



Jurnal Ilmiah Pendidikan Citra Bakti

p-ISSN 2355-5106 || e-ISSN 2620-6641

<https://jurnal.citrabakti.ac.id/index.php/jil>



INTERACTIVE FLANNEL BOARD AS A MATHEMATICS LEARNING MEDIA TO IMPROVE STUDENTS' UNDERSTANDING OF NUMBER CONCEPTS

Brillita Naja Ein Wyandha^{1)*}, Wahid Ibnu Zaman²⁾, and Widi Wulansari³⁾

^{1,2,3)}PGSD, Nusantara University PGRI Kediri

*Corresponding author email: najaein37@gmail.com

Article History

Received:
June 9, 2026

Accepted:
July 22, 2026

Published:
August 26, 2026

Abstract

Learning activities that mainly rely on lectures and textbooks tend to limit students' active participation, causing them to memorize concepts without fully understanding their meaning. This issue is particularly evident among children aged 6–7 years, who are still in the concrete operational stage of cognitive development and require direct learning experiences through tangible objects. Therefore, appropriate learning media are needed to bridge abstract mathematical concepts with students' concrete learning experiences. This study aims to develop an interactive flannel board learning medium that is suitable for improving first-grade elementary school students' understanding of number concepts. The study employed the Research and Development (R&D) method using the Borg and Gall development model, which was simplified into seven stages: needs analysis, planning, initial product development, expert validation, revision, field testing, and final product revision. The research subjects were first-grade students of SDN Mrican 3 and SDN Mrican 4, Kediri City. The research instruments included material expert and media expert validation sheets, a practicality questionnaire, and a number concept understanding test. The findings revealed that the interactive flannel board learning medium achieved a very high level of validity based on evaluations from both material and media experts. In addition, the medium was found to be practical for classroom implementation and effective in improving students' understanding of number concepts. Therefore, the developed learning medium can serve as an alternative instructional tool that promotes a more active, concrete, and enjoyable mathematics learning experience for lower-grade elementary school students.

Keywords: concept understanding, elementary mathematics, interactive flannel board, learning media, number concepts

Abstrak. Pembelajaran yang cenderung menggunakan metode ceramah dan buku paket membuat siswa kurang terlibat aktif, sehingga konsep yang dipelajari hanya dihafal tanpa dipahami maknanya. Kondisi ini semakin terlihat pada siswa usia 6–7 tahun yang masih berada pada tahap operasional konkret dan membutuhkan pengalaman belajar langsung melalui benda nyata. Oleh karena itu, diperlukan media pembelajaran yang mampu menghubungkan konsep abstrak dengan pengalaman konkret siswa. Penelitian ini bertujuan untuk mengembangkan media pembelajaran papan flanel interaktif yang layak digunakan untuk meningkatkan pemahaman konsep bilangan pada siswa kelas I SD. Penelitian menggunakan metode Research and Development (R&D) dengan model Borg dan Gall yang disederhanakan menjadi tujuh tahap, meliputi analisis kebutuhan, perencanaan, pengembangan produk awal, validasi ahli, revisi, uji coba lapangan, dan revisi akhir produk. Subjek penelitian adalah siswa kelas I SDN Mrican 3 & 4 Kota Kediri. Instrumen penelitian berupa lembar validasi ahli materi dan ahli media, angket kepraktisan, serta tes pemahaman konsep bilangan. Hasil penelitian menunjukkan bahwa media papan flanel interaktif memperoleh kategori sangat valid dari ahli materi dan ahli media, praktis digunakan dalam pembelajaran, serta efektif meningkatkan pemahaman konsep bilangan siswa. Dengan demikian, media yang dikembangkan dapat menjadi alternatif pembelajaran matematika yang lebih aktif, konkret, dan menyenangkan bagi siswa kelas awal sekolah dasar.

Kata Kunci : konsep bilangan, matematika sekolah dasar, media pembelajaran, papan flanel interaktif, pemahaman konsep

Background

Mathematics is a subject that plays a crucial role in developing logical, systematic, critical, and creative thinking skills from elementary school onward. Mastery of mathematical concepts at an early stage not only determines students' success in learning material at subsequent levels but also contributes to their ability to solve various problems encountered in everyday life. Therefore, the mathematics learning process needs to be designed to provide meaningful, contextual learning experiences that are appropriate to the developmental characteristics of students. According to Ahmad and Siller (2024) found that mathematics learning utilizing manipulative media can increase student engagement and positively impact learning outcomes at various levels of academic ability. Another study by Aini and Amrulloh (2025) also showed that manipulative media serves as a cognitive bridge, helping students transform abstract mathematical concepts into more concrete and understandable learning experiences.

