Vol. 15, No. 02, pp. 995-1010, 2025 DOI: 10.23960/jpp.v15i2.pp995-1010

Jurnal Pendidikan Progresif

e-ISSN: 2550-1313 | p-ISSN: 2087-9849

http://jurnal.fkip.unila.ac.id/index.php/jpp/

Enhancing Biodiversity Learning Outcomes of Fifth-Grade Students through PBL-Integrated Flashcards Media: A Development and Evaluation Study

Laely Ayu Candra Sasqia*, & Barokah Isdaryanti

Department of Elementary School Teacher Education, Universitas Negeri Semarang, Indonesia

*Corresponding email: laelyayucs@students.unnes.ac.id

Received: 17 April 2025 *Accepted: 01 May 2025* *Published: 27 May 2025*

Abstract: Enhancing Biodiversity Learning Outcomes of Fifth-Grade Students through PBL-Integrated Flashcards Media: A Development and Evaluation Study. **Objectives:** This study aims to improve learning outcomes on biodiversity and non-biodiversity material in grade V students using flashcard media development integrated with the Project Learning model. Flashcard media is developed based on biodiversity and non-biodiversity material by the curriculum and by PBL learning steps that encourage student involvement in learning. **Methods:** This research is a type of research and development (R&D) by Borg and Gall. Data was collected using non-test techniques in the form of observation, interviews, needs questionnaires, validation questionnaires, response questionnaires, and test techniques in the form of student learning outcomes tests in the form of pretests and posttests. The data analysis used was qualitative and quantitative. The product development validation test was carried out by material expert validators and media experts. The subjects of this study were students of class V B SD Negeri Wates 01, Semarang City, who were selected by purposive sampling. **Findings:** This study's results showed that the material experts' product feasibility test scored 86.66%, and from media experts scored 95%, including in the "very feasible" category, to be tested. The t-test results (2-tailed) show the sig value. 0.00 <0.05 with an N-Gain score of 0.77, including in the "high" category. There is a significant difference and increase in the average learning outcomes of students before and after using flashcards. **Conclusion:** The use of flashcard media development integrated with the PBL model on biodiversity and non-biodiversity material can improve the learning outcomes of fifth-grade students of SD Negeri Wates 01, Semarang City. This research can be a reference for teachers to innovate and create interesting learning media.

Keywords: learning outcomes**,** flashcard, problem-based learning.

To cite this article:

Sasqia, L. A. C., & Isdaryanti, B. (2025). Enhancing Biodiversity Learning Outcomes of Fifth-Grade Students through PBL-Integrated Flashcards Media: A Development and Evaluation Study. *Jurnal Pendidikan Progresif*, *15*(2), 995-1010. doi: 10.23960/jpp.v15i2.pp995-1010.

INTRODUCTION

IPAS education at the primary school level is important in building students' knowledge and critical thinking skills (Lancrin, 2021). One of the essential materials is biological and non-biological diversity, which is not only important to understand conceptually but also to foster concern for environmental conservation from an early age. Various studies show that students' learning outcomes on this topic are still relatively low, one of which is caused by a less interactive learning model and minimal use of learning media. Students tend to be passive and have difficulty understanding concepts related to biological and non-biological diversity, so innovation is needed, as well as the right learning strategy, to activate

the role of students in learning (Prabha, 2020).

Along with the development of technology in education, various innovative learning media have been developed to improve the quality of learning. Learning media is a tool that can be used to present material, concepts, and procedures more clearly and concretely to improve understanding (Moreira et al., 2018). The development of learning media can help teachers in delivering material in new ways and make it easier for students to understand complex concepts (Yuanta, 2020).

One of the media that has been broadly created is flashcards, to be specific, picture cards that contain brief data and can be adaptively utilized in learning (Ulum et al., 2021). Flashcards are considered viable in making a difference, students get it concepts through visualization and practice. Inquired about by Senzaki et al. (2017) appears that the utilize of flashcards can essentially improve students' retention, understanding, and application of materials. Understudies who utilize flashcards get higher test scores than the control group who don't utilize flashcards. This appears that flashcards are a simple medium that's viable in making a difference to make strides learning results.

In addition to learning media, learning models also play an imperative part in the success of learning. The Problem-Based Learning (PBL) model is an approach that places students as active subjects and encourages them to explore, analyze, and find solutions to problems in everyday life (Navy et al., 2021). Hendry's research (2016) explains that problem-based learning focuses on students to foster independent learning, teamwork in constructing knowledge, and internal motivation. PBL learning syntax is divided into five steps, namely (1) presenting the problem; (2) organizing students; (3) analyzing and discussing; (4) presenting the project; and (5) reviewing and evaluating the learning process. (Hendry et al., 2016).

In this study, step (1) before learning begins, students are given an initial knowledge test using pretest questions, students are then given a problem that needs to be solved by group discussion, the problem is given in the form of a student worksheet with the topic of biological and non-biological diversity; (2) organizing students by randomly dividing students into a discussion group, then the group is asked to solve the problems that have been given; (3) analyze and discuss problems by giving each individual to have an opinion in each group which the results of the discussion are then written in the worksheet; (4) each group presents the results of the group discussion; (5) the teacher and students jointly evaluate the learning outcomes. After the fifth step, students are given post-test questions to find out the final knowledge of the learning outcomes.

Research by Maolida et al. (2024) The topic of biotic and abiotic diversity shows that the integration of problem-based learning models can enhance students' digital literacy and critical thinking skills. Additionally, Sabrina et al. (2024) also demonstrated that the use of the PBL model integrated with education for sustainable development on biodiversity and non-biodiversity topics can significantly enhance students' IPAS literacy.

