Jurnal Pendidikan MIPA
Volume 16. Nomor 3, Tahun 2026 | ISSN: 2088-0294 | e-ISSN: 2621-9166
https://doi.org/10.37630/jpm.v16i3.4698

Development of *E-Flipbook* Material on Changes in Electrical Energy, Motion Energy, Light Energy, and Heat Energy in Science Learning

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ABSTRACT

The limited use of interesting and interactive technology-based teaching materials causes student learning outcomes to be low. The purpose of this study is to describe the design of development, testing the feasibility, and effectiveness of the E-Flipbook for energy change materials to improve the learning outcomes of grade IV students of SDN Kalibanteng Kidul 03. This type of research R&D using the ADDIE model includes the stages of analysis, design, development, implementation, and evaluation. The research subjects consisted of 23 students in grade IV. Data collection techniques use non-tests (observations, interviews, questionnaires, and documentation) and tests (pretest and posttest). The data analysis technique used normality tests, t-test and N-Gain. The results show that the E-Flipbook is designed using the Canva and Heyzine applications equipped with learning videos, simple experiments, and interactive quizzes. The feasibility of the E-Flipbook was shown by the validation results of material experts of 92.86% and media experts of 92.11% of the category was very feasible and supported by the results of 97.5% of the teacher's response and 88.53% of the students' response in the very feasible category. The effectiveness of E-Flipbook was shown by an increase in learning outcomes by 15,296. The significance value was <0.001 and the N-Gain test result was 0.5714 in the medium category. In conclusion, the E-Flipbook has been successfully developed, very feasible and effective to be used to improve the learning outcomes of grade IV students of SDN Kalibanteng Kidul 03.

Keywords: E-Flipbook; Energy Changes; Learning Outcomes

INTRODUCTION

Natural Science (IPA) refers to the study of natural and physical phenomena based on systematically organized knowledge obtained through observation and experimentation. Its fundamental dimensions include scientific knowledge products, processes, attitudes, and technology (Kusumawati, 2022). Science as a product is a body of knowledge consisting of concepts, principles, laws, and theories. The science process consists of process skills to obtain and develop science. The attitude of science is a character value for all who are involved in science. Science as a technology means that science is related to the development of technology used in daily life (Chusni, 2023)

In science learning in elementary school, there are limitations to the material/scope that will be taught. One of the scopes of science study materials for elementary school is energy and its changes include: force, sound, heat, magnetism, electricity, light, and simple planes (Permendikdasmen, 2025). In our daily lives, of course, we often use energy such as fans, stoves, flashlights, tvs, motor vehicles, ironing clothes, turning on lights, and playing the guitar. These events are clearly explained in the learning of social studies. Energy change is abstract, so teaching materials are needed to visualize the abstract concept of energy change. This is because one of the aspects that is very influential in the success of science learning is how students process and understand the information conveyed (Ar Rizky et al., 2025).

Teaching materials are broadly stated by (Siti Aisyah, 2020), Learning materials encompass the knowledge, skills, and attitudes that students are required to acquire in order to meet the predetermined competency standards. These materials specifically include aspects of knowledge, such as facts, concepts, principles, and procedures, as well as skills, values, and attitudes. Teaching materials can be in the form of text, audio, visual, audiovisual, or other digital forms that are arranged systematically and attractively to make it easier for students

ISSN: 2088-0294 | e-ISSN: 2621-9166
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to understand the material. Teaching materials include various learning elements such as information or material content, teaching instructions, practice questions, and other learning activities (Hayati et al., 2025). Teaching materials as learning support to make it easier for teachers to provide what materials students must master and the use of interesting teaching materials can make students better understand the material provided (Martatiyana, 2022). One form of teaching material is in the form of an e-flipbook.

Based on the results of pre-research through observation, interviews, and questionnaires of needs in grade IV of SDN Kalibanteng Kidul 03, it was found that the teaching materials used by teachers were only from student and teacher books provided by the school. As a result, learning becomes monotonous and less interesting, because students only receive the same form of material without innovative variations. Teaching materials should be developed by adjusting to the differences in students' abilities and needs, relating the material to the real-life context, and encouraging students to be actively involved in the learning process (Kemendikbudristek, 2022).

