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Development of Light Box 3D Learning Media for Teaching the Properties of Light in Grade V IPAS Subjects at Elementary Schools

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Abstract

The properties of light are one of the materials related to phenomena that often occur in the life of the living creatures. However, students are not provided with tangible resources to clarify the material. One way that can be done is to use a learning media namely Light Box 3D. This study aimed to measure the validity, practicality and effectiveness of learning media conducted on IPAS subject of light properties in class V SD Al-Islam Pengkol Jepara. Research and Development (R & D) with ADDIE stage is the research method used in this study. The result of the media validation test showed a presentation of 94%, while the materials validation test showed a presentation 92% which means both are classified as very valid categories. The results of the media practicality test given to teachers and students showed the same average score of 96% which belongs to the category of very practical. The result of the effectiveness test performed showed a sig. (2-tailed) value of 0.000<0.05, then H_o is rejected and H_a is accepted. That is, there is a significant difference between the result of the pretest and posttest values performed. While the presentation of N-Gain value obtained was 76.9166% which belongs to the category of effective interpretation, thus it was conclude that the Light Box 3D learning media is very valid, practical and effectively to use.

Keywords: *Development; Light Box 3D; Properties of Light.*

INTRODUCTION

Education that integrates natural and social aspects is very important in forming basic knowledge for students at school. Realizing this, the Ministry of Education and Culture took the initiative to combine IPA and IPAS into Natural and Social Sciences (IPAS) (Kemdikbud, 2022). In general, IPAS is subject that studies many phenomena about objects in the universe, ranging from inanimate objects, living beings, form of interaction and human life as social creatures (Septiana & Winangun, 2023). Despite the merger, IPA and IPS studies material has not been integrated into one integrated learning, but is separated into different topics (Wijayanti & Ekantini, 2023). The presence of IPAS aims to develop students' inquiry abilities and help foster curiosity about phenomena that occur in the surrounding environment (Nuryani et al., 2023). One of the science materials that is part of the phenomena in human life is the properties of light.

Light is a form of energy that is quite important for the survival of living things on earth. In everyday life, light is used for various purposes, from lighting to the photosynthesis process of plants. Light has properties that form the basis of human understanding of the universe (Widyastika et al., 2024). A deeper understanding of the properties of light supports technological advances in various fields, ranging from optical communications, medical devices, and sensory (Maharani et al., 2024). The properties of light itself are included in abstract learning. Therefore, in teaching this material it is necessary to adapt it to the characteristics of elementary school students to avoid misconceptions (Maswindah, 2019).

The explanation above is the basis for the importance of studying the properties of light using the right method. One of the famous

psychologists, Jean Piaget, believes that human development between the ages of 7 and 11 years is at the concrete operational stage, where at that stage individuals are not yet able to solve abstract problems and are only able to solve problems based on concrete things (Burhanuddin, 2021). However, in IPAS learning, especially material on the properties of light, students are not shown concrete examples to clarify the material being studied (Qomariyah et al., 2022). This is a challenge for teachers to be able to present abstract material into concrete material so that it is easy to understand. Apart from this, teachers must also be able to create learning that actively involves students so that it produces a fun and meaningful learning experience (Baiti, 2023).

One effective approach is to utilize learning media. The media serves as a crucial intermediary between teachers and students, enhancing the effectiveness and efficiency of material comprehension (Daniyati et al., 2023). Learning media can bridge the gap between concepts that students understand and new concepts they want to learn (Widyaningrum, 2022). In addition, learning media that is packaged attractively can increase learning motivation so that the material learned will be better understood by students later (Rahilah & Sofianto, 2023). Therefore, the use of learning media is important, especially for material that requires realistic examples.

The results of interviews and filling out pre-research questionnaires conducted in class V of SD Al-Islam Pengkol Jepara show that the learning process in IPAS subjects does not use much media. Furthermore, the results of the student needs analysis questionnaire showed that one of the most difficult IPAS materials to understand was the properties of light. This is motivated by the minimal use of learning media, which causes students to have difficulty distinguishing the properties of light. Based on the results of interviews with the class V teacher, it was stated that three-dimensional media was needed to teach IPAS subject material. This is because three-dimensional learning media supports real and concrete learning experiences. Apart from that, three-dimensional media is considered interesting, can clarify material, and actively involve students. Based on these problems, the Light Box 3D learning media is the main choice to overcome the problems that occur in class V.