Several studies have examined the effectiveness of using flashcard media and the PBL model, both separately and in an integrated manner. Sutarmi & Amrullah (2024) developed PBL-based flashcard media for Pancasila Education learning, finding that the flashcard media is highly suitable for use and received positive evaluations from expert validators. Meanwhile, Krajcik et al. (2023) A large-scale experimental study in the United States proved that the application of PBL in elementary school science education has a positive impact on learning outcomes from all backgrounds. Another study by Senzaki et al (2017) An international journal also emphasizes that flashcard media can

enhance understanding and meaningful applicaton of material at various educational levels.

Nevertheless, most previous research still focuses on the cognitive aspects and critical thinking skills of students. Previous research has not specifically examined the development and evaluation of flashcard media integrated with the PBL model on biotic and abiotic material at the elementary school level. Previous research has not comprehensively measured the improvement in learning outcomes through pretest and posttest with in-depth statistical analysis. The lack of studies developing interactive flashcard learning media tailored to the PBL syntax on biodiversity and non-biodiversity materials, as well as the statistical and empirical evaluation of their effectiveness.

The novelty of this study lies in the development of flashcard media that is specifically designed to support PBL syntax in science learning on biodiversity and non-biological materials. Flashcards, as concise and attractive visual media, can be used to introduce basic concepts in a more interactive way (Harisanty et al., 2020). Meanwhile, the problem-based learning model encourages students to think analytically, explore information, and develop solutions to a problem presented (Ali, 2019). The collaboration between flashcards and PBL models creates an active and meaningful learning environment, with flashcards as discussion topics and problems, while the PBL model is a means of problem-solving and discussion. Thus, the combination of these two approaches can support conceptual understanding and develop 21st-century skills such as collaboration, communication, and problem-solving.

The created flashcard media isn't as it were coordinated with the PBL demonstration, but too combines Augmented Reality (AR) within the shape of a QR code. The QR code on the flashcard can be checked using a smartphone camera (Hendriyani et al., 2019). The expansion of AR to flashcards can show a visualization of materials by utilizing innovation. Research by Wulandari et al. (2020) shows that the use of AR on flashcards makes the learning process more enjoyable and interactive. Flashcards integrated with the PBL model can be played in groups by matching cards according to the card series so that students can learn through visual representations that have been adjusted in real life. The use of flashcard media is developed by playing together so that students can actively participate in using flashcards.

The advancement of flashcard learning media coordinates with the PBL demonstrated in science learning on the subject of biodiversity and non-biodiversity is anticipated to significantly improve the learning results of lesson V B students at SD Negeri Wates 01. In this manner, these considerations are used to create and assess the viability of learning media in moving forward student learning results.

METHOD

Participants

The participants in this study were fifth-grade students of SD Negeri Wates 01. The sample was taken using a saturated sampling technique, with all students becoming members of the population as research samples (Flick, 2018). The research participants numbered 28 students, with a small group trial sample of 6 students taken using purposive sampling techniques. Purposive sampling techniques were used in this study to select trial participants who had certain characteristics in accordance with the research objectives (Robinson, 2023). The required characteristics are grade V B students who have basic knowledge of biodiversity and non-biological diversity and actively participate in science learning. The trial sample in the large group amounted to 22 students.

Research Design and Procedures

The type of research used is the Research and Development (R&D) type. Research and

development is an approach used to investigate, design, create, and test the authenticity of products developed by researchers (Sugiyono, 2021). This research uses the Research and Development (R&D) model by Borg and Gall with ten stages of research procedures, including (1) potential and problems; (2) data collection; (3) design product; (4) design validation; (5) revision design; (6) product trials; (7) revision product; (8) trial use; (9) final product revision; (10) mass production (Aka, 2019).

Due to time and budget constraints, out of the 10 stages in the Borg and Gall research and development model, the researcher only carried out 9 stages, namely (1) potential and problem, where the researcher identified the problem through field observations and interviews. The problem regarding the suboptimal use of learning media in IPAS lessons on the topic of biodiversity and non-biodiversity in fifth grade was identified, so the researcher developed a flashcard media integrated with the PBL model on the topic of biodiversity and non-biodiversity called "Flashcard KeHati"; (2) Data collection was conducted by distributing a needs assessment questionnaire for students and teachers in the IPAS learning topic of biodiversity and non-biodiversity. (3) product design includes the design of KeHati Flashcards using the Canva application; (4) design validation is carried out by subject matter experts and media experts; (5) design revisions are made according to feedback from subject matter experts and media experts; (6) small-scale trials are conducted on a predetermined sample. The sample was then given IPAS instruction using the PBL model stages with flashcards and student responses were recorded; (7) product revision based on teacher and student response questionnaires;(8) large-scale product trials are conducted after product revisions, using flashcards for learning, where the teacher presents problems related to the learning topic that students must solve. Students are introduced to the KeHati flashcard media. Students use KeHati flashcards to gather information and discuss in groups. The results of the group discussion are then presented. At the end of the lesson, the teacher and students evaluate the process and outcomes of the learning. (9) the final product revision in the form of the KeHati Flashcard product.

The research was conducted in the even semester of the 2024/2025 academic year. The research period was carried out for seven months, starting from the preparation stage, which focused on identifying problems and preparing proposals; continued to the implementation stage in the form of preparing product designs, validation by material experts and media experts, small-scale trials, and large-scale trials in class V of SD Negeri Wates 01; and continued with the completion stage, namely data analysis and preparation of the final report of the research.

