

Developing FlashCard Media for Mathematics Multiplication to Improve Learning Outcomes in Elementary Students

Sulistiyani Puteri Ramadhani¹, Tabitha Cristiavane Jeanetta²

Universitas Trilogi^{1,2}

*E-mail: sulistiyani@trilogi.ac.id

Abstract

This study is motivated by the limited use of interactive visual media in elementary mathematics, which significantly impacts low multiplication learning outcomes. The study aims to develop and evaluate the feasibility and effectiveness of thematic FlashCard media to improve students' numeracy skills on multiplication. The research adopts a Research and Development (R&D) design with the ADDIE model, involving 30 grade V students at SDN Jatinegara 03 Pagi Jakarta selected through saturated sampling. Data were collected using validation questionnaires, observations, and pre-test/post-test instruments, then analyzed through descriptive percentages and N-Gain. The findings reveal that the media is highly feasible based on material (86%), language (83.33%), and design (85.88%) expert validations. Implementation shows an average score increase from 53.83 to 74.50, with an N-Gain of 0.45 categorized as moderate. The study concludes that thematic FlashCard media is sufficiently effective in enhancing multiplication comprehension. The implications include practical recommendations for teachers to adopt thematic visual tools as an alternative to conventional teaching methods in elementary mathematics instruction.

Keywords: Flashcard, Learning Media, Mathematics, Multiplication, Elementary School



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Introduction

Becoming an educator is not a simple matter. Teachers are required to continuously hone their capacity to design learning experiences that are engaging, active, and innovative in the classroom (Herliana & Anugraheni, 2020). In the context of formal education, teachers play a central role as facilitators bridging students with various knowledge and new information. Consequently, creativity and innovation in teaching and learning activities are no longer merely options but necessities. One concrete strategy educators can pursue is integrating learning media into every face-to-face session. The presence of such media is not merely complementary; it functions as a catalyst that enlivens classroom interaction, so that students are no longer passive recipients but are directly involved in constructing their understanding.

The rapid advancement in various sectors, especially information and communication technology, is fundamentally inseparable from the foundation of mathematics. As affirmed by Novalia and Noer (2019), mathematics occupies a strategic cross-disciplinary position; it is universal and continuously evolves following the pace of development. At the elementary school level, this subject not only equips students with applicable concepts and principles for daily life but also forms systematic thinking patterns that produce quality individuals. One of the main objectives of mathematics learning at the elementary level is to hone students' thinking and reasoning abilities in

drawing conclusions through diverse activities ranging from investigation, exploration, and experimentation to problem-solving independently.

Conceptually, learning refers to the interaction between educators and students during the teaching and learning process. The indicator of success can be traced through learning outcomes achieved by students; the better the results obtained, the higher the quality of education organized (Kusuma & Yandri, 2021). It should be noted that this achievement does not stand alone. Salsabila and Puspitasari (2020) identify two groups of influencing factors: internal factors encompassing physical health, psychological condition, motivation, and emotional stability, and external factors such as school environment (including the teacher's role), social dynamics, and family support.

In efforts to elevate national education quality, the Indonesian government has taken strategic steps by replacing Curriculum 2013 with Kurikulum Merdeka. This innovation is designed to provide broader space for students to explore their potential while reducing the burden of academic pressure previously considered excessive. Amid these curriculum demands, teachers need to design learning experiences that are effective, engaging, and enjoyable. Nurdyansyah and Toyiba (2018) explain that learning strategies encompass designing teaching models and methods, including selecting media to be applied in the classroom. Particularly in Mathematics—a discipline continuously needed in daily life—the presence of media becomes increasingly crucial. The characteristics of mathematics material that tend to be abstract require concrete tools so that concepts can be visualized and understood more easily by students.

One medium considered aligned with these needs is FlashCard. Maryanto (2019) elaborates that FlashCard functions to enhance memory while helping students master various materials including terms, symbols, formulas, and spellings. In terms of definition, Wahyuni (2020) describes FlashCard as cards displaying pictures or symbols on one side, while the reverse side contains words or descriptive sentences related to the visual. The practicality of this medium is also affirmed by Febriyanto (2019), who states that FlashCard is simple, easy to carry and store, affordable, safe, and enjoyable for users.

In practice, FlashCard is not monopolized by teachers alone. Students can also utilize it actively: teachers pose questions based on descriptions of images or events on cards, while students observe the visual side and respond. This two-way mechanism makes the classroom atmosphere more interactive. Hendrawan (2021) adds that as a visual aid, FlashCard can strengthen students' retention through repetition packaged in an enjoyable manner, so their involvement in the teaching and learning process increases significantly. Ultimately, this interactive approach contributes directly to increasing motivation, participation, and student learning outcomes—a conclusion consistent with Rahayu's (2020) findings that attractively designed learning media can boost participants' academic achievement.