The Light Box 3D learning media is a box-shaped media with four partitions which contains an explanation of the properties of light along with examples. As the name suggests, Light Box 3D learning media is a type of three-dimensional media. In simple terms, three-dimensional media is a visual aid that has length, width and height and can be observed from various sides (Pratama et al., 2022). Three-dimensional learning media has three advantages, namely 1) providing real experience to students; 2) shows a concrete picture of the material being studied in full; 3) displays a complete picture of the structure of the material being studied (Rohmatulloh et al, 2022). On the other hand, the Light Box 3D learning media contains supporting tools that can be used directly by students to demonstrate the properties of light, such as flashlights, plastic bottles, mirrors, cassettes, cars and wooden boxes. This media development is also equipped with a guidebook for using the media so that teachers have no difficulty in using it. Through the Light Box 3D learning media, students become more active because they seek knowledge independently with the help of concrete objects. Therefore, the Light Box 3D learning media is very suitable to be applied to elementary school age children, especially in IPAS subjects on the properties of light.

This research is in line with several other studies that support the use of Light Box 3D learning media as an effort to make it easier for students to understand the materials. The first research was conducted by (Syaipul et al., 2024) where the research stated that the light box media used was effective in attracting students' interest in learning. The second research was conducted by (Laksono et al., 2023) who concluded that the development of light box learning media had very good quality and was suitable for use in learning. The third research was presented by

(Widiya & Nirwana, 2024) who stated that the development of light box media was successful in improving students' scientific thinking. Based on the results of these three studies, it can be concluded that three-dimensional light box media has advantages in making learning about the properties of light more interesting, interactive and active. Therefore, researchers are interested in conducting research with a similar theme. This research has a novelty that distinguishes it from previous research, that is on a broader research objective, where the three studies above have not yet reached the stage of testing the effectiveness and practicality of the media being developed. This research also places greater emphasis on practical activities and inclusivity to ensure that the media can be used by all students.

This research was carried out with the aim of developing Light Box 3D learning media for the IPAS subject material properties of Light for class V. The existence of Light Box 3D learning media is expected to help facilitate teaching and learning activities so that students understand the material more easily. Apart from development, this research was also carried out to complement previous research by testing the validity, practicality and effectiveness of the Light Box 3D learning media.

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RESEARCH METHODS

This research employed a research methodology known as Research and Development (R&D). (Sugiyono, 2013) believes that this type of research method is carried out in order to create or develop a new product to test its effectiveness. The goal is to develop science to produce new, and more innovative products. While the type of research carried out is Pre-Experimental Design with type One Group Pretest-Posttest Design that is to measure students understanding before and after applying Light Box 3D learning media.

The development of Light Box 3D learning media uses the ADDIE model which consist of 5 stages. The five stages are (1) analyze, is the stages of analyzing conditions, problems, and needs so that later it can be used as a basis for decision making on what to develop so that the problem can be resolved well. The class used as the subject of data analysis was class V SD of SD Al-Islam Pengkol Jepara with 26 students; (2) design, is the stage of designing the initial prototype for the development; (3) development, is the stage of development and validation to experts with suggestions to determine the validity of the media that has been developed; (4) implementation, is the stage of implementing or testing the development product to students; (5) evaluation, the evaluation was carried out with the intention of seeing the final results of the developed media effectiveness test (Branch, 2009).