This is supported by the fact that student learning outcomes are still low. Based on the results of the pretest that has been carried out, it shows that there are still many students who have not met the KKTP. The number of students in grade IV is 23 students. Of the 23 students, 65% of students have not met the KKTP while the other 35% have met the KKTP. The KKTP at SDN Kalibanteng Kidul 03 in the subject of Social Studies is 80. This condition shows that most students still have difficulty in working on the problem, both in understanding concepts, remembering the material, and solving problems related to the situation being studied (Rukman & Samsudin, 2022). Based on the results of observations, students have difficulty understanding the material of energy change because it is abstract.

The lack of understanding of students on the material of energy changes around is caused by the lack of connection between the concepts taught and real situations in daily life. Students have difficulty understanding the types of energy changes, such as from electrical energy to heat or light energy, because the material is presented in the abstract without real illustrations. The teaching materials available are often not presented in an engaging, innovative, or interactive manner, making it difficult for students to understand the concepts of energy change. In this case, teachers are expected to be able to facilitate students by providing efficient learning resources, so that students can learn independently. These learning resources can be in the form of electronic teaching materials (Wibisari & Mulyani, 2023).

Based on the problems described above, a solution is needed to improve the learning process, one of which is by using technology to create interesting and innovative teaching materials. In order to make it easier for teachers to deliver material so that they can create a fun learning process for students. Therefore, researchers are interested in developing an e-flipbook that can strengthen students' understanding of energy change materials. The benefit of flipbooks as teaching materials is that they can present learning materials in the form of text and images with an attractive appearance to students (Damayanti, 2023). This is in accordance with the opinion of Rizal, (2021) who states that the development of teaching materials needs to be carried out due to the lack of learning information sources and the lack of independence of students to learn, so that this can be the main factor in hindering the achievement of learning goals.

Based on the problem identified above, an appropriate solution is required to enhance the learning process, one of which involves utilizing technology to develop engaging and innovative teaching materials. The integration of technology can assist teachers in delivering instructional content more effectively while creating a more enjoyable learning environment for students. Therefore, this study focuses on the development of an e-flipbook aimed at improving students' understanding of energy transformation concepts. As a teaching medium, an e-flipbook offers the advantage of presenting learning content through a combination of text and visual elements in an appealing format that can increase students' interest in learning (Damayanti, 2023). This is supported by Rizal, (2021) who argues that the development of teaching materials is essential due to the limited availability of learning resources and students' low level of independent learning, both of which may hinder the successful attainment of learning objectives.

The selection of the E-Flipbook was based on the results of interviews with grade IV teachers of SDN Kalibanteng Kidul 03 that students have a low interest in learning when learning only uses student books. However, when learning uses interactive learning such as learning videos and interactive PPTs, students are very happy and students' learning outcomes increase. Therefore, E-Flipbook was chosen to address the issue. In

ISSN: 2088-0294 | e-ISSN: 2621-9166
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addition, the E-Flipbook has never been used or applied during the defense process in grade IV of SDN Kalibanteng Kidul 03.

The results of relevant research conducted by previous researchers who support the development of e-flipbooks are research conducted by (Putra et al., 2023) which shows that e-flipbooks are quite effective for learning. Also supported by research conducted (Butar-butar et al., 2023), teaching materials are able to improve students' ability to think carefully, critically, logically, and systematically. Another study conducted by (Mahyuni et al., 2021) shows that teaching materials are very suitable for use.

Based on previous research, the e-flipbooks developed have shown good results in supporting the learning process. However, there are still some limitations, namely not being equipped with learning videos, simple trial activities, and interactive quizzes that can provide a more meaningful learning experience for students. Therefore, the researcher developed an e-flipbook that is equipped with case study-based learning videos, simple experiments that allow students to gain a hands-on learning experience, and interactive quizzes to increase student engagement and understanding. These three components are expected to be able to improve the understanding of concepts and student learning outcomes optimally.