One of the basic competencies that first-grade elementary school students must master is understanding the concept of number. This concept serves as the primary foundation for almost all mathematics materials, such as arithmetic operations, measurement, number patterns, and mathematical problem-solving. When students don't fully grasp the concept of number, they tend to have difficulty connecting number symbols with their actual quantitative meanings, resulting in suboptimal subsequent learning. Lafay, Osana, and Levin (2023) explain that understanding number concepts at elementary school age is a crucial prerequisite for developing number representation and place value skills. Therefore, early learning should not only focus on memorizing number symbols but also emphasize developing conceptual understanding through activities that involve students' real-life experiences.

Although the concept of number plays a crucial role in mathematics learning, the reality on the ground shows that many early elementary school students still experience difficulties in understanding the relationship between number symbols, the number of objects, the order of numbers, and the process of comparing the values of numbers. These problems are generally influenced by teacher-centered learning, dominated by the use of textbooks, verbal explanations, and routine practice problems. As a result, students spend more time memorizing procedures than constructing their own understanding of the concepts being learned. This condition aligns with findingsSiregar (2025) stated that the use of conventional methods in learning mathematics causes students' conceptual understanding to develop less than optimally because students have not received concrete and interactive learning experiences.

The characteristics of the cognitive development of first-grade elementary school students are also an important consideration in determining the learning strategies used by teachers. At the age of six to seven, students are still in the concrete operational stage, making it easier to understand a concept when presented through real objects, manipulative activities, or direct learning experiences. In these conditions, learning media has a function as a link between abstract mathematical concepts and concrete experiences that students have. Research by O'Rear et al. (2023) shows that the use of manipulative media in numeracy learning provides a more meaningful learning experience than presenting material through pictorial representation alone. Similar results were also presented by Ponte et al. (2023), who stated that the use of manipulative media can increase learning motivation, active participation, and help students build an understanding of mathematical concepts through direct exploration activities.

Research developments in mathematics education in recent years have increasingly reinforced the importance of using manipulative media in elementary schools. Various studies have shown that learning utilizing concrete media not only improves learning outcomes but also strengthens students' conceptual understanding, mathematical representation skills, and learning retention. In the context of learning number concepts, media that allow students to directly manipulate objects has proven more effective than learning that only uses abstract symbols. One medium that possesses these characteristics is the flannel board. ResearchRahmawati and Subayani (2024) showed that the use of flannel board media was able to improve understanding of number concepts because students had the opportunity to connect number symbols with concrete representations through interactive and fun learning activities.

Method

This study used a Research and Development (R&D) approach to develop an interactive flannel board learning medium while simultaneously testing its feasibility, practicality, and effectiveness in improving the understanding of number concepts in first-grade elementary school students. This approach was chosen because it not only focuses on product development but also allows for evaluation and refinement based on field trial results (Sugiyono, 2022; Tegeh & Jampel, 2023). The development model refers to Borg and Gall (2003) which is simplified into seven stages: needs analysis, planning, initial product development, expert validation, product revision, field trials, and final revision. Simplification was carried out without reducing the essence of the development process so that the product still meets feasibility standards (Sugiyono, 2022).

The research was conducted at SDN Mrican 3 and SDN Mrican 4, Kediri City, in the even semester of the 2025/2026 academic year. The subjects were first-grade students, while product validation involved material expert lecturers, media expert lecturers, and first-grade teachers. The location selection was based on initial observations showing that number concept learning was still dominated by lecture methods and the use of textbooks, so that the use of interactive media was not optimal. This condition resulted in low student engagement and continued difficulties in understanding number concepts (Rahmawati et al., 2022; Ariella et al., 2025).

The research instruments consisted of a material expert validation sheet, a media expert validation sheet, a teacher and student response questionnaire, and a number concept comprehension test. The validation sheet was used to assess the suitability of the content, language, presentation, technical aspects, and feasibility of the media. The response questionnaire served to measure the level of practicality of the media after use, while the test was used to determine improvements in number concept comprehension. All instruments were first reviewed by a validator to ensure they met the research objectives and were suitable for use as data collection tools (Azwar, 2022; Retnawati, 2023).