The research instruments used were questionnaires and pretest-posttest questions. Interview, observation, questionnaires and test is the data collection technique used. The sample used was saturated sampling by including all samples into the population because the number of students is not large enough, namely under 30 students. The categorization of media validity was based on the result of the presentation of the level of achievement of the questionnaire result from media expert and material experts. Details of the media expert assessment grid, namely:

Table 1
Media Expert Questionnare Grid

Aspect	Number	Amount
Media Design	1, 2, 3, 4	4
Completeness of Media Content	5, 6, 7, 8, 9, 10	6
Others	11	1

Material experts assess based on the suitability of the material, presentation of the material, and benefits of the material. Details of the material expert assessment grid, namely:

Table 2
Material Expert Questionnare Grid

Aspeck	Number	Amount
Material	1, 2, 3, 4, 5	5
Learning	6, 7, 8, 9	4
Others	10	1

Furthermore, the practicality test is based on the results of questionnaire responses from teachers and students. The following is a table of media validity and practicality criteria:

Table 3
Media Validity and Practicality Criteria

Achievement Rate (%)	Criteria Validity	Criteria Practicality
80-100	Very Valid	Very Practical
66-79	Valid	Practical
56-65	Fairly Valid	Quite Practical
40-55	Less Valid	Less Practical
0-39	Invalid	Very Less Practical

Source: (Asyifa & Suwarno, 2024)

The calculation formula used in testing the validity and practicality of the media is: $\boldsymbol{P\ (s) = \frac{s}{N} x\ 100\%}$ with the information: 1) **S** is the total score obtained; and 2) **N** is the maximum number of scores (Putro & Setyadi, 2022). Furthermore, the data analysis used to determine the effectiveness of the development of the Light Box 3D learning media uses a descriptive quantitative method to calculate the effectiveness test results, namely the normality test, homogeneity test, Paired Sample T-Test test, and N-Gain test (Widiyono et al., 2022). The categorization of value interpretation in the N-Gain test is as follows;

Table 4
N-Gain Value Interpretation

N-Gain Value	Category
g > 0,7	High
0, 3 ≤ g ≤ 0,7	Currently
g < 0, 3	Low

Furthermore, the effectiveness interpretation categories for N-Gain can be seen in table 5.

Table 5
Interpretation of N-Gain Effectiveness

N-Gain Value	Category
< 40 %	Ineffective
40%- 55%	Less Effective
56%-75%	Quite Effective
>76 %	Effective

Source: (Hake, 1999)

RESEARCH AND DISCUSSION

Research

The result of the research was a learning media called Light Box 3D in the IPAS subject with the matter the properties of light. The media is created by following the steps of ADDIE. The explanation will be presented is full as follows:

The first stages is Analyze. This stages involves the analysis of issues arising during the learning (Rayanto & Sugianti, 2020). The things analyzed consist of studies from relevant source and information field with the intention of finding out the development needed to overcome the problem that occur, especially in the IPAS subject. At this stage, a questionnaire was filled out on student needs and interviews with homeroom teachers. Based on data obtained from the interview activities and filling out the pre-research questionnaire, it is known that students have difficulty understanding the material on the properties of light. Therefore, something is needed that helps students understand the IPAS material. To solve this problem, you can use one method that is using learning media. In this case, the learning media needed is media in three-dimensions form. This is in accordance with the opinion of the homeroom teacher who states that the media in IPAS lessons must be able to present the material in a more realistic way.

The second stage is Design. This stage is stage of creating the design of media starting from shape, color, and also how to use them. The first step begins with selecting the media title, namely "Light Box 3D" or can be interpretation as a three-dimensional light

box. After that, mapping of learning achievements and objectives is carried out so that the media developed gets optimal results. Furthermore, reference sources are collected as references used in developing the media. The creation of media design uses the Canva application which is then printed in the form of a banner. This aims to avoid damage to the media produced later so that the media can be used in the long term. In the development media, there is material on the understanding of the properties light along with examples. This is to make it easier for students when using Light Box 3D learning media. The following is a concept map containing the stages in media development:

