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Development of Problem-Based Learning Based Flipbook Teaching Materials to Improve Understanding of IPAS in Grade V Elementary School Students

Garsela Syakila Widyatama[1*], Desi Wulandari[1]

[1]Elementary School Teacher Education, Universitas Negeri Semarang, Semarang, Indonesia.

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Corresponding Author:
Garsela Syakila Widyatama
selagarsela@gmail.com

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Abstract: This research aims to research and develop (R&D) flipbook teaching materials based on the problem-based learning model for Class V Light materials. The development model used is Borg and Gall. Data were obtained by test and non-test methods. The test method is derived from the results of the pretest and posttest, while the non-test method is derived from the results of questionnaires, data, observations, interviews, and documents. The subject of the trial is a student of class V. In this research, media validators gave an average percentage of 90% product validation assessments, while material validators gave an average percentage of 93.33%. Both categories are considered very feasible. Both the pretest and posttest results for the student indicate progress. This is demonstrated by the 42.43 average difference between the pretest and posttest as well as a high N-Gain of 0.8106. Since the obtained N-Gain is greater than 0.70, it is regarded as high. From the improvement in student learning outcomes, it can be concluded that the use of flipbook teaching materials in class V light materials can improve student understanding.

Keywords: Flipbook; Problem based learning model; Understanding of IPAS

Introduction

Education is an educational activity carried out by a teacher to students, it is expected that adults in children to be able to provide examples, learning, direction, and improvement of ethics and morals, as well as explore the knowledge of each individual. In the National Education System Law Number 20 of 2003 article 1 paragraph 1 states that education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble morals, and skills needed by themselves, society, nation, and state (SISDIKNAS, 2003). Education is also a long-term investment in human resources that has strategic value for the survival of human civilization in the world (Yuliasari, 2017). With this education, human beings develop themselves so that they are able to face every change that occurs due to the advancement of science and technology (Putra & Ruli, 2016). Therefore, education is one of the important capitals to advance a nation because the welfare and progress of a nation can be seen from the level of education. Education plays an important role in creating quality individuals (Widyawati, 2016). In the world of education, there is a curriculum that functions as a guideline in the teaching-learning process. The curriculum plays a role in regulating educational objectives, learning materials, teaching methods, and evaluation of learning outcomes in order to achieve the

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expected competencies. In Indonesia, various curricula have been implemented along with the development of the times and educational needs. Some of them are the 1975 Curriculum, the 1984 Curriculum, the 1994 Curriculum, the 2004 Competency-Based Curriculum (KBK), the 2006 Education Unit Level Curriculum (KTSP), the 2013 Curriculum, and most recently the Independent Curriculum.

The Natural Sciences (IPA) and Social Sciences (IPS) courses are merged into Natural and Social Sciences (IPAS) subjects in the Independent Curriculum with the hopes of enabling kids to manage the social and natural environments as a single entity. Science learning is process- and outcome-oriented learning (Afandi et al., 2019). Elementary school science instruction aims to develop students' knowledge competencies, scientific abilities, and scientific attitudes as daily behaviors in interacting with the environment, society, and technology (Fakhriyah et al., 2017). The challenge identified by the field data mining process is that, despite the urgency of education in the twenty-first century, teachers generally continue to use traditional teaching methods with printed teaching materials. This clearly does not maximize the provision of information and does not encourage students to use technology to acquire knowledge in the best possible way. In line with this remark, Sousa & Rocha (2019) claimed that digital learning as the delivery of learning through the use of technology to boost the efficacy of students' knowledge and abilities must be implemented to satisfy the expectations of 21st century education. In line with the potential use of technology in the learning process, teachers are required to be able to integrate technology in teaching and replace their traditional methods with more modern tools and facilities (Singh, 2016).

