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Development of Smart Book Media Based on Guided Inquiry to Improve IPAS Learning Outcomes

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Abstract: The lack of use of learning media and the use of learning models that do not involve students are problems in learning IPAS. This study aims to develop and test the feasibility and effectiveness of guided inquiry-based smart book media to improve IPAS learning outcomes in grade IV material on changing energy forms. Data collection techniques using test techniques in the form of pretest posttest. Non-test techniques in the form of interviews, observations, documentation, and questionnaires. The results showed that the guided inquiry-based smart book media met the eligibility criteria with a score of 96.25% from media experts and 91.60% from material experts with very feasible criteria. The effectiveness of the media is seen from the increase in learning outcomes by 30.23 with an N-gain value of 0.62 with moderate criteria and t test with a sig. (2-tailed) value of 0.000 <0.005 which shows a significant difference before and after the use of learning media. Based on these results, it can be concluded that the guided inquiry-based smart book media is feasible and effective for improving the learning outcomes of IPAS fourth grade students of SDN Turusgede on the material of changing the form of energy.

Keywords: Guided inquiry; IPAS; Learning outcomes; Smart Book

Introduction

Education is a human need that is inseparable from everyday life (Fau et al., 2023). The goal of education is to provide people with the information and akills necessary to advance their capabilities (Nur'ariyani et al., 2023). Education plays an important role in developing the quality of human resources (Faizah et al., 2020; Lestari & Nuryanti, 2022; Rahmadin et al., 2024). Quality education is created by improving and developing of learning and teaching (Le et al., 2018; Zhou et al., 2019). The process of learning is an essential component of the entire educational process (Fitriani et al., 2021).

Learning is a process of providing guidance or to students in the learning process (Darsyah, 2024). Good quality learning is characterized by healthy students, a comfortable, and safe envitonment, a relevant curriculum, learner centered learning and integrated learning outcomes that include knowledge skills and attitudes (Setyosari, 2017). The curriculum used at this time is the independent curriculum. The independent curriculum combies the learning topics of natural sciences and social sciences into natural and social sciences (IPAS),the unfication of these two subjetc is because elementary school students tend to see everything as a whole and integrated (Wijayanti & Ekantini, 2023). As a result of combining the two subject of science and social studies, students must be able to manage the natural and social environtment in on secuil (Mafithroh & Wulandari, 2025). The learning objectives of IPAS in the independent curriculum are to develop interest and curiosity, engagement, develop inquiry skills, and develop knowledge and uderstanding of concepts in students (Agustina et al., 2022).

However, in reality there are still some problems in learning IPAS in elementary schools. Students find it difficult to learn IPAS because there is a lot of material

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that students must memorize and remember (Alfatonah et al., 2023). Additionally, using unsuitable media even in little amounts, makes students less motivated (Najma et al., 2024). Science learning sholud be able yo motivate students to develop their abilities (Nurafifah et al., 2024).

According to the findings of study interview with grade IV teachers at SDN Turusgede, information was obtained that teachers experienced obtacles in making and using minimal learning media, such as books, rocks, plants, and objects around. Meanwhile, the result of interviews with several fourth grade students of SDN Turusgede obtained that students have difficulty in understanding IPAS material. In addition, the results of observations obtained information that the implementation of learning does not involve students in learning due to the use of inappropriate learning models. The lack of use of varied learning media and the use of inappropriate learning models affect student understanding and learning outcomes. Based on the learning outcomes that have been analyzed, student learning outcomes are still below the KKTP, only 33% of students scored above KKTP. A learning process is said to be successful if the percentage of completeness reaches 75% or more of the number of students participating in learning who have met the criteria set by the education unit (Sukma & Setyasto, 2024).