The learning videos contained in the e-flipbook are designed not only to convey material, but also to present case studies or descriptions of problems related to the learning topic. The video includes a spark question that aims to encourage students to think critically. In addition, the e-flipbook comes with simple experiments that make use of concrete objects. This activity allows students to be directly involved in the learning process through observing, holding, and feeling the objects used so that the concepts learned become easier to understand (Amroellah, 2023). Furthermore, the e-flipbook also provides interactive quizzes designed to facilitate students' understanding through the provision of stimuli in the form of pictures and tables related to the material. The stimulus helps students connect the concepts learned with the situation presented, so that the evaluation process not only measures learning outcomes, but also trains the ability to analyze and interpret information in more depth (Fiqrilah et al., 2025).

Based on the problems that have been presented, the researcher is interested in conducting research and development research with the title "Development of E-Flipbook Material for Electrical Energy Change, Motion Energy, Light Energy, and Heat Energy in Science Learning."

The purpose of this study is to describe the development design, test the feasibility, and test the effectiveness of the E-Flipbook to improve students' learning outcomes in the energy change material of grade IV SDN Kalibanteng Kidul 03.

METHODS

(R&D) uses the ADDIE model, which consists of five stages, namely Analysis, Design, Development, Implementation, and Evaluation. In detail, the steps in this development research are as follows:

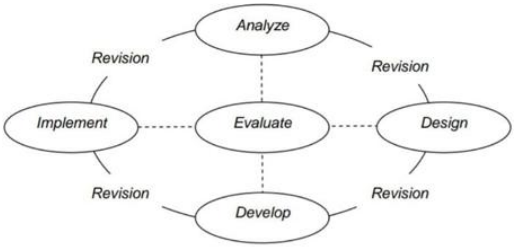

Figure 1. ADDIE Model R&D Steps (Damayanti, 2023)

The analysis stage is the initial stage of ADDIE model research. At this stage, researchers conduct observations, interviews, and questionnaires. This is done to analyze the problems, potential, and needs of students. The next stage is design. At this stage, the E-Flipbook is designed by compiling a framework for teaching materials and a presentation plan. The next stage is developing the E-Flipbook into a tangible product ready for use in learning. *The e-Flipbook* that has been developed is then tested by validating teaching materials with media experts and material experts. This step aims to determine the feasibility of *the E-Flipbook* developed and the initial product improvement before being tested on students. E-Flipbooks that have gone through the validation process

ISSN: 2088-0294 | e-ISSN: 2621-9166
https://doi.org/10.37630/jpm.v16i3.4698

from a team of experts and have been declared suitable for use are then applied to real situations. The purpose of the implementation stage is to determine the implementation of product use, observe student responses, and measure the practicality and effectiveness of the product. The last stage is evaluation, the goal at this stage is to find out how the quality of the product is by looking at the results of the teacher's response questionnaire, the student response questionnaire, the results of expert validation and the learning outcomes of students.

The subjects in this study are grade IV students at SDN Kalibanteng Kidul 03 Semarang City. The number of students who were the subjects was 23 students. With 6 students for small-scale trials based on the level of thinking ability (high, medium, low) and 17 for large-scale trials. Data collection was carried out by utilizing several instruments, namely a needs analysis questionnaire, a feasibility validation instrument by material experts and media experts, a questionnaire for teacher and student responses, and a pretest and posttest consisting of 20 questions. The needs questionnaire is used to identify the needs of teachers and students for the designed product. The validation instrument was made with a four-level likert scale to assess the linguistic aspects, the accuracy of the E-Flipbook with the material, the feasibility of the content, presentation, and appearance of the E-Flipbook. The analysis of the assessment results was carried out by calculating the percentage of feasibility to identify product feasibility categories (Adawiyah et al., 2026). The teacher and student response questionnaire was used to measure the level of display of the E-Flipbook, ease of learning, learning motivation, and quality of the material on the E-Flipbook. Meanwhile, pretest and posttest are used to measure student learning outcomes.