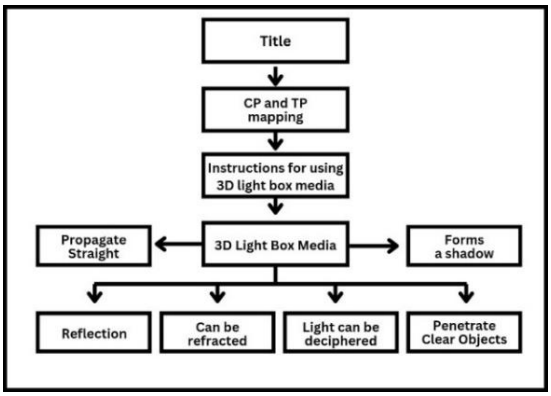

Figure 1
Concept Map of Stages in Media Design

The third stage is Development. This stage involves the concretization of the initial media design prototype into a tangible learning media. The Light Box 3D learning media is made in the shape of a cube consisting of four partitions made of plywood covered with banners. Each partition contains one to two light properties that have been adjusted in order. In this media there are also definitions and examples of the properties of light. Light Box 3D learning media contains tools that support the learning process such as flashlights, bottles, mirrors, cassettes, cars and wooden boxes. The tools used are objects that are easily found in everyday life with the aim of making it easier for students to understand the material more realistically.

Making Light Box 3D learning media prioritizes quality, practicality and effectiveness. The goal is to ensure that the media is safe and durable for a long time. The appearance of the background is adjusted to each characteristic so that the media is more interesting and interactive to make learning more fun. Thus, this media not only functions as a learning media, but can also increase students interest and motivation to learn. Therefore, the media is made as good as possible by putting forward referrals from expert. Here are the results of the improved media development according to the advice of the material expert, namely to clarify the writing on the media.

Figure 2
The Results of the Development Light Box 3D Learning Media

The Light Box 3D learning media is also accompanied by a user guide book which aims to make it easier to use the media in learning. The guidebook was created using the Canva application with customized designs, fonts and images. You should also pay attention to the arrangement of sentences so as not to create double meanings which make it difficult for the reader. This guidebook is also a solution to common problems that may occur when using media, so that both teachers and students are able to overcome problems more quickly and easily. This user manual consists of (1) cover; (2) foreword; (3) table of contents; (4) learning outcomes and learning objectives; (5) media introduction; (6) media use; (7) media benefits; and (8) glossary.

Figure 3
Instruction Book of Light Box 3D learning media

The Light Box 3D learning media that has been created is then assessed by media experts and material experts. The validity test was carried out by giving a questionnaire to media experts consisting of two people with a total of 11 questions, and material experts consisting of one person with a total of 10 questions. Upon receipt of completed quistionnaires from experts, data analysis was performed to evaluate the media's validity.

Table 6
Results of Questionnaire from Media and Material Experts

Media Experts				
Aspeck	**Total Score**	**Max. Score**	**Result**	**Cat.**
Design	36	40	90%	Very Valid
Content	55	60	92%	Very Valid
Others	10	10	100%	Very Valid
Average			94%	Very Valid
Material Experts				
Aspeck	**Total Score**	**Max Score**	**Result**	**Cat.**
Material	23	25	92%	Very Valid
Learning	17	20	85%	Valid
Others	5	5	100%	Very Valid
Average			92%	Very Valid

The media expert validation results show an average percentage value of 94%. According to the product validity criteria guidelines, the media developed is included in the very valid category so that it can be used in learning with minor revision notes. Based on the results of expert validation, the media developed makes students more active so that it has a good impact on achieving learning objectives and creates a pleasant learning experience because students are actively involved.

The results of the material expert validation show an average percentage of 92% which is included in the very valid category. This means that the material in the Light Box 3D learning media is valid and can be used for trials on the properties of light subject. The material contained in the learning media was created using the Canva application. The media is made in a fairly large size, namely 40 cm x 40 cm, which allows the writing on the media to be seen clearly. This was conveyed by material experts who stated that the material had good readability.

The fourth stage is the implementation. This stage is the stage where media that has been categorized as valid and has gone through revisions according to advice from experts is then tested on class V students at SD Al-Islam Pengkol Jepara. The implementation of learning media was carried out in three meetings. Testing of the effectiveness of the media being developed is measured using tests, namely by giving pretest and posttest questions to students who have gone through the validity test and reliability test stages using the SPSS.