Data collection was conducted according to the development stages. The research began with a needs analysis through observation and interviews with classroom teachers to identify learning problems. The analysis results formed the basis for developing a media design, which was then validated by material and media experts. After revisions based on input from validators, the media was piloted with first-grade students at both schools. During the pilot test, researchers conducted learning observations, distributed practicality questionnaires, and administered a number concept comprehension test. All stages were carried out systematically to ensure comprehensive evaluation of the media's quality (Borg & Gall, 2003; Tegeh & Jampel, 2023).

Data were analyzed using quantitative descriptive techniques. Validation results, practicality questionnaires, and user responses were converted into percentages to determine the media's suitability category. Meanwhile, test results were analyzed by comparing student abilities before and after media use to determine its effectiveness. This analysis was chosen because it can describe the media's quality in terms of validity, practicality, and effectiveness, in line with the objectives of the development research (Sugiyono, 2022; Riduwan, 2022). The entire research process was carried out with due regard for research ethics through obtaining school permission, coordinating with teachers, protecting the confidentiality of respondents' identities, and adhering to the ethical principles of educational research (BERA, 2024).

Results and Discussion

Results

The practicality of the interactive flannel board learning media was determined based on the results of a questionnaire of teacher and student responses after the media was used in learning activities on number concepts. The practicality assessment was conducted to determine the ease of use of the media, the clarity of instructions, the ease of presentation of the material, and user responses to the developed media.

The teacher assessment results showed that the media achieved a practicality score of 100%, categorized as very practical. All assessment aspects received maximum scores, indicating that the media was easy to prepare, easy to use during the learning process, and helpful in conveying number concepts. Furthermore, the media was deemed effective in increasing student engagement during the learning process.

The results of the student questionnaire also showed a very positive response. During the trial at SDN Mrican 3, the media achieved a practicality percentage of 99.61%, while at SDN Mrican 4, the percentage was 99.64%. Both results fall into the very practical category. High percentages indicate that students can use the media easily and follow the learning activities according to the instructions provided.

Table 1. Summary of Practicality Test Results

Respondents	Percentage	Category
Teacher	100%	Very Practical
Students of SDN Mrican 3	99.61%	Very Practical
Students of SDN Mrican 4	99.64%	Very Practical

In general, the results of the practicality test show that the interactive flannel board learning media has fulfilled the ease of use aspect for both teachers and students so that it is suitable for use in the effectiveness testing stage.

The effectiveness of the learning media was measured by comparing the pre-test and post-test results of students after participating in learning using an interactive flannel board. The testing was conducted in two stages: a limited-scale trial and a large-scale trial. Learning

outcome data was then analyzed using the Normalized Gain (N-Gain) formula to determine the improvement in understanding of number concepts after using the media.

A limited-scale trial involved 27 students. The analysis showed that all students experienced an increase in their scores after participating in learning using interactive flannel boards. Pre-test scores ranged from 40–80, while post-test scores increased to 70–100. The N-Gain calculation yielded an average of 0.67, with a percentage increase of 66.80%, categorizing the media as quite effective.

Table 2. Summary of Limited Scale Effectiveness Test Results

Number of Students	Average N-Gain	Percentage	Category
27	0.67	66.80%	Quite Effective

The next stage involved a large-scale trial involving 28 students. The results showed that pre-test scores were in the 50–80 range, while post-test scores increased to 80–100. All students experienced improved learning outcomes after using the interactive flannel board learning media.

The analysis using the N-Gain formula showed an average of 0.73, with a percentage increase of 72.64%. Based on the N-Gain interpretation criteria, these results are categorized as quite effective. These data indicate that the developed media can improve student learning outcomes after being applied to number concept learning.

Table 3. Summary of Results of Large-Scale Effectiveness Tests

Number of Students	Average N-Gain	Percentage	Category
28	0.73	72.64%	Quite Effective

Based on the results of both limited-scale and large-scale trials, there was an increase in the average N-Gain value after the media was applied to a larger number of students. A summary of the results of both testing stages is presented in Table 9.