Following observations by researchers at SD Negeri Wonosari 03, it was found that problems occurred during the IPAS learning process. In particular, two students needed special help from the homeroom teacher because they were late in understanding the teacher's material. Another problem is the use of exclusively printed teaching materials, which leads to the observation that many students in class V seem disinterested, daydreaming, and chatting to themselves while the teacher instructs them to read the material. Naturally, this will have an impact on students' understanding of the course material and learning objectives. Data on the learning outcomes of grade V students in the IPAS semester 1 subject provide credence to this issue. For the 2023–2024 academic year, there will be 28 pupils in grade V at SD Negeri Wonosari 03, Semarang City, consisting of 17 male and 11 female students. In the IPAS content of the Light material, most students obtained grades below the KKTP. Of the 28 students, 16 students (57.14%) have not met the criteria for achieving learning objectives (KKTP) and 12 students (42.86%) have met the KKTP, for the KKTP is 70.

The following is a diagram of the completeness of the learning outcomes of the IPAS content of Light Class V of SD Negeri Wonosari 03, Semarang City.

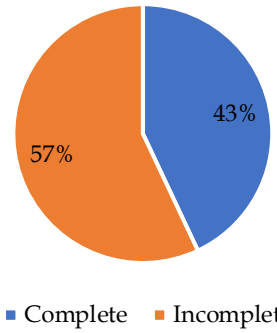

Figure 1. Percentage of the Completeness of Learning Outcomes of Class V Students of SD Negeri Wonosari 03

The researcher developed a problem-based learning flipbook teaching resource for the IPAS curriculum in class V at SD Negeri Wonosari 03 in order to address these issues and optimize learning. According to grammar, a flipbook is a flipping book (Ristanto et al., 2020). According to Ghavifekr & Rosdy (2015), the name "flipbook" refers to children's toys that have a number of different images that, when opened one by one from the page, give the impression that the picture is moving. Flipbooks, on the other hand, are described in this study as technology-based online books that are flexible, available anywhere, and accessible at any time for both teachers and students. It is anticipated that using flipbooks as a solution will be able to make learning more creative and less repetitive than learning that solely relies on printed instructional materials.

The flipbook teaching materials are presented in an engaging way, it helps increase students' drive to learn. In addition to written content, instructional materials are also supported by images, videos, and interactive game-based quizzes, which can help students learn. Not only helping students learn, the application of the syntax of the problem-based learning model in flipbook teaching materials will also invite students to think critically and solve problems related to light phenomena in daily life. In line with this statement, according to Safithri et al. (2021), the problems presented in the learning process reflect the real problems faced in daily life. According to Mirdad (2020), problem-based learning is a learning method that uses problems as the first step in collecting and integrating new knowledge. The application of this model provides flexibility for students to implement their experiences to solve problems in order to be able to

influence learning outcomes (Bosica et al., 2021). The learning steps using the PBL model according to Arends in Mudlofir (2021) include: Orienting students to problems; Organizing students to learn; Guiding individual or group research; Develop and present the work. Light material from Chapter 1 of the IPAS curriculum is the subject of this investigation. The fact that many students have not been able to learn from this light content is the basis for its selection.

The infrastructure and facilities at SD Negeri Wonosari 03 also support the choice of flipbook teaching materials as a means of resolving issues with social studies instruction in class V. The availability of Liquid Crystal Display (LCD) projectors in every classroom is one of the supporting infrastructural facilities.

A study by Sari & Atmojo (2021) lends credence to this research. The results of the study show that teachers usually make use of printed teaching materials that students may already access. The results of the survey also demonstrate that educators perceive flipbooks as a means of improving the usability of digital instructional resources. It is anticipated that the study's conclusions will serve as the foundation for educators' ideas as they develop and implement flipbook-based digital teaching materials to aid students in their learning.

This research is further supported by Pakpahan et al. (2022) with an average score of 96% on the practicality test and the student response questionnaire, the e-module was deemed very practical according to the data analysis results. It was also deemed very valid according to the validation questionnaire sheet of experts, particularly media experts, material experts, and linguists, with an average validity value of 98%. These findings demonstrate that the e-module product can be utilized with earth and universe-related content in SDN Sukakarya Musi Rawas' sixth-grade science curriculum.