Instruments

Quantitative data were obtained from the results of the assessment of the feasibility of the developed media, as well as the learning outcomes of class V B students of SD Negeri Wates 01 in the science learning of the topic of biodiversity and non-biodiversity through pretest and posttest.

Observations were carried out while learning was taking place, so that data was obtained during the implementation of the learning process. Interviews were conducted with class V B teachers of SD Negeri Wates 01 by asking several questions to obtain information. The needs assessment questionnaire for teachers and students contains several questions and statements aimed at identifying needs, problems, and expectations regarding the learning process and the learning media used. The completion of this questionnaire is done by providing a checklist of the answers that correspond to the respondents' opinions. The teacher and student response questionnaires were given to provide suggestions for the improvement of the developed

product. Documentation is carried out to strengthen the research data.

The feasibility assessment of the media was conducted through a validation questionnaire directed by subject matter experts and media experts. This validation questionnaire contains evaluation columns to assess product development. This type of questionnaire uses a Likert scale that includes the evaluation of product presentation and content within the product. The learning outcomes of the students were obtained from cognitive tests of the pretest and posttest (Malik & Alam, 2019). The pretest and posttest questions used were 25 multiple-choice questions that had been arranged based on indicators of learning objectives of biodiversity and non-biological diversity for grade V students. The pretest and posttest questions had been tested for their validity with the results of the question reliability test of 0.870 using the Cronbach's Alpha formula, included in the high reliability category. The results of the pretest and posttest were analyzed by comparing the results before and after using the KeHati Flashcard media. The results of the pretest and posttest were used to measure the effectiveness of the media in this study (Ramadhani & Izzati, 2023).

Data Analysis

The data analysis used includes initial data analysis and final data analysis. Initial data analysis was carried out using a normality test to determine whether the pretest and posttest scores of students were normally distributed or not. In this test, the Shapiro-Wilk test method is used because this method is more appropriate for smaller sample sizes (<50 samples) (Mishra et al., 2019). Based on the Shapiro-Wilk test, data is normally distributed if the significance value (sig.) or p-value from the conducted test is greater than 0.05 (sig. > 0.05).

The final data analysis involves a t-test used to examine the difference in the average pretest and post-test scores of the students. In this test, the Paired Sample t-test is used to examine the significant difference in means between two paired and related samples using parametric statistics because the data is normally distributed. After conducting the paired t-test, if the calculated t-value d" t-table, then H_0 is accepted. Conversely, if the calculated t-value e" the table t-value, then H_0 is rejected. Then, based on the significance results, if sig < 0.05, then H_0 is rejected. Conversely, if sig> 0.05, then H_0 is accepted (Liu & Wang, 2021). The next final data analysis is the N-Gain test. This test is conducted to determine the average increase in student learning outcomes before and after using the product. The N-Gain value criteria by Sukarelawan (2024). With the details:

Table 1. Interpretation of n-gain value

N-Gain Value	Interpretation
$0.70 \leq g \leq 100$	High
$0.30 \leq g < 0.70$	Medium
$0.00 < g < 0.30$	Low
$g = 0.00$	No increase
$-1.00 \leq g < 0.00$	There was a decrease

■ RESULT AND DISCUSSION

The results of this research and development are in the form of flashcard learning media products integrated with the PBL model in science and social learning on the topic of biodiversity and non-biodiversity. Flashcard media integrated with the PBL model can increase active participation of students and critical thinking, and

make it easier for students to understand and remember the information obtained (Erma et al., 2019).

Potential and Problems

Potential and problem analysis is carried out to identify obstacles during the learning process. Identification of potential problems is carried out through observation, interviews, and documentation as initial research. According to Tidd & Bessant (2018) what needs to be done when analyzing potential and problems is to solve problems by avoiding future issues, and to ask questions to support the collection of data related to the problems. The process of problem identification was carried out at SD Negeri Wates 01, Semarang City. The analysis conducted covers various aspects, including the curriculum, facilities and infrastructure, learning media, teaching models, assessment, and the implementation of the learning process.

Based on the needs analysis, several results were obtained, including the limited availability and innovation of learning media in schools, resulting in suboptimal use of learning media in the teaching and learning process. Most of the learning process only utilizes books as a tool for delivering material in IPAS learning. There is currently no development or provision of game-based learning media. The learning media used are still not very varied, causing students to be less motivated and have difficulty understanding the material presented. This is in line with the research by Gao et al. (2020) which highlights the importance of providing learning media to improve students' learning outcomes.

In addition to the aspect of learning media, the use of learning models also affects the success of learning. Besides the aspect of learning media, the use of learning models also affects the success of learning. Problem-based, project-based, and cooperative learning models are rarely used. The learning methods are dominated by lecture, question and answer, and assignment methods. Students' interest in learning the IPAS subject on the topic of diversity is still low because they find it difficult to follow the lessons, which causes their learning outcomes to still need improvement. Therefore, a new learning model is needed that can support the improvement of learning outcomes, one of which is the use of the Problem-Based Learning model. A study by Karan & Brown (2022) "Enhancing Students' Problem-solving Skills through Project-based Learning" explains that the PBL model can improve critical thinking skills, problem-solving, and learning motivation compared to other models. Most of the potential and existing challenges occur in Class V B SD Negeri Wates 01.

Data Collection

After understanding the potential and all the issues, data collection was continued as the basis for product development planning (Gunasena et al., 2024). The collected data includes an analysis of the needs of teachers and students regarding the use of learning media and the application of learning models, particularly in IPAS education. This needs analysis was conducted through a needs questionnaire distributed and filled out by teachers and students. Based on the results of the needs questionnaire analysis, it is necessary to develop effective, interactive learning media for students that are easy to understand (Feri & Zulherman, 2021). Align with Isdaryanti et al. (2023) Effective learning media should contain contextual material to make it easier for students to understand the material. In addition, learning media needs to be applied in the right way; namely, it can be integrated with problem-based learning models to train students' critical thinking (Anggraeni et al., 2023).