Therefore, a solution is needed to overcome these problems. One learning model that involves students in learning activities is the guided inquiry model. The syntax of the inquiry learning model makes students actively involved in learning so that they can develop their knowledge and critical thinkhing skills (Pursitasari et al., 2020). Inquiry learning helps students to formulate problems, test their own opinions, and have awareness of their abilities (Khoiri et al., 2020). Students actively increase their knowledge through inquiry-based learning activities which helps them reach the intended learning objectives (Dini et al., 2023). The guided inquiry is one way to help students become more proficient in the science process skills (Awaliyah et al., 2023). Based on research conducted by (Susilawati et al., 2022) which shows that the guided inquiry learning model is effective for improving students concept understanding. Research conducted by (Dani et al., 2021) also shows that the guided inquiry model can increase student motivation and creativity. So the selection of the guided inquiry model is the right solution to overcome problems in class IV SDN Turusgede. In addition to learning models, learning media also needed to overcome these problems. Learning media plays an important role in guiding students to gain learning experience (Lange & Costley, 2020). Presentation of material using can foster student curiosity and stimulate students to react physically and emotionally (Anggraeni et al., 2023). One of the learning media that can be used in learning activities is concrete learning media (Maryana & Wulandari, 2024). The use of real and interesting learning media can foster students curiosity to learn.

Based on the explanation above, the research will develop smart book media based guided inquiry to improve IPAS learnin outcomes. Science media plays a crucial function in helping students comprehend and embed concepts that are difficult to understand students (Wahyu et al., 2020). Smart book media is a textbook that combines various multimedia elements such as text/writing, images, and videos (Fitrihani et al., 2022). Smart book media in the form of books used in assisting learning activities and making it easier for students to absorb the material provided by the teacher (Paramesti et al., 2024). Smart book mediabased guided inquiry can make students more active in learning through investigation and experimentation activities well and more directed so as to create enjoyble learning with the active role of students in it. Media development with guided inquiry models can improve students critical thinking skills (Ilma et al., 2020). So that it will affect the learning outcomes. This is in line with research conducted by (Fitrihani et al., 2022) shows that smart book media based flipbook can improve students higher order thinking skills by obtaining a score of 95.45% on the media validity test, a score of 95.83% on the material expert validity test, teacher response results of 95.00% and an average score of 65.28 obtained before using smart book media, and the average score increased to 86.72 obtained after using smart book media based flipbook. Other research conducted by Hardiansyah et al. (2023) shows that smart book media can improve students understanding by obtaining a percentage of acceptance of 96.5% with an average pretest of 60.3 while the average posttest 84.2.

Research related to smart book media development has been conducted by several researchers. However, research on the development of smart book media based guided inquiry on the subject of altering energy form is still uncommon nonethless. Based on this, it is necessary to conduct further research on the development of guided inquiry-based smart book media to improve the learning outcomes of IPAS material on changing the form of energy. The novelty of this research lies in the concept of media, material, content components, and the use of guided inquiry models in the media. The novelty is what makes this research different from previous studies. This study aims to develop smart book media based on guided inquiry and test the feasibility and effectiveness of media used in IPAS learning.

Method

This research is a development research by producing products and testing their feasibility and effectiveness. The development model used is the model developed by Borg and Gall in Sugiyono which has been modified. This development model consists of 10 stages, including potential and problems; data collection; product design; design validation; design revision; product trial; product revision; trial use; product revision; and mass production (Sugiyono, 2019).

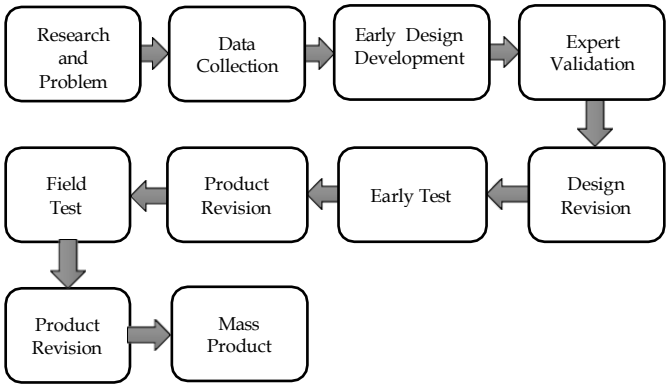


Figure 1. Steps of the Borg and Gall development model

The research conducted by researchers aims to test the feasibility and effectiveness of the developed media. Therefore, researchers only carry out the stages of Borg and Gall research only until the 8th stage, namely the trial of use.