The researcher is interested in conducting research under the title "Development of Flipbook Teaching Materials Based on Problem Based Learning Model to Improve Understanding of Science Materials in Grade V Students of SD Negeri Wonosari 03 Semarang City" because of the background description she provided. The researcher developed a digital flipbook teaching resource based on problem-based learning with the intention of enhancing students' comprehension of IPAS content in order to improve student learning outcomes.

Method

Research and development (R&D) research is the method used in this research to create and verify teaching materials (Setyosari, 2015). According to Sukmadinata (2016), development research is a step in the process of creating new products or improving existing products. This study uses quantitative data as the data type. Testing and non-testing methods are used to collect data. While the non-test method is collected through questionnaires, data, observations, interviews, and documents, the test method is derived from the student's pretest and posttest results.

The development model that will be used is the Borg and Gall model. There are ten steps in Borg and Gall's paradigm (Sugiyono, 2015): potentials and issues; gathering data and information; designing a product; validating the design; revising the design; testing the product; revising the product; using it experimentally; revising the product; and manufacturing the product in large quantities. The development model is described as follows.

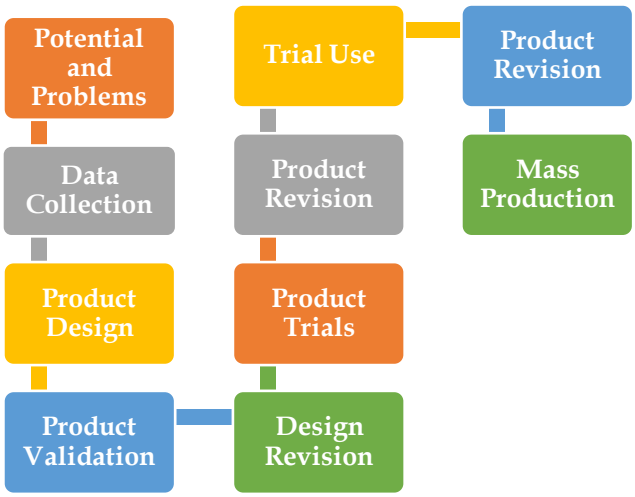

Figure 2. Development of Borg and Gall

Based on Figure 2, the first stage is a potential and problem, the potential and problems in this study include, some students look bored in learning, the use of teaching materials is less varied, and most students have not met the KKTP in the Light material.

The next stage is data collection, at this stage the researcher will conduct class observations, interviews with classroom teachers, and share the needs of teachers and students regarding the teaching materials needed. After data collection, the next stage is product design. At this stage, the researcher designs the product based on the results of the analysis of the needs of teachers and students that have been collected.

The flipbook teaching materials that have been designed are then carried out product validation tests. Validation of the design of the product being developed is carried out by comparing it with experts or specialists who have experience in their field to provide an assessment of the product developed by the researcher. Each expert will be asked to assess the project so that the advantages and disadvantages of the developed product

can be known. Product validation is carried out by two experts, namely media experts and material experts. Before the product is used in education, validators are also given a questionnaire to fill out to confirm its viability. To test the feasibility of the media, a formula is used according to Purwanto (2018). Kustandi & Darmawan (2020) state that the following grid of evaluation instruments is appropriate for media and material specialists.

Table 1. Media expert assessment instrument grid

Aspects	Item Number
Learning	1, 2, 3, 4
Presentation Eligibility	5, 6, 7
Interactivity	8, 9, 10
Display and Media	11, 12, 13, 14, 15, 16
Language	17, 18
Media	19, 20

Table 2. Grid of subject matter assessment instruments

Aspects	Item Number
Learning	1, 2, 3, 4, 5, 6
Language	7, 8, 9
Contents	10, 11, 12, 13, 14, 15

Table 3. Validator rating scale

Alternative Answers		Score
Very Good	(SB)	4
Good	(B)	3
Enough	(C)	2
Less	(K)	1

The results of the percentage of feasibility data are then interpreted into certain criteria by determining the interval distance (Ji) (Widyoko, 2016).