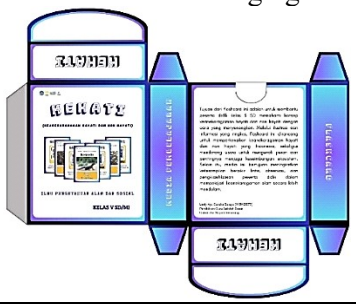
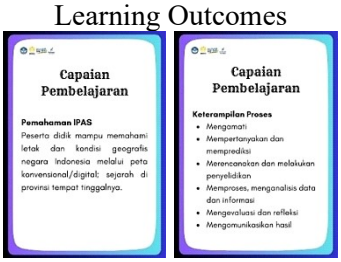
Product Design

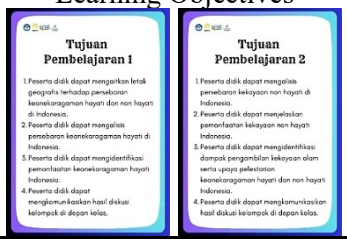
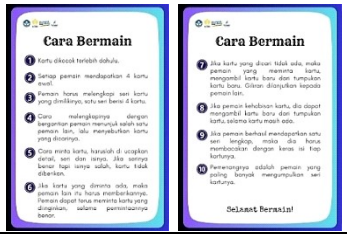
The next stage is designing the product. The product is designed with several considerations, namely the development of material content, image selection, color adjustment, and selection

of writing fonts. The KeHati flashcard media design was created using Canva. Canva is a website design platform that allows users to easily create various types of designs, such as posters, infographics, and presentations, with visually appealing designs (Gehred, 2020).

The content of the material presented in the flashcard media focuses on biodiversity and non-biodiversity, which is arranged according to the learning achievements and learning objectives of science in phase C of class V. The media design is designed to be as attractive and clear as possible to motivate students to learn. The development of KeHati flashcard media combines image objects, colors, and writing that are adjusted to the material. Flashcard media consists of several card components presented in Table 2.

Table 2. Product design

Media Design	Description
Flashcard Packaging 	The packaging of KeHati Flashcard is in the form of a block, with a size adjusted to the cards. The packaging of the KeHati Flashcard uses a combination of bright and dark colors that match the background of the contents of the KeHati Flashcard media. The packaging of Flashcard KeHati contains the logo, media name, examples of Flashcard KeHati, subjects, grade levels, a brief explanation of the Flashcard KeHati media, and the profile of the compiler.
Explanation Card and Component Card 	The KeHati Flashcard Media consists of several sections designed to support learning about biotic and abiotic diversity. The first section contains an explanation of the development of the KeHati Flashcard media, outlining the background and objectives of creating this media.
Profile of the Author 	The profile of the compiler is prepared as information about the party developing the KeHati Flashcard media.
Learning Outcomes 	KeHati flashcards contain learning achievements and learning objectives that have been adjusted to the class level and are expected to be achieved by the students.

Learning Objectives 	
Problem-Based Learning Model Syntax and Concept Map of the Material 	The KeHati Flashcard Media, integrated with the PBL model, contains the Problem-Based Learning (PBL) syntax that explains the stages of problem-based learning. Concept maps are also presented to provide a systematic overview of biotic and abiotic diversity materials..
How to Use the KeHati Flashcard 	To make it more interactive, the way to play is explained to make it easier for students to use the KeHati Flashcard media.
KeHati Flahscard Series Card 	This series of cards is the most important part of the Flashcard KeHati. This is the part that learners use to study. The total number of KeHati flashcards is 48 cards, consisting of 12 series, with each series containing 4 cards that must be collected.
Educative Content 	Students can access educational resources, such as explanations, by scanning the code.

Design Validation

The purpose of design validation is to evaluate the feasibility of the product being developed based on assessments from subject matter experts and media experts. The feasibility testing procedure is carried out by assessing and evaluating the quality of the developed media based on the needs of teachers and students. According to Sugiyono (2021) The assessment is conducted based on the instruments that have been designed, and the results are converted into feasibility categories, namely very feasible (82%-100%), feasible (63%-81%), fairly feasible (44%-62%), and not feasible (25%-43%).

Validation by subject matter experts is carried out to assess the information's accuracy

and the way it is presented in the learning process. By examining the technical and construction components of the generated media design, media experts validate it to determine its applicability (Handayani et al., 2020). The assessment from content experts based on the aspects of content feasibility, presentation feasibility, and contextual evaluation received a percentage of 86.66% with the category "Very Feasible."The validation results by media experts in the aspects of media engineering, visual communication, and learning aspects obtained a percentage of 95% with the category "Very Feasible."Based on the assessment results from material and media experts, the KeHati Flashcard media integrated with the PBL model is very suitable for trial with several revisions according to the suggestions and comments from the experts.

In line with Dewanti's (2024) research titled "Development of Flashcard Media Based on Teams Games Tournament for Civics Education in Elementary Schools," the research results show that material validation received a percentage of 93.3%, media validation 94.6%, and language validation 82%. An average percentage of 95% was obtained with the category "Very Good".Thus, the media is suitable for being tested in the learning process.