Table 4. Comparison of Effectiveness Test Results

Trial Phase	Number of Students	N-Gain	Percentage	Category
Limited Scale	27	0.67	66.80%	Quite Effective
Large Scale	28	0.73	72.64%	Quite Effective

The data shows an average N-Gain increase of 0.06 from the limited-scale trial to the large-scale trial. Furthermore, the percentage increase in learning outcomes also increased by 5.84%, indicating that the media continues to deliver consistent results when applied to a larger number of students.

Product revisions were made after the media received feedback from validators during the validation process. Improvements focused on the material, media presentation, language use, and user instructions to make the media easier for teachers and students to understand. Some of the input provided included adjusting terminology in the learning tools, refining the

instructions, and improving the media's visual design to make it more appealing. After all suggestions were acted upon, the media was refined and reused in the next trial phase.

Table 5. Summary of Product Revisions

Validator	Input	Follow-up
Subject Matter Expert	Adjustment of terms and material editorial	The material was revised according to the validator's suggestions.
Subject Matter Expert	Improvement of question instructions	Instructions are clarified for easy understanding
Media Expert	Improved media usage instructions	Instructions for use have been revised and made more systematic.
Media Expert	Media display improvements	Layout and visual design refined

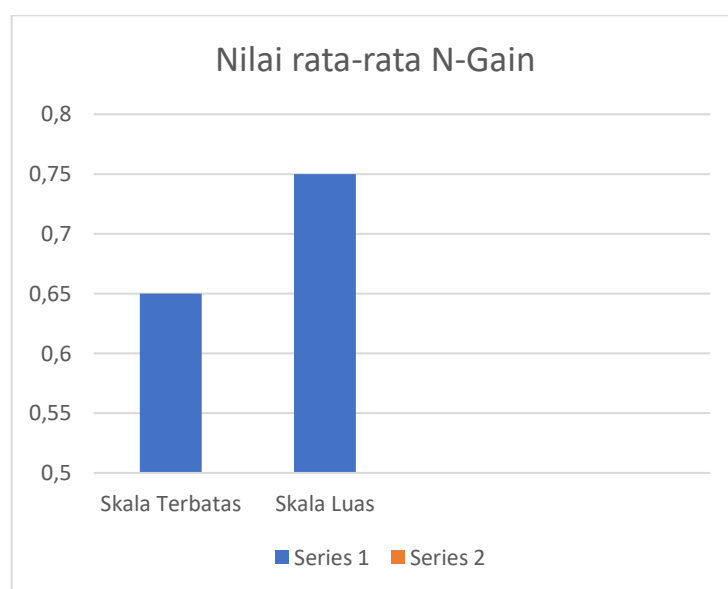


Figure 1. Comparison of Average N-Gain Values

Based on the overall research results, the interactive flannel board learning media met the requirements of validity, practicality, and effectiveness. These findings establish the suitability of the developed product for use in teaching number concepts in first-grade elementary school students.

Discussion

The results of the study indicate that the interactive flannel board media meets the criteria of validity, practicality, and effectiveness in improving the understanding of number concepts in first-grade elementary school students. High media validity indicates that the content, appearance, language, and presentation are in accordance with the learning objectives and characteristics of students. The development process through needs analysis, design, expert validation, revision, and trials contributed to the quality of the resulting product. These findings are in line with Tegeh, Jampel, and Pudjawan (2023) and the Borg and Gall model which emphasizes the importance of validation and revision in producing appropriate educational products. The suitability of the material with learning outcomes, indicators, and

student developmental characteristics is one of the factors supporting the feasibility of the media. According to Retnawati (2023), systematically arranged material helps students build relationships between mathematical concepts. In addition, the visual design of the media that uses concrete components supports the characteristics of students at the concrete operational stage as described by Piaget (1972). These results are supported by Carbonneau, Marley, and Selig (2023) who stated that manipulative media helps connect abstract concepts with real experiences. From a design perspective, Mayer's (2021) multimedia principles also support the use of simple and organized displays to reduce students' cognitive load.

The results of this study align with Rahmawati and Subayani (2024) and Sari et al. (2024) who reported that manipulative media had a high level of feasibility after undergoing expert validation. The difference is that this study not only developed the media but also tested its practicality and effectiveness through direct implementation, thus providing a more comprehensive picture of product quality. The media's practicality was categorized as very high based on teacher and student responses. Teachers assessed the media as easy to prepare and use, thus helping to deliver material more systematically. Students also showed high enthusiasm because they could interact directly with the media components. These findings align with Tegeh and Jampel (2023) who stated that developed products must be not only valid but also practical to use. Research by Nurlaily et al. (2023) also showed that manipulative media can improve teacher-student interaction during learning. This practicality is supported by a constructivist approach. Through activities such as transferring numbers, matching number symbols with the number of objects, and arranging number sequences, students construct knowledge through direct experience. This view is in accordance with Bruner (1966) and is reinforced by Hidayat et al. (2024) that active learning helps students build conceptual understanding in a more meaningful way.