In this study, the data analysis technique was carried out descriptively using quantitative and qualitative data. Quantitative data analysis was carried out by calculating the percentage of assessment scores using the percentage equation (Lestari et al., 2026). The assessment scale applied in this questionnaire uses a Likert scale of 1-4. The assessment criteria in this study can be seen in table 1

Table 1. Criteria for assessing expert validation scores and response questionnaires (Mardianto et al., 2022).

Criteria	Score
Strongly agree	4
Agree	3
Disagree	2
Strongly Disagree	1

Furthermore, the score is calculated to obtain the percentage of feasibility and practicality of the product and to determine the product category. Product feasibility can be tested using equation formula (1)

$$NP = \frac{R}{SM} \times 100\% \quad (1)$$

The evaluation of the feasibility of the product is determined through the calculation of percentages. In the formula, NP presents the percentage number that is sought or expected, R is the score obtained, and SM indicates the maximum score of the test in question (Fatmawati & Andriani, 2024). This analysis is carried out by comparing the score obtained with the maximum score so that the percentage of product feasibility level is obtained. The percentage value obtained is then grouped according to the eligibility criteria that have been determined in the research. Details of the eligibility criteria can be seen in table 2:

Table 2. Eligibility Criteria (Basrina et al., 2023).

Presentase	Criteria
86% - 100%	Highly Worth It
61% - 85%	Worthy
31% - 60%	Less Worthy
< 30%	Not Eligible

Learning using E-Flipbook can be found to be effective on students' learning outcomes by looking for an N-Gain value with an equation (2)

$$< g >= \frac{<Spost> - <Spre>}{100 - <Spre>} \quad (2)$$

In the formula <g> presents the normalized average gain, <Spost> is the average posttest score obtained by the student, and <Spre> shows the average pretest score obtained by the student. The average N-gain obtained

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in the measurement of student learning outcomes shows the category of improvement in student learning outcomes. These categories can be seen in Table 3.

Table 3. N-Gain Score (Harianja et al., 2023)

Range	Category
N-Gain ≥ 0.70	Height
0.30 ≤ N-Gain < 0.70	Medium
N-Gain ≤ 0.30	Low

RESULTS AND DISCUSSION

Research and Development *of the E-Flipbook E-Flipbook* Science subject on energy change material grade IV SD Negeri Kalibanteng Kidul 03 Semarang City, produces 3 things, namely: 1) e-flipbook development design, 2) e-flipbook feasibility, and 3) e-flipbook effectiveness.

E-Flipbook Development Design

The results of this research led to the development of *an E-Flipbook* on energy change material. The researcher designed *the E-Flipbook* using the Canva application which was then made into *an E-Flipbook* using *the Heyzine flipbook* platform. Product development follows the ADDIE model in five stages:

The first stage is analysis. This stage of analysis aims to identify the possible causes of a learning performance gap (Hidayat & Muhammad, 2021). The analysis was obtained from pre-research activities, namely observation, interviews, and distributing questionnaires of needs to teachers and students of grade IV SDN Kalibanteng Kidul 03. Based on the results of the pre-research, it shows that there are problems found in grade IV of SD Negeri Kalibanteng Kidul 03, namely that teachers are not optimal in making technology-based teaching materials so that learning becomes monotonous and less interesting. The learning outcomes of students on energy change materials are still low, judging from the results of the pretest, there are 65% of students who have not met the KKTP. Students' lack of understanding of the material of energy change around them is often caused by the lack of connection between the concepts taught and real situations in daily life. According to Khoirunisa & Sodiq, (2023). One of the aspects that causes low student learning outcomes is that educators are less creative in packaging teaching materials. Educators only inform students to read the material in printed books and provide materials packaged in pdf so educators do not make good use of learning resources.

The results of the needs questionnaire analysis also show that teachers and students need technology-based teaching materials that are more interesting and interactive. As many as 15 out of 23 students stated that the material on energy change was difficult to understand, while all students stated that it was easier to understand the material if it was presented with the help of learning technology. The findings are in accordance with Piaget's theory of cognitive development, which states that students aged 7-12 years are at a concrete operational stage so they need teaching materials that are able to present abstract concepts more clearly through visualization, images, and direct experience (Sudianto & Ismayanti, 2023). Therefore, E-Flipbook was developed as a solution to help students understand the concept of energy change in a more concrete way.