Design Revision

Design revisions are carried out to refine the developed product based on suggestions and feedback from experts. Pigai et al. (2024) explain that based on input from expert validators regarding the media feasibility assessment, several recommendations were provided as a reference for further product development. Subject matter experts recommend adding the potential found in the city of Semarang and its surrounding areas as sources of teaching materials for IPAS in the teaching module. Media experts suggest adding a second author's name on the packaging, changing the grade level to the 5th-grade logo, adjusting the packaging size to fit the size and number of flashcards, improving the related institution's logo, and changing the background color of the flashcard elements to differentiate between biotic and abiotic diversity.

Small-Scale Trial Product

The product that has been tested for feasibility by expert validators and has passed the revision results is then trialed on a small scale to assess the effectiveness of the KeHati Flashcard media before being implemented on a larger scale. The use of flashcard media integrated with the PBL model was carried out using the PBL syntax. A small-scale trial was conducted on a sample of 6 students who were selected using a purposive sampling technique. Purposive sampling is a sampling method chosen based on the researcher's judgment (Subedi, 2021).

The effectiveness of the media is measured through the pretest and posttest results of 6 selected students. The data analysis used includes normality tests, t-tests, N-Gain tests, and response questionnaires. The normality test uses the Shapiro-Wilk formula with the SPSS version 23 application. The Shapiro-Wilk formula is used because the number of samples processed is small (Ahadi & Zain, 2023). Based on the results of the normality test, a significance of $0.489 > 0.05$ was obtained in the pretest and a significance of $0.960 > 0.05$ in the posttest, indicating that both data sets are normally distributed. Next, a t-test was conducted, and since the data is normally distributed, a t-test with parametric statistics was performed. In this study, the researcher used the Paired Sample t-test to examine the pretest and post-test results of the students. The results of the t-test show that sig (2-tailed) $0.002 < 0.05$, which means there is a significant difference between the pretest and post-test results. Next, an N-Gain test was conducted to determine the average improvement in the small group. Based on the N-Gain test, the pretest score was initially 51.33 and increased to 85.33 in the posttest, with an average difference of 39.33 and an N-Gain

increase of 0.77, which falls into the high category. This improvement indicates that the use of KeHati Flashcard media is effective in small-scale product trials.

Product Revision

After conducting a small-scale trial, the results showed that the flashcard media integrated with the PBL model was effective in improving science learning outcomes in small group trials (Afandi et al., 2024). Students' interest in using the KeHati Flashcard media. Researchers encountered obstacles in scanning barcodes because a strong and stable internet signal was needed to access the explanatory material contained in the QR code.

Large-Scale Testing

Data obtained from large-scale product trials, including pretest-posttest scores and teacher and student response questionnaires, were analyzed to assess the effectiveness of the developed learning media. The analysis carried out included normality tests, tests for differences in average pretest and posttest scores, N-Gain tests to determine the increase in average pretest and posttest scores, and analysis of teacher and student response questionnaires. Large-scale trials were conducted in class V B SD Negeri Wates 01, Semarang City, with 22 students.

The calculation of the normality of the pretest and posttest questions was carried out using the normality test (Saputro et al., 2020). Due to the limited number of samples, the Shapiro-Wilk test was used to conduct the normality test (Ahadi & Zain, 2023). The normality test was calculated using the Shapiro-Wilk formula, assisted by the 23rd version of the SPSS application.

Based on the Shapiro-Wilk statistical test, the pretest data produced a sig. value of 0.56 > 0.05, and the posttest produced a sig. value of 0.084 > 0.05, indicating that the data are normally distributed. From these results, the parametric statistical method was used to calculate the difference in data means. The test for the difference in means is presented in Table 3 as follows.

Table 3. T-Test

Aspect	Test Type	T-test	Sig. (2-tailed)
Learning Outcomes	Pretest-Post-test	-15.350	0.000

The average difference test was conducted using the Paired Sample T-test. Based on the average difference test in Table 3, it shows that sig (2-tailed) 0.000 < 0.05, which means there is a significant difference between the pretest and posttest results. This indicates a significant difference between the pretest and posttest results that have been conducted. The effectiveness test was also conducted using the N-Gain test. The N-Gain test aims to determine the average improvement in students' learning outcomes. The results of the N-Gain test are presented in Figure 1 as follows.

The N-Gain test on the large-scale product trial was conducted using the SPSS version 23 application. Based on the results of the N-Gain test, an N-Gain score of 0.77 was obtained, which falls into the high category. The N-Gain analysis results show that the fifth-grade students of class V B at SD Negeri Wates 01 experienced an average increase from a pretest average of 47.45 to a posttest average of 88.18, with an average difference of 40.72. The percentage of pretest passers was only 18.18%. However, after using the KeHati Flashcard media, the passing percentage on the posttest increased to 100%. This improvement indicates that the developed media effectively helps students enhance their learning outcomes. The process of large-scale product testing is presented in Figure 2 as follows.

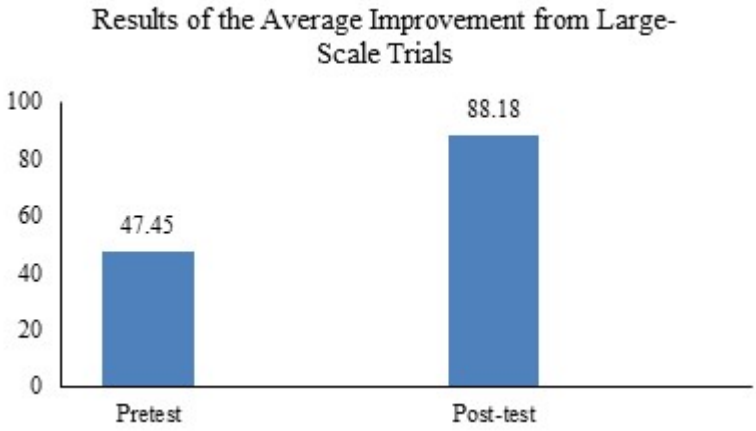


Figure 1. Increase in average large-scale testing

Figure 2. Large-scale product trial

Final Product Revision

The final revision was conducted after a large-scale trial of the KeHati flashcard media based on response questionnaires from teachers and students. The feasibility of media development is also determined by the assessment of teachers and students through response questionnaires. The response questionnaire was given after the learning process using flashcard media integrated with the PBL model on biodiversity and non-biodiversity materials was completed. The results of the teacher response questionnaire are displayed in Table 4 as follows.