Besides being practical, media has also been proven effective in improving understanding of number concepts. Improved learning outcomes indicate that the use of concrete media makes it easier for students to understand the relationship between number symbols, the number of objects, and number sequences. This finding supports Lafay, Osana, and Levin (2023) who stated that understanding of number concepts develops more optimally through manipulative activities. The results of research by Ahmad and Siller (2024) also show that manipulative media has a positive impact on the development of numeracy skills. These results are consistent with research by Rahmawati and Subayani (2024) and Sari et al. (2024) who stated that concrete media can improve mathematics learning activities and outcomes. The difference is, this study integrates the validation process, practicality testing, and effectiveness testing so that the quality of the media can be assessed comprehensively. The novelty of the research lies in the development of an interactive flannel board specifically

designed for learning number concepts in grade I of elementary school. The media not only functions as a visual aid but also facilitates manipulative activities so that students can build conceptual understanding gradually. This is in accordance with Carbonneau, Marley, and Selig (2023) and Piaget's (1972) and Bruner's (1966) theories regarding the importance of concrete experience before students understand symbolic representations.

Practically, this media can be an alternative for teachers because it uses simple materials, is easy to make, and can be modified according to learning needs. Hidayat et al. (2024) explained that simple media designed according to students' needs can improve the quality of learning. This study still has several limitations. The trial was only conducted in two schools with a limited number of students, so the results cannot be generalized widely. In addition, the media was only developed for number concepts, and its effectiveness has not been tested in the long term. Therefore, future research is recommended to test the media in more schools, develop other mathematics materials, and integrate concrete media with digital technology as recommended by the OECD (2023). Overall, the results of the study show that interactive flannel boards are a feasible, practical, and effective medium to support the learning of number concepts in first-grade elementary school students. These findings provide evidence that the use of manipulative media that is appropriate to the developmental characteristics of students can improve the quality of mathematics learning and is an alternative innovation for elementary school teachers.

Conclusion

This research successfully developed an interactive flannel board learning media designed to improve the understanding of number concepts in first grade elementary school students through a Research and Development approach using the Borg and Gall model. Based on the research results, the developed media has met the eligibility criteria based on the assessment of material experts, media experts, and question experts. In addition, the trial results showed that the media has a very high level of practicality based on the responses of teachers and students and is able to improve students' understanding of number concepts after being used in the learning process. These findings indicate that interactive flannel board media can be an effective alternative learning media in helping students understand abstract mathematical concepts through more concrete, active, and meaningful learning experiences.

This research contributes to the development of mathematics learning media, particularly for number concepts in early elementary school. This contribution is evident not only in the production of learning media that meets the aspects of validity, practicality, and effectiveness, but also in the systematic application of development stages to produce products that are appropriate to the characteristics of students. The findings of this study reinforce the importance of using manipulative media in mathematics learning and provide

empirical evidence that learning involving hands-on activities can help students build a more optimal understanding of concepts.

Practically, the results of this study can be utilized by elementary school teachers as an alternative learning media that is easy to use, interesting, and appropriate to the developmental characteristics of first grade students. The use of interactive flannel boards is expected to support the creation of more interactive learning, increase student participation, and reduce teacher-centered learning. For schools, this media can be used as one of the learning innovations that support improving the quality of the teaching and learning process, especially in mathematics subjects.

However, this study still has several limitations. The media development focused only on number concepts and was implemented in two elementary schools with a limited number of students, so the results cannot be generalized to a broader context. Furthermore, the measurement of media effectiveness was conducted over a relatively short period of time, thus not providing a clear picture of the impact of media use on student learning retention in the long term.

Based on the results and limitations of this study, further research is recommended to develop interactive flannel board media for other mathematics materials, involving a more diverse number of students, and testing the effectiveness of the media over a longer period of time. Future research can also integrate concrete learning media with digital technology to provide a more innovative learning experience and be in line with the development of 21st-century learning. Thus, the development of learning media is expected to continue to contribute to improving the quality of mathematics learning in elementary schools and support the creation of more effective, meaningful, and student-centered learning.