The potential and problem stage was carried out to find out the potential and problems found in class IV SDN Turusgede. This stage was carried out with interviews, observations, and data documentation in the form of learning outcomes of fourth grade students.

The next stage is data collection, this stage is carried out to plan the product to be developed in accordance with the problems found. Data collection by distributing teacher and student needs questionnaires. The results of the questionnaire were analyzed to design the products needed in learning.

The next stage is the researcher designing the product based on the results of the teacher and student needs questionnaire. Researchers designed several aspects of the product including design and material. The product design has an attractive appearance and the material used is changing the form of energy. The initial design in the form of a prototype is then designed using the Canva application.

The next stage is design validation. Design validation is carried out to determine the feasibility of the product developed. Design validation includes media validation and material validation conducted by expert validators. The assessment was carried out by filling out an assessment sheet in the form of a Likert scale.

The next stage is design revision. The design revision aims to improve the product developed based on suggestions from media experts and material experts. The design revision aims to improve the developed product so that a product that is suitable for testing is obtained.

The next stage is the trial. The trial was conducted with a small-scale trial involving six fourth grade students selected by purposive sampling technique based on different levels of cognitive ability. After the learning was carried out, then the researchers distributed response questionnaires to teachers and students, then analyzed to determine the results of responses from teachers and students to the use of the product as well as suggestions or comments that were used to revise the product.

The next stage is the usage trial. The large-scale trial aims to determine the effectiveness of the developed product. At this stage students are given a pretest before using the product and posttest after using the product. After learning, researchers distributed teacher and learner response questionnaires to find out the responses of teachers and students to the use of the product.

The research design uses a pre-experimental design with a one group pretest-posttest design model, where the pretest is done before the use of the product and the posttest is done after the use of the product. This aims to compare the results before and after the use of the product. The results of the pretest and posttest scores were then analyzed through two stages, namely initial data analysis consisting of a normality test which aims to determine the normality of pretest and posttest data. While the final data analysis consists of t-test and N-gain test. Normality test using SPSS version 23 using the Shapiro-Wilk formula with the number of research samples < 50. Normality test criteria, namely a significance value> 0.05 is declared normally distributed data, while a significance value < 0.05 is declared not normally distributed data.

The t-test was conducted using a significance level of 0.05 ($\alpha = 5\%$). The paired sample t-test test criteria are based on a significance value> 0.05, then the null hypothesis (H0) is accepted and the alternative hypothesis (H1) is rejected. This means that there is no significant influence on the use of guided inquiry-based smart book media. Meanwhile, if the significance value is <0.05, the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted. This means that

there is a significant influence on the use of smart book media based guided inquiry.

The N-gain test was used to calculate the percentage of student learning completeness. The N-gain test aims to determine the effectiveness of the media in one group pretest and posttest design research. The calculation results obtained are then converted into the N-gain value criteria in table 1.

Table 1. N-gain score criteria

N-gain score	Criteria
N-gain ≥ 0.70	High
0.30 < N-gain < 0.70	Medium
N-gain ≤ 0.30	Low

Result and Discussion

Potential and Problems

Potential and problems were obtained by identifying problems using interview and observation techniques with grade IV teachers at SDN Turusgede. The results of interviews and observations in class IV SDN Turusgede, researchers obtained information that teachers experience obstacles in making and using learning media and implementing learning that does not involve students because of the selection of inappropriate learning models so that it affects student learning outcomes. Based on these problems, researchers provide solutions in the form of guided inquiry-based smart book media development to improve IPAS learning outcomes in grade IV. Smart book media based guided inquiry as a concrete learning media that can involve students in learning through inquiry activities.