The results of the teacher response questionnaire analysis can be concluded that the flashcard media integrated with the PBL model

Table 4. Results of teacher response questionnaire

No.	Indicator	1	2	3	4	5
1.	Material in learning media Flashcard KeHati according to the material in the book.					✓
2.	The material in the KeHati Flashcard learning media is easy for students to understand.					✓
3.	The KeHati Flashcard learning media enhances students' knowledge.					✓
4.	The presentation of the KeHati Flashcard learning media is interesting.					✓
5.	Learning mediaFlashcardKeHati motivates students to learn.					✓

6.	The Flashcard Keanekaragaman KeHati learning media helps students understand the material.	✓
7.	The KeHati Flashcard learning media is easy to use.	✓
8.	The KeHati Flashcard learning media can be studied together.	✓
9.	The KeHati Flashcard learning media makes learning more interesting.	✓
10.	The language used in the KeHati Flashcard learning media is easy to understand.	✓
11.	The shape, model, and size of the font used are simple and easy to read.	✓
12.	The design of the KeHati Flashcard learning media is interesting.	✓
13.	The images used in the Flashcard KeHati learning media are from the material.	✓
14.	The color settings on the KeHati Flashcard learning media are already appropriate..	✓

in IPAS learning on biodiversity and non-biodiversity materials received a 100% evaluation percentage with the criteria "Very Feasible. "However, with input from teachers and students to replace some of the less accurate biodiversity names in one of the card series. The next step is for the researchers to revise according to the suggestions and feedback that have been provided. The final result of the KeHati Flashcard media is presented in Figure 3.

Figure 3. Final product of kehati flashcard

Implementation of the Integrated Flashcard Model PBL

At the initial stage, the teacher presents problems relevant to the student's lives in the form of worksheets containing several issues that need to be solved by the students through group discussions. The problems pertain to the distribution of biotic and abiotic diversity, environmental damage, and conservation methods. In addition, the teacher also introduced

the KeHati flashcard media to the students. Next, the teacher divided the students into small groups to solve the problems presented by the teacher. The teacher distributed a set of flashcards for exploration. The flashcards here aim to help students organize their prior knowledge and design information-seeking strategies. In the stage of guiding the investigation, the teacher acts as a facilitator who ensures that each group finds important information and deepens their understanding of the concept. After the investigation, each group compiles the information that has been received and discussed in the answer sheet provided by the teacher. Each group presents the results of their group discussion. In the final step, the teacher and students jointly reflect on and evaluate the learning process. Flashcards are used to review the initial material and identify misunderstandings.

Another study that integrates learning media with the PBL model is the Augmented Reality media by Maharani (2025) titled "Development of an PBL-Based Augmented Reality Media for Enhanced Social and Natural Science Learning Outcomes in Elementary School Students" The research results show that there was an improvement in student learning outcomes after using the Augmented Reality media integrated with the PBL model, with an N-Gain value of 0.74, which falls into the "High" category.

In addition to Augmented Reality media that can be integrated with the PBL model, Audiovisual media can also collaborate with the PBL model. Research by Irawati et al. (2024) titled "Peningkatan Hasil Belajar IPAS dengan Penerapan Model Pembelajaran Problem Based Learning Berbantuan Audiovisual pada Siswa Kelas IV" shows that in cycle 1, the N-Gain value of student learning outcomes was 0.6 with a "Moderate" category, and in cycle 2, the N-Gain value of learning outcomes increased to 0.8 with a "High" category.

The development of other media, such as comics, was integrated with the PBL model by Safitri (2023) titled "Pengembangan Media Komik Strip Digital Berbasis Problem Based Learning Untuk Meningkatkan Kemampuan Berpikir Kritis IPA," the results of the study showed an N-Gain value of 0.515 with the category "Moderate."

Based on this research, the development of interactive learning media integrated with the problem-based model is feasible and effective for use as a learning media to help students improve learning outcomes.

■ CONCLUSION

Based on the research results of developing integrated flashcard media using the PBL model in fifth-grade IPAS learning on biodiversity and non-biodiversity materials, it is said to be very feasible and effective as a learning medium. This is demonstrated by the feasibility test results from subject matter experts who scored 86.66% and the media experts who scored 95%, both categorized as "Very Feasible."In addition, the effectiveness test was also proven by the t-test results, which showed a sig (2-tailed) value of $0.000 < 0.05$, indicating a significant difference between the pretest and post-test results. In the N-Gain test, the N-Gain value was 0.77, which falls into the "High" category. Based on several tests, the flashcard media integrated with the PBL model in the IPAS learning for 5th grade on biodiversity and non-biodiversity materials can be used as a learning medium.

This research provides one alternative for developing learning media that can significantly enhance students' motivation and learning outcomes. Flashcard media integrated with the PBL model is easily adaptable by teachers to help improve the quality of learning in the classroom. However, this research has limitations, namely that the population and sample used are still limited to one school. The results of this study cannot yet be widely generalized. This research also focuses on the cognitive aspects of students, thus exploring fewer other aspects, such as psychomotor and affective aspects of students.