Reference

- Ahmad, S., & Siller, H.-S. (2024). Manipulative media in mathematics education: Enhancing student engagement and academic achievements. *International Journal of Mathematical Education in Science and Technology*, 55(3), 412-428.
- Aini, N., & Amrulloh, MF (2025). Manipulative media as a cognitive bridge in elementary school mathematics learning. *Jurnal Elemen*, 11(1), 89–104.
- Ariella, S., Pratiwi, D., & Lestari, P. (2025). Analysis of learning problems Mathematics in numeracy material in early grades. *Journal of Elementary Education Archipelago*, 10(2), 201–215.
- Azwar, S. (2022). *Compiling a psychological scale* (3rd edition). Yogyakarta: Pustaka Students.
- BERA (British Educational Research Association). (2024). *Ethical guidelines for educational research* (5th ed.). London: British Educational Research Association.
- Borg, W.R., & Gall, M.D. (2003). *Educational research: An introduction* (7th ed.). New York: Longman.

- Bruner, J. S. (1966). *Toward a theory of instruction*. Cambridge, MA: Harvard University Press.
- Carbonneau, K. J., Marley, S. C., & Selig, J. P. (2023). A meta-analysis of the efficacy of teaching mathematics with concrete manipulatives. *Journal of Educational Psychology*, 115(4), 521–538.
- Hidayat, A., Wahyuni, S., & Nugroho, B. (2024). Constructivist approach and implementation of interactive media in 21st century mathematics learning. *Journal of Mathematics Learning Innovation*, 6(1), 45–58.
- Lafay, A., Osana, H. P., & Levin, J. A. (2023). Number concept understanding in early elementary school: Prerequisites for number representation and place value. *Cognitive Development*, 66, 101–118.
- Mayer, R.E. (2021). *Multimedia learning* (3rd ed.). New York: Cambridge University Press.
- Nurlaily, VA, Susanti, R., & Pratama, Y. (2023). Improving the quality of interactions and active learning through concrete manipulative media in elementary schools. *Journal of Elementary School Learning Theory and Practice*, 10(1), 34–46.
- OECD. (2023). *PISA 2022 Assessment and analytical framework*. Paris: OECD Publishing.
- O'Rear, C. D., McNeil, N. M., & Kirkland, P. K. (2023). Concrete object manipulation versus pictorial representations in early numeracy learning. *Early Childhood Research Quarterly*, 64, 112–124.
- Piaget, J. (1972). *The principles of genetic epistemology*. New York: Basic Books.
- Ponte, J.P., Mata-Pereira, J., & Quaresma, M. (2023). Concrete manipulatives and mathematical exploration: Enhancing motivation and active participation in elementary school. *Educational Studies in Mathematics*, 112(2), 289–307.
- Rahmawati, A., & Subayani, H. (2024). The use of flannel board media for improve the understanding of number concepts in early grade elementary school students. *Jurnal Ilmiah Pendidikan Citra Bakti*, 11(1), 123–135.
- Rahmawati, E., Setiawan, A., & Kurniawan, D. (2022). Comparative study of research methods conventional lectures and interactive media on learning activity Students' mathematics. *Journal of Elementary Learning*, 4(3), 312–324.
- Retnawati, H. (2023). *Validity, reliability, and characteristics of instrument items learning*. Yogyakarta: Parama Publishing.
- Riduwan. (2022). *Easy research learning for teacher-employees and novice researchers*. Bandung: Alfabeta.
- Sari, MP, Utami, T., & Wijaya, R. (2024). Development of interactive media based on concrete activities to improve students' understanding of mathematical concepts elementary school. *Basicedu Journal*, 8(2), 1450–1462.
- Siregar, N. (2025). The impact of conventional methods on conceptual understanding Mathematics for early grade elementary school students. *Journal of Mathematics Education And Science*, 13(1), 54–63.
- Sugiyono. (2022). *Research and development methods (Research and Development)*. Bandung: Alfabeta.
- Tegeh, IM, & Jampel, IN (2023). *Development research methods in the field education*. Singaraja: Undiksha Press.
- Tegeh, IM, Jampel, IN, & Pudjawan, K. (2023). *Development research model (R&D) based on formative evaluation*. Singaraja: Undiksha Press.