Data Collection

Data was collected by distributing teacher and student needs questionnaires. Teacher and student needs questionnaires are used to develop appropriate learning media so that student learning outcomes increase. The results of the teacher and student needs questionnaire show that the learning media developed must have an attractive appearance, such as having bright colors, learning videos, and Augmented Reality (AR) to attract students' interest in learning. The content of the material in the guided inquiry-based smart book media is about "Changing the Form of Energy" and has been adjusted to the learning objectives that have been determined.

Product Design

The smart book media based guided inquiry is designed based on the results of the teacher and student needs questionnaire and the learning objectives that have been determined. The guided inquiry-based smart book media is designed using the Canva application by inserting several elements that are in accordance with the content of the material so as to form interesting learning media. The final result of the developed media is concrete media in the form of a book measuring 17.6 cm × 25 cm. The components of this guided inquiry-based smart book media include the front cover, preface, table of contents, learning instructions, learning objectives, guided inquiry model, learning material containing material about energy transformation and stored energy, evaluation questions, crossword puzzles, glossary, bibliography, developer profile, and back cover which contains a guided inquiry-based smart book digital barcode that can be scanned using a smartphone. Here are some guided inquiry-based smart book media design as shown in Figure 1.

Feasibility Smart Book Media Based on Guided Inquiry: Design Validation

The smart book media based guided inquiry that has been developed will then be subjected to a design validation test to determine the feasibility of the media that has been developed before being tested on students. Guided inquiry-based smart book media is assessed by two experts, namely media experts and material experts. The media feasibility assessment is guided by an assessment instrument that has been made by researchers in the form of a likert scale. Experts will provide checklists on the aspects assessed and provide suggestions and criticism so that the media developed becomes feasible and effective for use in learning. The assessment by media experts includes three aspects, namely aspects of media display, aspects of media use, and aspects of media utilization (Rantung et al., 2023). While the assessment by material experts consists of three aspects, namely aspects of content feasibility, presentation aspects, and linguistic aspects (Kamilah et al., 2023). The results of the validation assessment of media experts and material experts as shown in Table 2.

Table 2. Result of media experts and material experts assessment

Aspectn Feasibility	Percentage %	Criteria
Media expert	96.25%	Very feasible
Material expert	91.60%	Very feasible

(a) (b) (c) (d)

(e) (f) (g) (h)