REFERENCES

Afandi, D. D., Subekti, E. E., & Saputro, S. A. (2024). *Pengaruh model pembelajaran problem based learning terhadap hasil belajar IPAS. Jurnal Inovasi, Evaluasi, Dan Pengembangan Pembelajaran (JIEPP)*, *4*(1), 113–120. https://doi.org/10.51574/kognitif.v3i2.955

Ahadi, G. D., & Zain, N. N. L. E. (2023). *Pemeriksaan uji kenormalan dengan Kolmogorov-Smirnov, Anderson-Darling dan Shapiro-Wilk. Eigen Mathematics Journal*, *6*(1), 11–19. https://doi.org/10.29303/emj.v6i1.131

Aka, K. A. (2019). Integration Borg & Gall (1983) and Lee & Owen (2004) Models as an alternative model of design-based research of interactive multimedia in elementary school. *Journal of Physics: Conference Series*, *1318*(1). https://doi.org/10.1088/1742-6596/1318/1/012022

Ali, S. S. (2019). Problem based learning: a student-centered approach. *English Language Teaching*, *12*(5), 73. https://doi.org/10.5539/elt.v12n5p73

Anggraeni, D. M., Prahani, B. K., Suprapto, N., Shofiyah, N., & Jatmiko, B. (2023). Systematic review of problem based learning research in fostering critical thinking skills. *Thinking Skills and Creativity*, *49*(May), 101334. https://doi.org/10.1016/j.tsc.2023.101334

Dewanti, A., Nurhasanah, N., & Sumantri, M. S. (2024). Development of flashcard media based on teams games tournament for civics education in elementary schools. *22*(August), 87–100.

Erma, E., Koeswanti, H. D., & Giarti, S. (2019). Improving critical thinking skills using problem based learning on the media flash card. *International Journal for Educational and Vocational Studies*, *1*(6), 619–622. https://doi.org/10.29103/ijevs.v1i6.1671

Feri, A., & Zulherman, Z. (2021). *Analisis kebutuhan pengembangan media pembelajaran ipa berbasis nearpod. Jurnal Imiah Pendidikan Dan Pembelajaran*, *5*(3), 418. https://doi.org/10.23887/jipp.v5i3.33127

Flick, U. (2018). The sage handbook of qualitative data collection. SAGE Publications Ltd. https://doi.org/10.4135/9781526416070

Gao, F., Li, L., & Sun, Y. (2020). A systematic review of mobile game-based learning in STEM education. *Educational Technology Research and Development*, *68*(4), 1791–1827. https://doi.org/10.1007/s11423-020-09787-0

Gehred, A. P. (2020). Canva. *Journal of the Medical Library Association*, *108*(2), 338–340. https://doi.org/10.5195/jmla.2020.923

Gunasena, P., Hapuarachchi, T., Ekanayake, U., Rajapaksha, S., Gunawardana, K., Aluthge, P., Alvis, K., & Gunathilake, S. (2024). The crucial role of data collection in research: techniques, challenges, and best practices.

Harisanty, D., Srirahayu, D., Kusumaningtiyas, T., Anugrah, E., & Permata, I. (2020). The Utilization of Flashcards in Children Information Literacy Development. *Library Philosophy and Practice*, *2020*(November), 1–12.

Hendry, G., Wiggins, S., & Anderson, T. (2016). The discursive construction of group cohesion in problem-based learning tutorials. *Psychology Learning and Teaching*, *15*(2), 180–194. https://doi.org/10.1177/1475725716643267

Irawati, R., Sholikah, O., & Wahyuningtyas, S. (2024). *Peningkatan hasil belajar ipas dengan penerapan model pembelajaran problem based learning berbantuan audiovisual pada siswa kelas IV. Jurnal Ulul Albab*, *28*, 49. https://doi.org/10.31764/jua.v28i1.24433

Isdaryanti, B., Ahmadi, F., Nuzulia, S., Wahyuningrum, I. F. S., & Irvan, M. F. (2023). What kind of learning media that lecturers and students want? need analysis on hybrid science learning. *PUPIL: International Journal of Teaching, Education and Learning*, *7*(3), 17–31. https://doi.org/10.20319/pijtel.2023.73.1731

Karan, E., & Brown, L. (2022). Enhancing student's problem-solving skills through project-based learning. *Journal of Problem Based Learning in Higher Education*, *10*(1), 74–87. https://doi.org/10.54337/ojs.jpblhe.v10i1.6887

Krajcik, J., Schneider, B., Miller, E. A., Chen, I. C., Bradford, L., Baker, Q., Bartz, K., Miller, C., Li, T., Codere, S., & Peek-Brown, D. (2023). Assessing the effect of project-based learning on science learning in elementary schools. *American Educational Research Journal*, *60*(1), 70–102. https://doi.org/10.3102/00028312221129247

Lancrin, S. V. (2021). Fostering students' creativity and critical thinking in science education bt - education in the 21st century: stem, creativity and critical thinking (A. Berry, C. Buntting, D. Corrigan, R. Gunstone, & A. Jones (eds.); pp. 29–47). Springer International Publishing. https://doi.org/10.1007/978-3-030-85300-6_3

Liu, Q., & Wang, L. (2021). t-Test and ANOVA for data with ceiling and/or floor effects. *Behavior Research Methods*, *53*(1), 264–277. https://doi.org/10.3758/s13428-020-01407-2

Maharani, D. S. (2025). Jurnal pendidikan progresif development of an pbl-based augmented reality media for enhanced. *15*(01). https://doi.org/10.23960/jpp.v15i1.3

Malik, T. G., & Alam, R. (2019). Comparative analysis between pre-test/post-test model and post-test-only model in achieving the learning outcomes. *Pakistan Journal of Ophthalmology*, *35*(1), 4–8.