Learning tools are first prepared before implementation is carried out, namely teaching modules which contain learning implementation guidelines, teaching materials, student worksheets and evaluation sheets. At the first meeting, students were asked to work on pretest questions and then given an explanation regarding the material of light and its properties. In the second meeting, students were given material to strengthen the properties of light using the Light Box 3D learning media. At the third meeting, students

were given material about the application of the properties of light in everyday life and then worked on posttest questions to measure the effectiveness of the media that had been developed. Both tests were carried out offline at SD Al-Islam Pengkol Jepara. After the media was implemented, teachers and students provided feedback via quistionnaires, which were then analyzed to ascertain the media's practicality. The results of this analysis are summarized in the following table:

Table 7
Result of Teacher and Students Practicality Test

Teachers				
Aspeck	**Total Score**	**Max. Score**	**Result**	**Category**
Design	23	25	92%	Very Practical
Content	19	20	95%	Very Practical
Others	5	5	100%	Very Practical
Average			96%	Very Practical
Students				
Aspeck	**Total Score**	**Max. Score**	**Result**	**Category**
Design	627	650	96%	Very Practical
Content	501	520	96%	Very Practical
Others	125	130	96%	Very Practical
Average			96%	Very Practical

The media practicality assessment, administered to both teachers and students, yielded a consisten mean percentage of 96%. Based on these finding, it can be concluded that the Light Box 3D learning media is deemed to be highly practical.

The fifth stage is the Evaluation. The evaluation stage aims to analyze the effectiveness of the Light Box 3D learning media developed on students' understanding of the properties of light in science subjects. To carry out an effectiveness test, prerequisite tests are required which include a normality test and a homogeneity test. Prerequisite tests are needed because they are a requirement for researchers to test the hypotheses that have been prepared (Usmadi, 2022). This is crucial to mitigate bias and ensures data accuracy of the subsequent analysis. The results of the test are summarized in table 8.

Table 8
Normality Test Result

	1	**2**
N	26	26
Normal Parameters[a] Mean	54.92	89.00
Std. Dev	9.695	6.974
Most Extreme Diff. Absolute		
Positive	.156	.195
Negative	.156	.190
Kolmogorov-Smirnov Z	-.130	-.195
Asymp. Sig. (2-tailed)	.793	.993
	.555	.277

The data presented above yields a significance value of 0.277. Data is deemed normally distributed if this value surpasses 0.05. consequently, the tested data adheres to a normal distribution. A subsequent homogeneity test, as outlined by (Annisak et al., 2024) was executed to evaluate the equality of variances across different groups. The finding of this test are detailed in table 9.

Table 9
Homogeneity Test Result

	Levene Statistic	**df1**	**df2**	**sig.**
Bas. on Mean	3.517	1	50	.067
Bas. on Med.	2.598	1	50	.113
Bas. on trimmed	3.584	1	50	.064

The data above shows a significance value of 0.067. Data must be greater than 0.05 if it is to be categorized into a homogeneous data type. Based on this, the data obtained is classified as homogeneous because 0.067 > 0.05. the results of the two prerequisite tests then became the basis for conducting a hypothesis test using the Paired Sample T-Test. Hypothesis testing was carried out to find evidence that could be used as a basis for made conclusions from the research

conducted (Jumadiyah & Zumrotun, 2024). Below this are the result of the hypothesis test:

Table 10
Paired Sample T-Test Result

	Paired Differences		t	df	Sig. (2-tailed)
	Std. Dev	Std. Error Mean			
Pre-pos	6.609	1.296	-26.293	25	.000

Statistical analysis revealed a significance (2-tailed) value of 0.000, which being less than 0.05, so H_O was rejected and H_a was accepted. Consequently, it was concluded that a statistically significant difference existed between the pretest and posttest scores of class V students at SD Al-Islam Pengkol Jepara from before the media was implemented to after the Light Box 3D learning media was implemented. Therefore, the analysis of the increase in the students pretest and posttest scores was then continued using the N-Gain test to determine the category of improvement that occurred (Sukarelawan et al., 2024)

Table 11
N-Gain Result

	N	Min.	Max.	Mean	Std Dev.
Score	26	.39	1.00	.7692	.14097
Persen	26	39.39	100.00	76.9166	14.09723
	26				

The data presented in the preceding table indicates an average N-Gain value of 0.7692 which exceeds 0.7. Based on established criteria for N-Gain categorization, this result signifies a high level of improvement. While the percentage of N-Gain obtained is 76.9166% which is included in the effective interpretation range. This shows that the development of Light Box 3D learning media has very effectiveness.