The second stage is design, the design stage aims to make a design for the product to be developed complete with product specifications. This design stage sets a "monitoring line" for the progress of the next stage of ADDIE (Hidayat & Muhammad, 2021). The design stage is carried out based on the results of the needs analysis that have been obtained from the previous stage. At this stage, the researcher designed the structure and appearance of the E-Flipbook using the Canva application. The product is designed by combining various visual elements such as text, images, audio, and audio visuals that are relevant to the energy change material. The e-Flipbook is also equipped with various supporting components such as covers, instructions for use, activity instructions, learning outcomes, learning objectives, concept maps, learning materials, learning videos, simple experiments, interactive quizzes, glossaries, developer profiles, and bibliographies (Mulyasari & Doly, 2023).

The design of the E-Flipbook considers the characteristics of elementary school students with the use of bright colors, attractive illustrations, and ease of use. This design principle is in line with Bruner's theory which explains that the learning process will be more effective if students gain learning experience through visual and

ISSN: 2088-0294 | e-ISSN: 2621-9166
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symbolic representations gradually (Purnomo, 2022). Through images, videos, and interactive activities contained in the E-Flipbook, students have the opportunity to build their understanding independently.

The third stage is development, the development stage is the process of realizing the design into a ready-to-use product. The design of the E-Flipbook, created in Canva, will be completed in Heyzine Flipbooks for further editing, including the addition of videos and evaluation exercise links. The final product will be uploaded to the web and shared with students via *a link*, which requires internet access to use the E-Flipbook. The e-Flipbook consists of the following parts:

Figure 1. Learning Videos of Various Energies

Figure 1 contains a learning video of various energies as a stimulus that can be accessed by students. Video presentation aims to provide a more concrete, engaging, and easy-to-understand learning experience because it combines visual and audio elements. The use of learning videos can improve students' understanding because they can see the material directly and prevent students from feeling bored, so that students can understand the material quickly (Ailulia et al., 2022).

Figure 2. Simple Experiment of Heat Energy Change

Figure 2 is a simple experiment contained in the let's try menu, which contains practicum activities to prove the concept of heat energy change. Simple experiment activities like this provide students with the opportunity to build understanding through hands-on experience so that learning becomes more meaningful (Seyra et al., 2024).

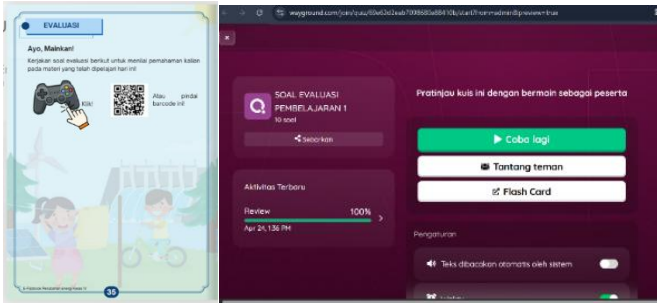

Figure 3. Quizizz Interactive Quiz & Quiz View

The evaluation page contains interactive quizzes that can be accessed via QR Code or the link that has been provided. Quizzes are designed in the form of games so that students can work on evaluation questions in a more fun atmosphere. Through interactive quizzes, students get direct feedback on the answers given so that they can find out their level of understanding of the material that has been studied (Pakudu & Safaat 2024).