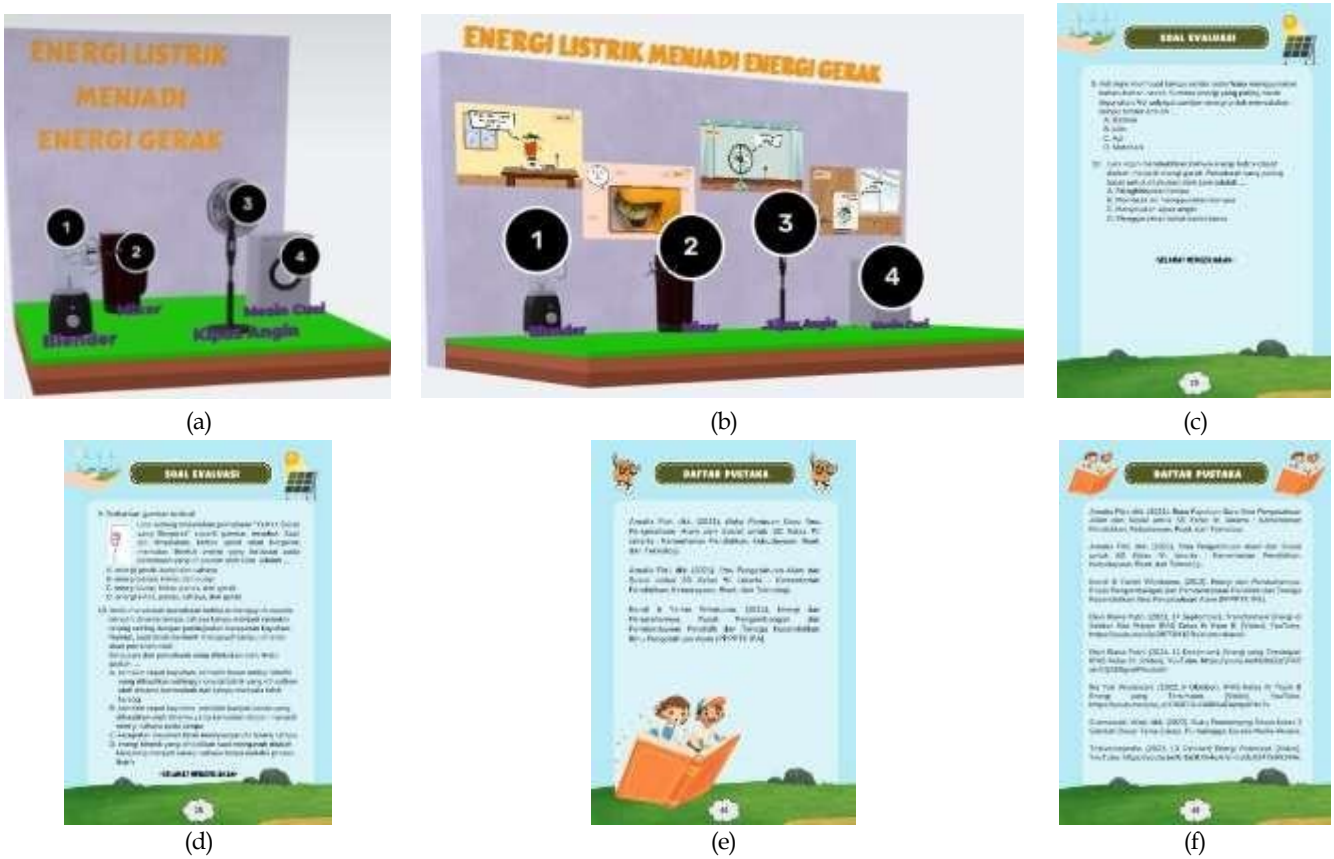
Figure 1. Display of smart book media: (a) front cover; (b) learning instructions; (c) learning objective; (d) guided inquiry model; (e) comic; (f) syntax of guided inquiry model; (g) evaluation; and (h) back cover.

Based on table 2, it can be seen that the media feasibility test with media expert validators and material experts obtained the criteria "Very Feasible". The results of validation by media experts obtained a feasibility percentage of 96.25% and the results of the material expert assessment obtained a feasibility percentage of 91.60%. Based on the results of the validation that has been done, it can be concluded that the guided inquiry-based smart book media is very feasible to use in IPAS learning.

This is reinforced by rsearch conducted by (Emiliana & Alfiansyah, 2023) which shows that the smart book media obtained a percentage of 87.50% in the "very valid" category and obtained a response questionnaire result of 88% in the "very good" category, which means that the media that has been developed has met the criteria in terms of material and media feasibility so that it can be used in the learning process. Other research shows that digital smart book media can be used as learning media to improve student understanding with a validity percentage of 75% and a practicality test of 92% (Husnia & Nuryami, 2024). Other research shows that smart book media can support learning activities with a score of 95.5 from media experts and 94 from material experts with the category "very valid" (Nasikhah et al., 2022). Based on the results of validation conducted by researchers and previous research, it is concluded that guided inquiry-based smart book media is suitable for use as learning media.

Design Revision

Design revision aims to improve inquiry-based smart book media in accordance with the suggestions of media and material experts. Based on suggestions from several experts, there are several inputs and suggestions that are used in improving learning media. Suggestions from media experts include: adding moving animations or videos to Augmented Reality (AR) and adding two HOTS questions to evaluation questions in learning media. While suggestions from material experts include: adjusting the use of capital letters in learning media and adding a bibliography. The display of guided inquiry-based smart book media design before and after revision is as shown in Figure 2.