Discussion

The Light Box 3D learning media developed is suitable for use in teaching material about the properties of light in class V elementary schools. The development of media with a three-dimensional model was chosen because it adapts to the final results of the learning outcomes and objectives, namely that students can demonstrate the properties of Light in everyday life. In this case, the Light Box 3D media focuses on student activity. According to (Malo et al., 2025) students who are actively involved in learning not only gain knowledge, but are also better prepared to face learning challenges which have an impact on achieving optimal learning outcomes. The ADDIE model was chosen because it is in line with the research objectives to be achieved. Light Box 3D learning media also functions to facilitate students in carrying out simple trials or experiments so that they can form independence and experience. This is supported by the statement put forward (Sudirman & Aditya, 2019) that using media when IPAS learning can help improve students scientific skills.

The Light Box 3D media has been determined to be suitable for use in fifth-grade classrooms, as it aligns withs established theories of human developmental psychology, where in this class students are still at the concrete operational stage. Using appropriate media can significantly increase students' understanding. This is supported by (Wulandari et al., 2023) stating that choosing the right media can reduce students' passive learning behavior and encourage independent knowledge acquisition. This is in accordance with the Light Box 3D learning media which places more emphasis on student activity, where students are asked to try to demonstrate the properties of light using tools that already exist in the learning media. Light Box 3D learning media is not only useful for facilitating interaction and improving the quality of learning, but also helps students to remember material in different ways. Through media, students will be better able to answer their curiosity through direct experience in

operating learning media (Padmasari et al., 2024).

The Light Box 3D learning media been shown to be efficacious in improving students conceptual understanding of light properties. The conversion of abstract constructs into tangible visual representation enables students to develop more comprehensive grasp of the material. Apart from that, Light Box 3D media can help students understand complex natural science phenomena. This is supported by (Purba & Anas, 2024) who reported that light box media exerts a positive influence on the development of students critical thinking abilities. Apart from that, research results (Maimunah & Abdullah, 2024) which state that light box media makes learning more meaningful and active further strengthen that Light Box 3D learning media is effective in increasing students' understanding regarding the properties of light. Furthermore, the material contained in the media increasingly supports the effectiveness of implementing the Light Box 3D learning media. The material is equipped with colorful visuals that support an impressive appearance on the media. According to (Julianto et al., 2019) attractive illustrations help eliminate student boredom while learning. Furthermore, the use of interesting illustrations can increase students' interest in learning. In addition, the appearance aspect is one of the most important aspects in learning media because it can stimulate the brains of students, so that they are more focused (Putri et al., 2024).

The Light Box 3D learning media developed has potential limitations related to technical aspects. This is because the size of the media is relatively large so it can limit the mobility of media use in the classroom. Apart from that, this media also has limitations in terms of usage time. Where in its application, teachers must pay attention to the length of learning time. This is because media that emphasizes direct student activities takes a long time so it is not suitable for use in learning with a short duration (Khasinah, 2021).

CONCLUSION

This study concludes that the Light Box 3D learning media is a valid, practical, and effective tool for teaching the properties of light in Grade V IPAS subjects. By providing tangible and interactive learning experiences, the media addresses students' difficulties in understanding abstract concepts. With a validity expert score 94% and practicality expert score of 92% and a high N-Gain effectiveness of 76.92%, the Light Box 3D enhances both student engagement and comprehension. Future improvements could include integrating digital features for increased interactivity.

This study has successfully demonstrated that the developed Light Box 3D learning media is of exceptional quality and highly effective in the learning. These findings are supported bt several key results: (1) validity, both of media experts gave extremely positive evaluation of the media, with an scores average is 94%. This indicates that the media’s content and design meet the established standards; (2) practicality, the media is also considered highly practical for use, with an average score of 92%. This means the media is user-friendly for both teachers and students; (3) effectiveness, the effectiveness test results show a significant improvement in student learning outcomes after using the Light Box 3D. The significance value obtained in the hypothesis test is 0.000, indicating a substantial difference in scores before and after using the media. Additionally, the N-Gain value of 76.9166% also indicates that the media can significantly enhance students understanding. The light box 3D media can also be further developed by adding more engaging interactive features.

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