Table 4. Product eligibility criteria

Percentage (%)	Criteria
82 – 100	Very Feasible
63 – 81	Feasible
44 – 62	Enough Feasible
25 – 43	Not Feasible

After the product is developed, it is tested for feasibility by media experts and material experts. Next is to revise the design and revision of the existing material in the flipbook teaching materials based on the problem based learning model according to the suggestions of media experts and material experts, as well as conducting test questions. The test questions were carried out on grade VI students with a total of 50 questions. Furthermore, the questions are tested for validity. The validity test of the instrument in this study used the biserial point correlation formula (Arikunto, 2013). The following are the results of the validity test of the questions that have been tested.

Based on Table 5, the researcher selected 25 of the 26 valid items in Table 5 as pretest and posttest questions. The next stage is the trial use of flipbook teaching material products. In this first trial use, the researcher used a small group with a total of 6 test subjects of class V B students. At this stage, students and classroom teachers were also given a response questionnaire regarding flipbook teaching materials.

Table 5. Results of validity of question trials

Criteria	Question Number	Sum
Valid	1, 3, 5, 6, 7, 9, 10, 12, 13, 16, 19, 24, 25, 27, 28, 29, 30, 31, 32, 35, 36, 39, 42, 43, 46, 47	26
Invalid	2, 4, 8, 11, 14, 15, 17, 18, 20, 21, 22, 23, 26, 33, 34, 37, 38, 40, 41, 44, 45, 48, 49, 50	24

After the product trial, the next stage is to revise based on the results of the questionnaire of teacher and student responses regarding the flipbook teaching materials that have been developed. Products that have been repaired and considered feasible, then a trial use can be carried out. The trial of the use of the product in this study involved a large group with a number of students as subjects as many as 28 children from class V A. At this stage, students will work on pretest and posttest questions, and in the implementation teachers and students are also distributed response questionnaires regarding the flipbook teaching materials that have been developed. Product revisions are carried out again if necessary, based on the questionnaire. If there are no revisions, then product development can be continued at the last stage, namely mass production.

After carrying out all stages of development, the researcher will conduct an N-Gain test based on the results of the pretest and posttest that have been obtained. This N-Gain test is used to determine the effectiveness of the product that has been developed. The N-Gain test is also carried out to ensure the difference in student learning outcomes between the pretest and posttest. The following is the formula for N-Gain.

$$N_{Gain} = \frac{\text{Posttesst Score} - \text{Pretest Score}}{\text{SMI} - \text{Pretest}} \quad (1)$$

Furthermore, in accordance with Lestari & Yudhanegara (2017), the N-Gain obtained is changed to the following criteria for interpretation of the gain index.

Table 6. Interpretation criteria for the gain index

N-Gain Value	Criteria
N-Gain ≥ 0.70	High
0.30 < N-Gain < 0.70	Medium

N-Gain Value	Criteria
N-Gain ≤ 0.30	Low

Result and Discussion

Flipbook Development Process Based on Problem Based Learning Model (PBL)

The goal of this development research is to create products. The study's output is a flipbook for SD/MI grade V pupils that uses problem-based learning techniques. Because flipbooks include motion animations, movies, audio, and other materials, flipbooks can be used as an interactive learning tool to make learning more interesting and not repetitive (Wibowo & Pratiwi, 2018). The learning approach with problem-based learning flipbook teaching materials provides relevant experiences to students in addition to conveying theory. According to Duch in Shoimin (2017) Problem Based Learning is a teaching model characterized by real problems as a context for students to learn critical thinking and problem-solving skills and acquire knowledge. Meanwhile, the Problem Based Learning model according to Torp in Setyo et al. 2020) states that Problem Based Learning is a learning model whose focus is on its implementation to bridge students to gain learning experience in organizing, researching and solving complex life problems. A problem-based learning strategy can be implemented on flipbooks to make learning activities more interesting and motivate students to actively engage in the process of learning by letting them answer issues (Misla & Mawardipro, 2020). In line with this statement, according to Afriana et al. (2020), learning using the Problem Based Learning model can attract and motivate students, help understand topics, and foster creativity.