ISSN: 2088-0294 | e-ISSN: 2621-9166
https://doi.org/10.37630/jpm.v16i3.4698

After *the E-Flipbook* has been completed, the researcher then conducts a validation test of material and media experts. From the validation of the researcher's material, it was revised in the form of 1) In the question on page 31, the word material was changed to components, 2) the video display on page 11 was enlarged. From the media experts, the researcher received revisions in the form of 1) adding a synopsis on the back of the cover and 2) adding a click button on the QR Code so that it can be accessed directly

The fourth stage is implementation, The implementation stage is the stage where the product that has been developed begins to be applied in real learning situations (Siregar & Rhamayanti, 2025). At this stage, it is divided into two, namely small-scale trials and large-scale/usage tests. The researcher conducted a small-scale trial in grade IV of SD Negeri Kalibanteng Kidul 03 with 6 students, 2 students with high understanding, 2 students with medium understanding, and 2 students with low understanding. The researcher used pre-test and post-test questions to measure the improvement of students' learning outcomes. Large-scale trials/use were carried out on 17 students using written tests (pre-test and post-test). The test was carried out with the aim of obtaining a conclusion whether learning science of energy change materials using the E-Flipbook developed by the researcher was effective or not.

The fifth stage is evaluation, At the evaluation stage, an evaluation is carried out on the results of product implementation. Then the product must be revised according to the results of the evaluation or needs that have not been met (Rachma et al., 2023). The evaluation phase was conducted to determine the quality of both the developed product and the instructional process, encompassing assessments before and after the implementation stage. This phase involved analyzing feedback collected through teacher and student questionnaires following the use of the E-Flipbook.

The findings of this study are consistent with those reported by (Dayanti et al., 2021), who found that the flipbook model is highly suitable for supporting learning activities. Its integration of multimedia elements, including animations, images, videos, and audio, enhances the learning experience and increases student engagement by effectively utilizing advances in technology. (Dayanti et al., 2021).

The development of the E-Flipbook for the subject of science and energy change material grade IV SD Negeri Kalibanteng Kidul 03 according to the results of the questionnaire on the needs of teachers and students, the researcher succeeded in designing and developing an E-Flipbook for energy change materials using the Canva application and then made an E-Flipbook using *the Heyzine flipbook* platform, which contains learning videos, simple experiments, and interactive quizzes.

E-Flipbook Eligibility

The feasibility of the E-Flipbook energy change material is determined based on the assessment of the validation of the material expert and the validation of the media expert. After the E-Flipbook is developed, it then enters the validation stage of material and media experts. At this stage, the researcher will validate the product with validators of material experts such as lecturers of Natural Sciences subjects from the Elementary School Teacher Education study program and competent media experts, including lecturers from the Elementary School Teacher Education study program to test the feasibility of the product. After being evaluated by the validator, suggestions will be given regarding the products developed by the researcher, so that the researcher can revise the product that has been developed.

Table 4. Material Expert Validation Results

Expert Validation	Presentase	Category
Material	92,86%	Highly Worth It

Based on table 4, the validation results that have been carried out with material experts obtained a score of 78 out of a maximum score of 84. So that it received a score of 92.86% and obtained very decent criteria. The material validation questionnaire contains 21 questions and 5 aspects of assessment, namely the accuracy of the e-flipbook with the independent curriculum, the accuracy of the e-flipbook with energy change materials, the accuracy of the e-flipbook with the maturity and ability of the students, the material presented in the e-flipbook, the accuracy of the use of language and images in the e-flipbook. From 21 questions, the researcher obtained 4 scores on 15 questions and obtained 3 scores on 6 questions, so that the total score obtained was 78. The researcher got a score of 78 so that he got a percentage of 92.86% and obtained very decent criteria. The

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researcher received suggestions from the validation of the material to be revised in the form of 1) In the question on page 31, the word material was changed to components, 2) the video display on page 11 was enlarged. E-Flipbook has the advantage of presenting material in it which supports many formats including audio, video, images, and text (Silalahi & Budiono, 2023).