Based on observation and interview results with the homeroom teacher of class VB, Mrs. Yulis Supriyanti, S.Pd., many students experience difficulties in mathematics, especially in multiplication operations. The characteristics of learning media from the school are still inadequate, so students only receive learning material through textbooks and whiteboards. This is evidenced by the average daily test results of mathematics for grade 5 students being 50, while the Minimum Completeness Criteria (KKM) for mathematics is 75. Generally, the learning design packaged by teachers at the beginning of the semester delivers material through the lecture method, so students tend to be less active and less challenged to explore and express their abilities.

From the limitations of objects in previous research, the researcher is interested in developing FlashCard learning media. The media developed is designed to facilitate students in understanding basic multiplication operations from 1 to 10. With the development of FlashCard learning media by the researcher, it is expected to facilitate students in mastering basic multiplication operations. A student must master the basics of arithmetic operations in mathematics to proceed to the next level of material. Therefore, mastering a good foundation of mathematical arithmetic operations is the most important aspect to be able to solve problems in life.

Based on the background described, the problem faced is students' low ability in calculating multiplication results. This study proposes the development of FlashCard-based learning media for students of class VB at SDN Jatinegara 03 Pagi, with the assumption that this media can boost their learning outcomes in Mathematics. Methodologically, this study adopts a research and development approach referring to the ADDIE model. Through a series of stages in that model, the developed FlashCard media has passed the validation process and is declared feasible and tested for validity to be implemented in class.

Methods

This research employs the Research and Development (R&D) method, which is a process or steps to create a new product or improve an existing product. Research and development functions as a bridge between basic research and applied research (Okpatrioka, 2023). The products produced in education can be in the form of specific curricula, teaching methods, media, textbooks, modules, evaluation materials, and other educational products (Sugiyono, 2019).

The development model used in this research is the ADDIE model. The ADDIE model is based on an effective and efficient systems approach with interactive processes between teachers and students as well as the environment. Evaluation results bring development to the next stage. The ADDIE development model has advantages, namely being simpler, more organized, and widely used in creating programs and learning products effectively and validated by experts (Munawar, 2020). The ADDIE development model consists of five stages: Analysis, Design, Development, Implementation, and Evaluation.

The research was conducted from September 2022 until completion, at SDN Jatinegara 03 Pagi, located at Jl. Bekasi Raya KM. 17, Jatinegara, Cakung, East Jakarta. The subjects were 30 students of grade VB. The object of research is FlashCard learning media to improve learning outcomes in calculating multiplication.

In the Analysis stage, the researcher conducted performance analysis through interviews with the class VB teacher, student analysis through observation and diagnostic tests to 10 randomly selected students, and material analysis through literature study. In the Design stage, the researcher designed the storyboard, pre-test and post-test questions. In the Development stage, the researcher developed the physical product and conducted validation by design experts, material experts, and practitioners on December 1, 2022. In the Implementation stage, the media was tested on students with pre-test and post-test. In the Evaluation stage, comprehensive analysis was conducted based on validation results and learning outcome improvement.

Data collection techniques included observation (structured and participatory), interviews (structured with the class teacher), documentation, questionnaires (for expert validation using Likert scale 1-5), and tests (15 multiple-choice questions for pre-test and post-test adapted from Nuriyani, 2020). The data analysis used descriptive analysis with the validity formula:

$$P = (\text{Total Score} / \text{Maximum Score}) \times 100\%$$

The validity criteria were: 81%-100% (Very Feasible), 61%-80% (Feasible), 41%-60% (Fairly Feasible), 21%-40% (Less Feasible), 0%-20% (Very Not Feasible). Effectiveness was measured using the Normalized Gain (N-Gain) formula:

$$\text{N-Gain} = (\text{Posttest Score} - \text{Pretest Score}) / (\text{Ideal Score} - \text{Pretest Score})$$

Results and Discussions

1. Results

The research produced a FlashCard Mathematics Multiplication media product developed through the ADDIE model. The product consists of a flashcard board designed with forest and nature themes, question cards, answer cards, number cards, and a user guide book. All components were designed using Canva application and printed on art carton material with lamination for durability.

The feasibility assessment was conducted through expert validation. Table 1 presents the validation results from three experts.