Potential and Problems

Problems are used as research and development (R&D) opportunities, which is why research is conducted. The pre-research findings reveal a number of issues, including student learning outcomes, less varied learning tools, and students who are not focused on their studies. Given the wide range of media available, educators must make an effort to select them carefully so they may use them efficiently (Kustandi & Darmawan, 2020). The information on the learning outcomes of grade V students in the IPAS semester 1 of the Light material further supports the issues that have been raised. Of the 28 students, 16 students (57.14%) have not met the criteria for achieving learning objectives (KKTP) and 12 students (42.86%) have met the KKTP.

The researcher decided to create flipbook teaching materials based on problem-based learning as a solution to the issues raised. The selection of this product is supported by the facilities and infrastructure available at SD Negeri Wonosari 03 such as LCD and Wifi.

Data Collection

The initial step in gathering data is distributing surveys regarding the requirements of educators and learners in their chosen learning materials. The findings of gathering information on teacher needs have shown that there are not many learning resources available. Schools do not have adequate instructional materials to meet their material needs. Teachers require additional learning resources so that students may comprehend Light subjects more thoroughly. Learning resources should be developed as captivating instructional materials that make use of color and imagery in order to boost students' interest in learning. Teachers need flipbook electronic teaching tools, which are non-print resources that can be viewed on laptops and smartphones. According to Nakajima & Goode (2019), Flipbooks (e-books) are more interesting than printed books because they contain hypermedia elements such as animation, music, and videos. Teachers also concur that the way instructional materials are presented is informed by the problem-based learning model.

Meanwhile, based on the results of the data collection on student needs, it was recognized that certain students struggled to understand the content of light. Students need engaging instructional resources. Students agree that instructional resources can be viewed as flipbooks on computers and smartphones. To encourage children to learn, the content in the teaching material should be presented with pictures and colors. Along with the content, there are interactive quizzes and video games to help students understand it better.

Product Design

Data collecting is followed by product design. The final product at this stage is flipbook teaching materials built on a light material problem-based learning methodology. The educational resources created are ones that both teachers and students can access on their own. Thus, flipbooks can be used as a teacher's handbook. Teachers' handbooks have a function in motivating, developing creations, and recognizing potential in learning to students (Asrizal et al., 2017). Flipbook teaching materials are incredibly adaptable online resources that are available on computers, laptops, mobile phones (HPs), and other devices at any time and from any location. To meet educational expectations in the twenty-first century, Sousa & Rocha (2019) state that digital learning—defined as the delivery of education through the use of technology to increase students' knowledge and skills—must be introduced.

Learning objectives and outcomes are considered when creating flipbook teaching materials. The flipbook's instructional materials are also designed with additional visual components, such as interactive game-based quizzes, learning movies, online LKPDs, and graphics. According to Hamdani (2011), the elements in the teaching materials include: learning instructions, competencies that will be achieved by students, material content, supporting information, practice questions, work instructions, evaluation, and responses to evaluation results. The first stage in creating resources based on problem-based learning approaches is creating flipbook instructional materials using Canva. After the completion of the flipbook instructional material design process, the design should be saved as a PDF file. To create a flipbook, the saved flipbook teaching material file is then entered into the Heyzine website. Modify the previously inserted flipbook by adding movies and educational links to allow direct access to the links. The next step is to copy the link and save the flipbook's instructional materials so that teachers and students can access them.