Maolida, A. S., Purwianingsih, W., & Rahman, T. (2024). SSI-Integrated PjBL model in biodiversity topics/ : is it effective for increasing students ' digital literacy/ ? *10*(2), 196–209.

Mihas, P. (2019). Qualitative data analysis. Oxford University Press. https://doi.org/10.1093/acrefore/9780190264093.013.1195

Mishra, P., Pandey, C. M., Singh, U., Gupta, A., Sahu, C., & Keshri, A. (2019). Descriptive statistics and normality tests for statistical data. *Annals of Cardiac Anaesthesia*, *22*(1), 67–72. https://doi.org/10.4103/aca.ACA_157_18

Moreira, I. X., Pereira, S., & Gusmão, H. F. (2018). The influence of concrete instructional media on learning archivement. *Journal of Innovative Studies on Character and Education*, *2*(1), 104–114.

Navy, S. L., Jennifer L., M., Randy L., B., & and Kaya, F. (2021). Beginning secondary science teachers' implementation of process skills, inquiry, and problem-based learning during the induction years: a randomised controlled trial. *International Journal of Science Education*, *43*(9), 1483–1503. https://doi.org/10.1080/09500693.2021.1919334

Pigai, F. Y. P., & Yulianto, S. (2024). Development of flipbook learning media to improve learning outcomes IPAS. *Jurnal Penelitian Pendidikan IPA*, *10*(8), 5775–5781. https://doi.org/10.29303/jppipa.v10i8.7937

Prabha, S. (2020). Students' views on difficulties in conceptual understanding of science at secondary stage. *The Eurasia Proceedings of Educational & Social Sciences (EPESS)*, *16*(June), 1–10. https://doi.org/10.13140/RG.2.2.33117.03044

Ramadhani, R., & Izzati, N. (2023). *Keefektifan*

dan kepraktisan modul dasar pemrograman. Journal of Mathematics Education and Science, *6*(1), 47–53. https://doi.org/10.32665/james.v6i1.1142

Robinson, R. S. (2023). Purposive sampling bt - encyclopedia of quality of life and well-being research (F. Maggino (ed.); pp. 5645–5647). Springer international publishing. https://doi.org/10.1007/978-3-031-17299-1_2337

Safitri, Y. E. (2023). *Pengembangan media komik strip digital berbasis problem based learning untuk meningkatkan kemampuan berpikir kritis ipa. Joyful Learning Journal*, *12*(2), 92–98. https://doi.org/10.15294/jlj.v12i2.73776

Saputro, N. V., Masturi, & Supriyadi. (2020). The effectiveness of instructional media based on lectora inspire towards student's achievement. *Journal of Physics: Conference Series*, *1567*(2). https://doi.org/10.1088/1742-6596/1567/2/022063

Senzaki, S., Hackathorn, J., Appleby, D. C., & Gurung, R. A. R. (2017). Reinventing flashcards to increase student learning. *Psychology Learning and Teaching*, *16*(3), 353–368. https://doi.org/10.1177/1475725717719771

Shabrina, A., Suhartini, S., & Huang, T. C. (2024). Problem-based learning tool integrated with education for sustainable development on biodiversity topic to improve science literacy. *Jurnal Pendidikan Sains Indonesia*, *12*(2), 338–353. https://doi.org/10.24815/jpsi.v12i2.36218

Subedi, K. R. (2021). Determining the sample in qualitative research. *Scholars' Journal*, *4*(December), 1–13. https://doi.org/10.3126/scholars.v4i1.42457

Sugiyono. (2021). *Metode penelitian kuantitatif, kualitatif dan R&D*. ALFABETA.

Sukarelawan, M. I., Indratno, T. K., & Ayu, S. M. (2024). *N-Gain vs Stacking*.

Sutrami, K. F., & Amrullah, M. (2024). *Pengembangan media pembelajaran flashcard berbasis pbl (problem based learning) pada pembelajaran pendidikan pancasila. Dharmas Education Journal (DE_Journal)*, *4*(1 SE-Articles), 97–107. https://doi.org/10.56667/dejournal.v4i1.922

Tidd, J., & Bessant, J. (2018). Potential problem analysis. In *Innovation Portal* (Issue June, p. 2).

Ulum, M. S., Yafie, E., Putri Wahyuningtyas, D., & Rofiki, I. (2021). Improving linguistic intelligence through graphic introduction with flashcard media for early childhood. *International Journal of Computational Intelligence in Control*, *13*(2), 79–87.

Waruwu, M. (2024). *Metode penelitian dan pengembangan (r&d): konsep, jenis, tahapan dan kelebihan. Jurnal Ilmiah Profesi Pendidikan*, *9*(2), 1220–1230. https://doi.org/10.29303/jipp.v9i2.2141

Wulandari, R. A., Hafidah, R., & Pudyaningtyas, A. R. (2020). The effect of augmented reality (AR) flashcard on early literacy of early childhood. *Proceedings of the 4th International Conference on Learning Innovation and Quality Education*. https://doi.org/10.1145/3452144.3452246

Yuanta, F. (2020). *Pengembangan media video pembelajaran ilmu pengetahuan sosial pada siswa sekolah dasar. Trapsila: Jurnal Pendidikan Dasar*, *1*(02), 91. https://doi.org/10.30742/tpd.v1i02.816