(a) (b) (c)

(d) (e) (f)

Figure 2. Display of guided inquiry-based smart book media: (a) Augmented Reality (AR) before revision; (b) Augmented Reality (AR) after revision; (c) Evaluation questions before adding HOTS question; (d) Evaluation questions after adding HOTS questions; (e) Bibliography before revision; and (f) Bibliography after revision.

The final result in this study is concrete media in the form of guided inquiry-based smart books that have gone through the stages of revision from media experts and material experts and have been tested for feasibility and effectiveness, so that they can be used as IPAS learning media in grade IV SDN Turusgede. This media contains material about "Changing Forms of Energy" and has been adapted to the learning objectives set. The components of this media include the front cover, preface, table of contents, learning instructions, learning objectives, guided inquiry learning model, concept map, material about energy transformation and stored energy containing learning videos and Augmented Reality (AR), evaluation questions, crossword puzzles, glossary, bibliography, and back cover which contains a barcode that can be scanned using a smartphone.

Product Trials

The product trials was carried out on s small scale in the IV class. The selection of these six students used purposive sampling technique. Purposive sampling is a sampling technique with certain criteria (Sugiyono, 2022). The selection of students is based on academic levels, namely students who have high, medium, and low academic levels. This aims to determine the response after using guided inquiry-based smart book media from various academic levels. After the trial using the media was carried out, the researcher gave a questionnaire response to the use of guided inquiry-based smart book media to students and teachers to find out the response to the use of guided inquiry-based smart book media.

The results of the teacher and student response questionnaires were then converted into 4 criteria, namely very good criteria with a value range of 82%-100%, good criteria between 63%-81%, good enough criteria between 44%-62%, and less good criteria with a range of 25%-43%. The following are the results of teacher and student responses on small-scale trials, namely:

Table 3. Results of small scale teacher and student responses

Respondents	Percentage	Criteria
Teacher	95%	Very good
Students	96.67%	Very good

Based on Table 3, the guided inquiry-based smart book media received positive responses from teachers and students. The media obtained a response from the

teacher of 96.67% and a student response of 95%. The results of teacher and student responses are feedback that is used to determine the weaknesses of the developed media so that improvements can be made and effective learning media are obtained in achieving learning objectives. In the questionnaire responses of students and teachers there were no suggestions for improvement so that researchers did not revise the smart book learning media based guided inquiry.

Table 4. Result of large scale teacher and student responses

Respondents	Percentage	Criteria
Teacher	95%	Very good
Students	98.50%	Very good

Based on the table 4, the smart book media based on guided inquiry received positive responses from teachers and students. The mediareceived a response from the teacher of 95% and 98.50% from the students. This is in line with research conducted by Kristianto et al. (2023) which shows that the development of smart book media is said to be valid with a percentage of 86%. The response results are said to be practical with a percentage of 94%.

Effectiveness of Smart Book Media Based on Guided Inquiry: Trial Use

The effectiveness of the media was carried out with a large-scale trial involving 21 class IV SDN Turusgede. The results of the product usage trial were used to determine the effectiveness of guided inquiry-based smart book media as seen from the pretest and posttest scores in the large-scale trial. Pretest scores were obtained before students used guided inquiry-based smart book media in the learning process, while posttest scores were obtained after students used guided inquiry-based smart book media.

The results of the pretest and posttest scores were then analyzed by normality test, N-gain, and t-test to determine the effectiveness of guided inquiry-based smart book media. The effectiveness test was carried out using the te-test and N-gain test which were previously tested for normality (Novitasari et al., 2023). The following are the results of the large-scale pretest and posttest normality tests:

Table 5. Pretest and posttest normality test result

Learning Outcomes	Statistic	df	Sig.
Pretest	0.914	21	0.65
Posttest	0.932	21	0.150

Based on the Table 5, the results of the normality test of pretest and posttest scores with the shapiro-wilk test assisted by SPSS version 23, the results of the pretest value normality test have sig = 0.065 which means 0.065 > 0.050 and the posttest value normality test has sig = 0.150 which means 0.150> 0.050 so that the pretest and posttest data are normally distributed.