Figure 3. Design flipbook teaching materials in Canva

Figure 4. Save flipbook teaching materials in PDF file

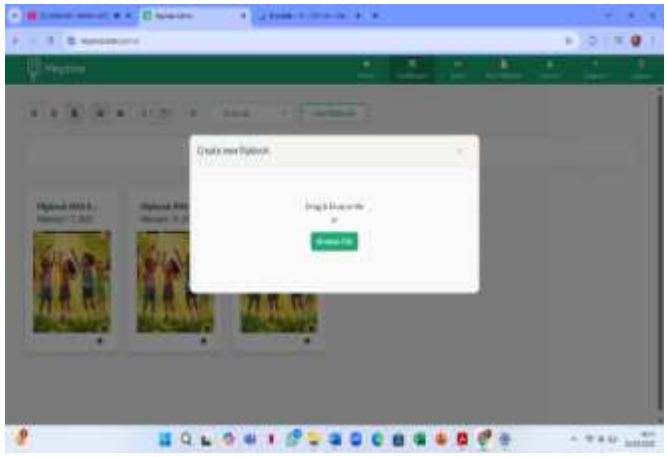

Figure 5. PDF file input on Heyzine

Figure 6. Edit flipbook on Heyzine

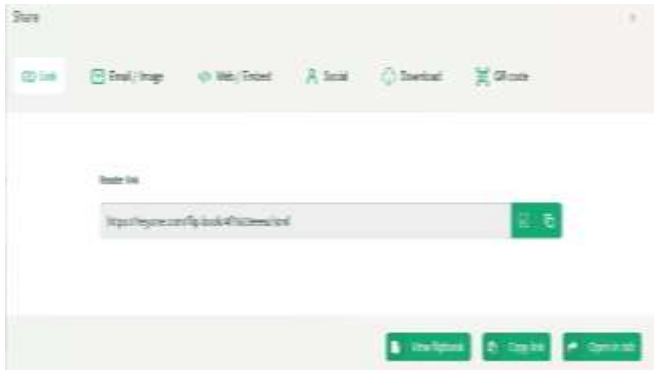

Figure 7. Save and copy flipbook link

Validation of the Feasibility of Flipbook Teaching Material Design Based on Problem Based Learning Light Materials Product Design Validation

Validating the product design is the next stage. The expert chosen to act as a validator will fill out a questionnaire used in the validation process. Product evaluation is carried out with the help of knowledgeable and skilled professionals to determine the strengths and disadvantages of a product (Sugiyono, 2015). This phase is also important to determine whether or not the

educational resources and media created can be used in the classroom. Two media specialists and material specialists participated in this study's product validation. Below is a summary of the results of media and material specialists' validation of flipbook teaching materials.

Table 7. Recapitulation of media expert assessment results

Aspects	Percentage (%)	Criteria
Learning	9375	Very Feasible
Presentation Eligibility	91.66	Very Feasible
Interactivity	83.33	Very Feasible
Display and Media	91.66	Very Feasible
Language	87.5	Very Feasible
Media	87.5	Very Feasible
Sum	90	Very Feasible

In Table 7, it can be concluded that the average overall validation results of media experts are 90% with a very feasible category. Validity results with similar categories were also found in previous research by Khairunnisa & Wulandari (2025).

Table 8. Recapitulation of material expert assessment results

Aspects	Percentage (%)	Criteria
Learning	91.66	Very Feasible
Presentation	100	Very Feasible
Eligibility	91.66	Very Feasible
Sum	93.33	Very Feasible

In Table 8, it can be concluded that the average overall validation results of media experts are 93.33% with a very feasible category.

So that in both tables, namely Tables 7 and 8 it can be concluded that flipbook teaching materials based on the problem based learning model are very feasible to be used in learning IPAS of light material, this is because in both tables it shows an average result of more than 82%. Research by Pakpahan et al. (2022) is consistent with this. The data analysis results indicated that the e-modules developed fell into the category of very valid based on the validation questionnaire sheets of professionals, particularly media experts, material experts, and linguists, with an average validity score of 98%. Other research with the title "Development of Flipbook Teaching Materials for Energy Benefits in Grade IV in Elementary Schools" by Martatiyana et al. (2022). With an average percentage of 91.90% based on the overall average value of validation results from material, media, and language professionals, data analysis showed that flipbook instructional materials are very appropriate for use.