Table 5. Media Expert Validation Results

Expert Validation	Presentase	Category
Media	92,11%	Highly Worth It

Based on table 5, the validation results that have been carried out with media experts obtained a score of 70 out of a maximum score of 76. So that it received a score of 92.1% and obtained very decent criteria. The media validation questionnaire contains 19 questions with 4 assessment aspects, namely the feasibility assessment of the linguistic aspect, the feasibility assessment of the presentation aspect, the feasibility assessment of the influence of the media on the learning strategy, and the feasibility assessment of the overall display. From 19 questions, the researcher obtained 4 scores on 13 questions and obtained 3 scores on 6 questions, resulting in a total score of 70. The researcher got a score of 70 so that he got a percentage of 92.11% and obtained very feasible criteria. From media experts, the researcher received revisions in the form of 1) adding a synopsis on the back of the cover and 2) adding a click button on the QR Code so that it can be accessed directly. E-Flipbooks make the display more attractive because it can open each page to be like a book on a smartphone or computer so that it provides a dynamic effect (Sucini et al., 2022). This is supported by the results of the questionnaire of teacher and student responses. The following is a table of responses from teachers and students:

Table 6. Results of Teacher and Student Responses

Response	Presentase	Criteria
Teacher	97,5%	Highly Worth It
Students	88,53%	Highly Worth It

Table 6 shows that the teacher's response to the use of E-Flipbook received a teacher response percentage of 97.5% with very feasible criteria and a student response percentage of 88.53% with very feasible criteria. So, the E-Flipbook is very suitable for use in learning science of energy change material in grade IV of SD Negeri Kalibanteng Kidul 03 Semarang City.

Relevant research as a support for this research is research that has been conducted by Aulia Usman, Nurul Kemala Dewi, Dyah Indraswati, (2023) stating that the development of E-Flipbook teaching materials is declared feasible and practical to use. The results of the research conducted by the researcher are in line with the research entitled Development of E-Book Teaching Materials Using Flipbooks on the Subtheme of My Region (Annisa Salsabila, Nurlinda Safitri, Yudhie Suchyadi, 2023) The results of this study were stated to be very feasible to be used in the learning process (Salsabila et al., 2023).

Keefektifan E-Flipbook

The effectiveness of the e-flipbook was tested using the normality test, the t-test for dependent samples (paired samples), and the N-gain test. Effectiveness was measured through a comparison of pretest and posttest scores. Data that had met statistical assumptions were then analyzed to test the differences in learning outcomes before and after the use of E-Flipbook.

Before statistical tests are carried out, the data is first tested for analysis prerequisites in the form of normality tests to assess whether the data used in the study is normally distributed or not (Isnaini et al., 2025). The respondents in this study were 17 students, so the normality test applied was the Shapiro Wilk test, because this test was more accurately applied to the respondents who were < 50 (Arifin & Aunillah, 2021).

Table 7. Shapiro Wilk's Normality Test Results

	Significance	Remarks
Pretest	0,492	Normal
Posttest	0,180	Normal

ISSN: 2088-0294 | e-ISSN: 2621-9166
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From the results of the normality test with the Shapiro-Wilk test, it is known that the significance of the pretest is 0.492 and the significance of the post-test is 0.180. Because the significance value is more than 0.05, the data is declared normal and eligible for analysis through a parametric test, namely a t-test of two paired samples.

Table 8. Paired Sample t-test

Number of Students	Mean Pretest Score	Mean Posttest Score	Signifikansi (2-tailed)
17	68,824	84,12	< 0.001

The results of the Paired Samples Test showed that the average pre-test score was 68.824 and the average posttest score was 84.12 so there was an increase of 15.296. A significant value (2-thailed) of < 0.001 < 0.05 showed that there was a significant difference between learning outcomes before and after the use of the E-Flipbook. Furthermore, the level of effectiveness of improving learning outcomes was evaluated through the N-Gain test.

Table 9. N-Gain Test Results

Yes	Measured Aspects	Results	Category
1	Average N-gain	0,5714	Medium

The results of the N-Gain test showed an average result of 0.5714. The N-Gain test result of 0.5714 is in the medium category. This shows that the results of the increase in pre-test and post-test students are in the medium category.

