization, drilling, and routine exercises, with a percentage of up to 80%. The use of educational game-based learning media is still limited, where only 40% of teachers have used it in learning. In addition, the majority of media used is still conventional, while the use of innovative media such as educational games and learning combinations is still relatively low. These findings show that mathematics learning in multiplication materials is still

dominated by traditional approaches and has not fully utilized the potential of interactive learning media.

The results of the study showed that grade III students had a high level of familiarity with the use of digital games in daily life. All students have experience playing games, with a fairly high frequency of use and the majority of students use mobile phone devices. In addition, most students also state that they understand learning more easily when presented in the form of games. These findings show that students have readiness to receive educational game-based learning.

On the other hand, the results of the teacher's questionnaire show that the use of game-based learning media is still limited and mathematics learning, especially in multiplication materials, is still dominated by conventional methods such as memorization and practice of routine questions. This shows that innovation in the use of learning media has not developed optimally in the classroom.

In addition, based on the results of observations and regional context studies, Temanggung Regency has the potential for local wisdom that can be used in learning, such as Temanggung coffee and Jaran Kepang art. However, this local wisdom has not been optimally utilized in mathematics learning, especially as a context in understanding the concept of multiplication calculation operations.

Based on these findings, it can be concluded that there is great potential in developing educational games based on local wisdom as a learning medium. The high familiarity of students with digital games and the availability of local wisdom that is relevant to students' lives shows that the development of learning media that integrates these two aspects is a significant opportunity in improving the quality of mathematics learning.

DISCUSSION

Mathematics learning in primary school students should emphasize understanding concepts, not just memorization, because students are at a concrete operational stage that requires a meaningful learning experience [19]. In addition, from the perspective of constructivism, conceptual understanding will be formed through the active involvement of students in the learning process, not through mere procedural methods [20]. The results of the study show that the average score of students is still low and most of them have not reached the completeness of learning in multiplication materials. Therefore, it can be concluded that the learning that takes place has not been able to develop students' conceptual understanding optimally.

Previous research has shown that the use of conventional methods such as memorization and drilling tends to result in understanding that is superficial and does not last long [21]. In addition, learning that does not involve interactive media can lead to low student involvement in the learning process [22]. The results of this study show that most teachers still use conventional methods and have not utilized learning media optimally. Thus, innovation in learning strategies is needed so that the learning process becomes more active and meaningful.

The use of educational games in learning has been proven to increase student motivation and engagement because it provides an interactive and fun learning experience [23]. In addition, game-based media is able to help students understand abstract concepts through more concrete visualizations and simulations [24]. The results showed that all students were familiar with digital games and most of them

found it easier to understand learning through games. Therefore, educational games have great potential to be used as a medium for learning mathematics in elementary schools.

The integration of local wisdom in learning can increase the relevance of the material to students' lives so that learning becomes more meaningful [25]. In addition, the use of local cultural contexts can also assist students in understanding abstract concepts through situations that are close to everyday experience [26]. The results of the study show that local wisdom in Temanggung Regency has not been optimally utilized in mathematics learning. Thus, the integration of local wisdom in learning is important to improve the quality and meaningfulness of student learning.

The development of effective learning media must be able to bridge the gap between student characteristics and learning needs [27]. In addition, the combination of digital technology and local cultural contexts can create innovative and contextual learning [28]. The results of the study show that students are familiar with digital games, while learning is still conventional and has not taken advantage of local wisdom. Therefore, the development of educational games based on local wisdom is a relevant solution to improve students' understanding of the concept of multiplication.

CONCLUSION

Based on the results of the study, it can be concluded that the difficulty of learning multiplication operations in grade III students of SD/MI in Temanggung Regency is still relatively high, which is shown by the low average learning outcomes and the high percentage of students who have not reached completion. These difficulties are caused by learning that is still dominated by conventional methods such as memorization and routine exercises, so that students' understanding tends to be procedural and has not developed conceptually.

On the other hand, the results showed that students have a high level of familiarity with the use of digital games and show a great interest in game-based learning. This shows that students have the readiness to receive more interactive and technology-based learning. However, the use of game-based learning media by teachers is still limited and has not been optimally integrated in the learning process.

In addition, the potential of local wisdom in Temanggung Regency, such as Temanggung coffee and the art of Jaran Kepang, has not been utilized optimally in mathematics learning. In fact, the integration of local wisdom can provide a context closer to students' lives so that learning becomes more meaningful and contextual.

Therefore, the development of learning media in the form of educational games based on local wisdom is a relevant solution to overcome students' learning difficulties. The integration between digital technology and local wisdom is expected to increase student engagement and help them understand the concept of multiplication in a more concrete, contextual, and meaningful way. Thus, this research contributes to the development of innovative learning media that is in accordance with the characteristics of students in the digital era

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