The next step is the t-test which is used to determine the difference in the average pretest and posttest and test the difference in learning outcomes on the average pretest and posttest on the use of guided inquiry-based smart book media. The following are the results of the t-test calculation on the large-scale pretest and posttest:

Table 6. Pretest and posttest t-test results

Average Difference	Sig.(2-tailed)	Criteria
-30.23810	0.000	Significant difference

Based on the table above, the t-test results show the difference in pretest and posttest averages with a sig. (2-tailed) value of 0.000 which means the sig. (2-tailed) value of 0.000 <0.005 so it can be seen that there is a significant difference between the pretest and posttest results.

The next step is the N-gain test which is used to determine whether there is an increase in learning outcomes before and after using guided inquiry-based smart book media. The results of the N-gain test of the large-scale trial are as follows:

Table 7. N-gain test results pretest and posttest

Learning outcomes	Number of students	Average	N-Gain Schore	Criteria
Pretest	21	50.95	0.62	Medium
Posttest	21	81.19		

Based on table 7, the N-gain value is 0.62 with "medium" criteria. Based on the results of the t-test and N-gain test that have been carried out, it can be seen that the guided inquiry-based smart book media is effective in improving the learning outcomes of IPAS class IV SDN Turusgede.

This is reinforced by research conducted by (Ramadhan, 2024) This study showed that smart book media can improve students' critical thinking skills with an average pretest score of 58.50 and an average posttest score of 88.67, as well as a t-test result of 0.000 which shows a significant difference between pretest and posttest scores. Other research shows that smart book media can improve students' understanding of science learning with an average pretest of 60.3 and posttest of 84.2 which shows an increase in value and is supported by a t-test obtained of 1.699 which means there is a significant difference before and after the use of smart book media (Hardiansyah et al., 2023). Other research shows that smart book media can improve

student learning outcomes with t_{count} (0.0000000000005) < t_{table} (2.051830493) which means there are differences in students' pretest and posttest scores before and after using the media (Mariantini et al., 2022).

Based on the analysis that has been done, it is found that guided inquiry-based smart book media can improve the learning outcomes of IPAS class IV SDN Turusgede on the material of changing the form of energy. The components contained in the guided inquiry-based smart book media can attract students' attention to learning. The presentation of interesting and relevant problems can foster students' curiosity and encourage them to think critically and find a solution. Activities such as experimental activities can improve student understanding because students are directly involved in the learning process. Thus, guided inquiry-based smart book media can create a more effective, meaningful, and student-centered learning experience so that students' understanding increases and affects the learning outcomes obtained.

Conclusion

According to the findings of the research, fourth-grade students learning outcomes in the IPAS topic of altering the form of energy may be enhanced using smart book media based guided inquiry learning materials. This is evidenced by the feasibility assessment of media experts of 96.25% and material experts of 91.60% with the criteria "very feasible" which shows that guided inquiry-based smart book media is suitable for use in learning activities. While the results of the pretest posttest analysis obtained an average pretest value of 50.95 and an average posttest of 81.19 with an N-gain value of 0.62 and a "medium" category. This means that there is a moderate effect of using guided inquiry-based smart book media on student learning outcomes. While the t-test results show that the sig. (2-tailed) value of 0.000 <0.005 which shows that there is a significant difference between learning outcomes before and after using guided inquiry-based smart book media. Based on the results of the study, it is concluded that the guided inquiry-based smart book media is feasible and effective to use to improve the learning outcomes of IPAS grade IV students on the material of changing the form of energy.

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D.R.P. contributed to conducting research, developing products, analyzing data, and writing articles. D.W. contributed as a supervisor during the research and article writing activities.

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Conflicts of Interest
The authors declare no conflicts of interest.

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