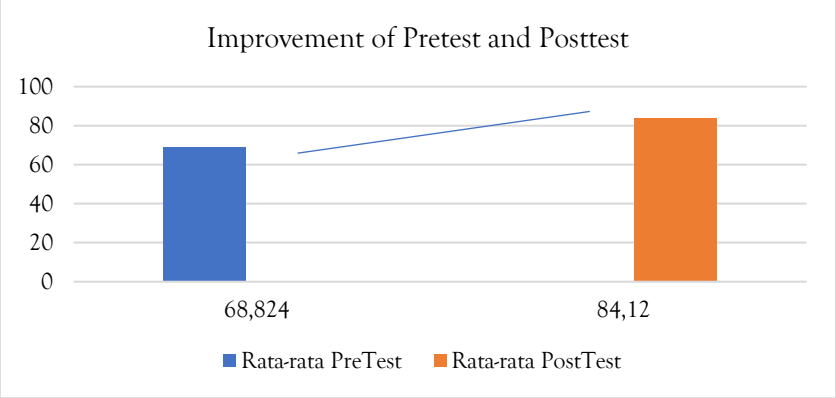

Figure 4. Improvement of Pretest and Posttest

From the diagram above, it shows that there is an increase in student learning outcomes seen from the average increase in pre-test and post-test scores. The average pre-test score was 68.824 and the average post-test score was 84.12, so there was an increase in the average score of 15.296. Thus, there is an increase in student learning outcomes after students use E-Flipbook.

The N-Gain value that is still in the medium category can be affected by several factors, such as the experience of students who are using e-flipbooks for the first time. At the time of implementation, students still need time to adapt to the features, appearance, and how to use e-flipbooks. In line with (Rismawati & Tyas, 2025) which states that the factors that affect learning outcomes are the first new students to use website-based technology as a learning medium so that some students still have difficulties when operating the media.

The results of improving student learning outcomes after using E-Flipbook can be explained through Jean Piaget's theory of cognitive development. According to Piaget, elementary school students are at a concrete operational stage that it is easier to understand learning when it is presented through real objects, visualizations, and direct experience. Therefore, the presentation of energy change materials through images, learning videos, and simple experiments in the E-Flipbook helps students gain the opportunity to build their understanding independently (Sudianto & Ismayanti, 2023). In addition, the E-Flipbook was developed to suit various learning styles of students, namely visual, auditory, and kinesthetic so that it can help learning be more effective (Angkat et al., 2023). Students with visual learning styles can understand the material through text, images, and animations. The auditory learning style is supported by the explanation of the material in the form of interesting

ISSN: 2088-0294 | e-ISSN: 2621-9166
https://doi.org/10.37630/jpm.v16i3.4698

audio and video. Meanwhile, students with kinesthetic learning styles can learn actively through observation activities or direct experiments.

Thus, it can be concluded that the development of E-Flipbook is effective in improving students' learning outcomes in the science subject of energy change material in grade IV of SD Negeri Kalibanteng Kidul 03 Semarang City.

CONCLUSION

Based on the results of the research and discussion that has been obtained, the researcher can conclude that the researcher succeeded in designing and developing *an E-Flipbook* on energy change material using the Canva application and then made an e-flipbook using the Heyzine flipbook, which contains learning videos, simple experiments, and interactive quizzes. *The e-flipbook* developed was declared very feasible for use in learning based on the validation results of material experts of 92.86% and media experts of 92.11%. This feasibility is also supported by the results of the teacher response questionnaire of 97.5% and the response of students of 88.53%, all of which are on the very feasible criteria. Thus, *the E-Flipbook* of energy change material is suitable for use in learning for grade IV students of SDN Kalibanteng Kidul 03. The e-Flipbook developed was declared effective in learning, it was seen from the results of the Paired Samples Test which showed that the average pre-test score was 68.824 and the average posttest score was 84.12 so that there was an increase of 15.296. A significant value (2-thailed) of < 0.001 < 0.05 showed that there was a significant difference between learning outcomes before and after the use of the E-Flipbook. The results of the N-Gain test showed an average result of 0.5714 in the medium category. Thus, the E-Flipbook on energy change material is stated to be very feasible and effective to be used as teaching material to improve the learning outcomes of grade IV students of SDN Kalibanteng Kidul 03.

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