Table 1.
Expert Validation Results of FlashCard Media

No.	Validator	Score Obtained	Maximum Score	Percentage	Category
1	Material Expert (Putri Amelia, S.Pd., M.Mat.)	43	50	86%	Very Feasible
2	Language Expert (Riana Puspita, M.Pd.)	50	60	83.33%	Very Feasible
3	Design/Media Expert (Rian Pratama, S.Ds.)	73	85	85.88%	Very Feasible

Based on Table 1, all three validators gave the "Very Feasible" category with percentages above 80%. The material expert assessed that the multiplication content was appropriate with learning objectives, student competencies, and the applicable curriculum. The language expert confirmed that the language used was appropriate for grade V elementary students' developmental level. The design expert evaluated that the visual appearance, layout, color selection, illustrations, and media function were attractive and capable of supporting the learning process.

The small group trial involving 6 students showed improvement from pre-test to post-test. Table 2 presents the small group trial results.

Table 2.
Small Group Trial Results

Stage	Total Score	Maximum Score	Persentase	Category
Pre-test	47	90	52.22%	Low
Post-test	79	90	87.78%	Very Good

The large group trial involving 30 students showed significant improvement. Table 3 presents the comparison between pre-test and post-test results for the large group.

Table 3.
Large Group Pre-test and Post-test Results

Stage	Total Score	Maximum Score	Average
Pre-test	1.615	3.000	53.83
Post-test	2.235	3.000	74.50

Based on Table 3, there was an increase in average student scores from 53.83 in the pre-test to 74.50 in the post-test. The highest score increased from 85 to 90, while the lowest score increased from 35 to 55. The N-Gain analysis produced an average score of 0.45 with a percentage of 45.00%, categorized as moderate and sufficiently effective.

Regarding negative data/anomalies, the data showed that student J.H.Y experienced a score decrease from 80 in the pre-test to 55 in the post-test, while student R.I.T obtained a stagnant score (55 in both tests). Based on field observation notes, these anomalies were caused by external factors including loss of focus and social interaction disturbances during the independent trial session. This demonstrates data objectivity that although the media is effective in aggregate, individual psychological variables still affect learning outcomes.

2. Discussions

The research results prove that the integration of forest and animal-themed visual elements into FlashCard successfully translated the abstraction of multiplication operations into concrete forms easily digested by students. The increase in average scores from 53.83 to 74.50 indicates that this media can facilitate the construction of repeated addition understanding independently and in groups. The thematic design with forest and animal illustrations aligned with elementary students' psychological characteristics created an engaging learning atmosphere that stimulated intrinsic motivation.

These findings align with Hendrawan's (2021) research stating that visual aids packaged enjoyably can strengthen students' memory retention through interactive repetition mechanisms. Additionally, these results support Rahayu's (2020) findings that attractively designed learning media can boost academic achievement. The FlashCard's practicality, as emphasized by Febriyanto (2019)—being simple, portable, easy to remember, affordable, safe, and enjoyable—was confirmed during implementation, where students showed higher participation, enthusiasm, and direct involvement compared to conventional learning.

The implications of this study encompass theoretical contributions to visual cognitive learning literature for elementary numeracy and practical recommendations for teachers to adopt thematic visual media as alternatives to conventional teaching methods. Theoretically, this study enriches the literature on instructional design based on visual cognition for basic numeracy literacy. Practically, this research provides recommendations for teachers and decision-makers at the elementary level to transition from one-directional lecture methods toward using manipulative tools that encourage collaboration and active student participation.

However, this research has several limitations. First, the implementation was slightly constrained by school facility rearrangements that limited students' movement space when using the large-sized flashcard board. Second, the generalization of findings is limited to one school with specific sociocultural characteristics, so confounding variables such as students' intrinsic motivation have not been fully controlled. Third, the N-Gain score of 0.45 (moderate category) indicates that while the media is effective, there remains room for further improvement through additional interventions or extended implementation periods.

Conclusion

This study confirms that the FlashCard Mathematics Multiplication media with forest and animal themes achieved the "Very Feasible" category based on multidimensional validation (material 86%, language 83.33%, design 85.88%). The results show that this media is sufficiently effective in improving students' mathematics learning outcomes (N-Gain = 0.45), answering the problem formulation regarding low numeracy achievement in class VB SDN Jatinegara 03 Pagi Jakarta. The study provides main contributions in the form of empirical validation regarding the importance of aligning visual media themes (contextual and imaginative) with the cognitive development stage of elementary-age children, an aspect previously under-documented in elementary mathematics R&D

literature. Recommendations for further studies include: (1) longitudinal exploration to verify the stability of students' memory retention regarding multiplication concepts; (2) sample expansion to various regions with different demographics to increase generalization; and (3) digitization of this FlashCard media into interactive application formats or Augmented Reality (AR) to answer educational challenges in the Society 5.0 era.

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