Design Revision

Teaching materials in the form of a flipbook based on the problem-based learning model that have been assessed by validators will subsequently be improved based on feedback from media and content validators. Table 9 displays the presentation of enhancement suggestions made by media and material specialists.

Table 9. Suggestions for improvement from validators

Expert	Suggestion
Media	Add a developer profile, namely the profile of the supervisor.
Material	Adjustment of learning activity scenarios, learning objectives, cognitive level of test questions; The PBL syntax is brought to the developed teaching materials, the addition of stimulus, oriented problems and work areas as well as LKPD in the developed teaching materials.

Figure 8. Addition of supervisor profile

(a) (b)

Figure 9. CP and TP adjustments: (a) Before revision, (b) After revision

Figure 10. Flipbook before implementing PBL syntax

Figure 11. Flipbook after implementing PBL syntax

Figure 12. No stimulus

Figure 13. With stimulus

Product Trials

Following evaluation by media and materials experts, the researcher modified the flipbook teaching materials using problem-based learning. Next step, researchers conducted small-scale product trials. Six students of SD Negeri Wonosari 03 class V B participated in this small-scale experiment. To verify the effectiveness of problem-based learning, small-scale product trials are conducted prior to large-scale testing. Flipbook instructional resources. Pretest and posttest scores reveal the results of small-scale experiments. The following test results show the efficacy of using this flipbook teaching resource on a simple scale.

Table 10. Pretest and posttest results in small scale tests

Test Type	Average	Average Difference
Pretest	59.33	35.33
Posttest	94.66	

The data in Table 10 showed a substantial difference between the pretest results, which had an average score of 59.33, and the posttest findings, which had an average score of 94.66. This accomplishment demonstrates an increase in the comprehensiveness of students' learning. For the usage of flipbook instructional materials to be deemed effective. The N-Gain test is performed by comparing the differences between SMI and pretest to determine the criteria for the average improvement of the pretest and posttest. The following are the outcomes of a small-scale N-Gain test.

Table 11. Large-scale N-Gain test results

Average Difference	N-Gain	Criteria
35.33	0.8743	High

The results of the analysis of the small-scale N-Gain test indicate that students' comprehension of the material covered in Light for the IPA V A SD Wonosari Negeri 03 class has improved, as seen in table 11. Using problem-based learning flipbook teaching materials with six students yielded an N-Gain score of 0.8743, falling into the high group.

The researcher also gave feedback questionnaires to teachers and students about flipbook teaching materials based on problem-based learning when small-scale exams were being implemented. 17 questions with two possible "yes" or "no" answers form the assessment tool. Options yes have a score of 1, while options do not have a score of 0. Four criteria were used to analyze the answers from students and teachers: 82–100% (Very Feasible), 63–81% (Feasible), 44–62% (Enough Feasible), and 25–43% (Not Feasible). The results of instructor and student reactions to small-scale tests on flipbook teaching materials are summarized here.

Table 12. Results of teacher and student responses to small-scale tests on flipbook teaching materials based on problem based learning model

Respondents	Percentage (%)	Criteria
Teacher	100%	Very Feasible
Student	100%	

Based on the results of the teacher and student response questionnaire in Table 12, it can be said that flipbook teaching materials based on problem-based learning are appropriate for use in teaching light material science. This is indicated by the fact that each item on the questionnaire generates a single score, so it is quite possible to achieve a maximum score with a category percentage of 100%. According to Abdullah et al. (2024) and Wulandari & Wulandari (2025).

Figure 14. Small-scale product trials

Product Revision

The next stage is to revise the product based on the comments obtained from teachers and students using flipbook teaching resources that focus on problem-based learning. Researchers found that there were some errors in the wording even if the findings were perfect. The author must thus rectify all terms that are still misspelled in accordance with the General Guidelines for Indonesian Spelling (PUEBI).

The Effectiveness of Trial Use of Flipbook Teaching Materials Based on the Problem Based Learning Model (PBL)

Trial Use

After a small group trial with six students from class V B, a large group trial with twenty-eight students from class V A was conducted. At this point, students use flipbook materials to study after working on the pretest questions. Students will then complete the post-exam questions at the end of the class to determine how their learning has changed as a result of the use of flipbook teaching materials. The effectiveness of flipbook teaching materials based on problem-based learning was evaluated by comparing the pretest and posttest outcomes. The results of a large group experiment reveal how students' comprehension of IPAS is impacted by the usage of problem-based learning resources.

Table 13. Pretest and posttest results on large-scale tests

Test Type	Average	Average Difference
Pretest	48.71	42.43
Posttest	91.14	

The use of problem-based learning flipbook teaching resources in scientific education shows significant progress, as shown by the learning results of students in grade V A SD Wonosari 03 in Table 13. The average results of the pretest and posttest demonstrate the difference in student learning outcomes before and after using flipbook instructional materials. in line with previous research conducted by Saktilia & Wulandari (2024) that the average difference is 28 in large-scale product trials. This statement is also supported by Hidayatullah & Rakhmawati (2016), who note that flipbooks have proven to raise students' interest and comprehension of the material, which enhances learning outcomes. The N-Gain test is performed by comparing the differences between SMI and pretest to determine the criteria for the average improvement of the pretest and posttest. In large-scale tests, the N-Gain test yields the following results.

Table 14. Large-scale N-Gain test results

Average Difference	N-Gain	Criteria
42.43	0.8106	High

According to Table 14, the findings of the large-scale N-Gain test analysis show that students' understanding of Light material in science class V A SD Wonosari Negeri 03 has increased. Using problem-based learning flipbook teaching materials with 28 students yielded an N-Gain score of 0.8106, falling into the high group. Thus, it can be concluded that utilizing problem-based learning flipbook teaching materials to enhance the IPAS light materials learning process is highly advantageous.

In addition to conducting the N-Gain test, teachers and students of grade V A SD Wonosari 03 during the large-scale test also provided feedback on the efficacy and success of problem-based learning flipbook teaching materials in helping the science learning process. A summary of the findings from teacher and student responses is provided below.

Table 15 shows that instructional materials are well received and appropriate for use in the teaching of light science. This is indicated by the fact that each item on the questionnaire generates a single score, so it is achieving a maximum score with a category percentage of 100%. Other research that supports this research is Santi et al. (2023). The student response questionnaire's practicality falls into the very practical category with an average score of 83.25%.

Table 15. Results of teacher and student responses to large-scale tests on flipbook teaching materials based on problem based learning model

Respondents	Percentage (%)	Criteria
Teacher	100	Very Feasible
Student	100	

Based on the results of the study, the use of flipbook teaching materials based on the problem-based learning model in learning IPAS Cahaya material is effective in increasing understanding of the material presented and improving the learning outcomes of grade V students at

SD Negeri Wonosari 03. This statement is in line with the results of research from Suwandi et al. (2021) that the developed product is effectively used in learning.

Figure 15. Large-scale product trials

Conclusion

The study's findings suggest that using flipbook teaching materials based on the problem-based learning model to teach Light materials can enhance students' comprehension of the subject matter and improve their learning outcomes in grade V at SD Negeri Wonosari 3. This can be evidenced by the results of the product validation assessment by validators with an average percentage of 90% of media validators and an average percentage of 93.33% of material validators with both categories being very feasible. Both the pretest and posttest results for the student indicate progress. This is demonstrated by the 42.43 average difference between the pretest and posttest as well as a high N-Gain of 0.8106. Since the obtained N-Gain is greater than 0.70, it is regarded as high. From the improvement in student learning outcomes, it can be concluded that the use of flipbook teaching materials in class V light materials can improve student understanding.

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