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THE VALIDITY AND FEASIBILITY OF A HANDBOOK ON THE PROPERTIES OF LIGHT AND REFLECTIONS INTEGRATED WITH 1-SIDE HOLOGRAM LEARNING MEDIA FOR MIDDLE SCHOOL STUDENTS

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ABSTRACT

Based on the needs analysis conducted by the researcher, we found that 71% of students had difficulty with the properties of light and reflection material, and 75% of students preferred innovative books integrated with learning media over conventional books that were often used by teachers. Therefore, it is necessary to develop a handbook on the properties of light and reflection, which is integrated with 1-side hologram media. The purpose of this study was to develop and analyze the level of validity and feasibility of this handbook. The method used to develop the handbook is the ADDIE model (Analysis, Design, Develop, Implement, and Evaluate). To obtain the validity and feasibility, the instruments were developed and distributed to expert validators, teachers, and students. We successfully developed the handbook and it was declared valid with a percentage of 81.5% and 95.2% from the material and media aspects. This product was also declared feasible with a percentage of 81.4% and 92.9% according to students and teachers. This result means that the handbook can be used by middle school students to study the properties of light and reflection with 1-side hologram media. This study contributes to how to teach the properties of light and reflection in another media, a 1-side hologram.

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1. INTRODUCTION

Technology has made human life better and easier (Ali, 2021). This also applies in the field of education, where teachers and students are required to be able to use technology in the learning process. The use of learning media is also considered capable of saving time for teaching preparation, minimizing student misconceptions, and increasing learning motivation (Shofwan, 2009). Learning media is a learning process aid that can be heard, seen, and touched with the five senses to convey information to students to stimulate thinking skills and as a communication tool between teachers and students (Rahmawati, 2020).

Learning media are grouped into various types and varieties. However, if classified broadly, learning media are divided into visual media, audio media, and audio-visual media

(Pradekso & Widagdo, 2013). Learning media that utilize visuals and audio have many benefits, one of which is to attract attention and focus students' concentration on the learning process. Therefore, the greater the student's attention in the learning process, the better the students will understand the material (Sholihah, 2019). Therefore, it can be concluded that audio-visual media is a media that helps students to understand the material.

One example of audio-visual media developed by previous researchers is hologram media. Hologram media is a holographic technology product that utilizes various coherent light perspectives to create objects that appear realistic (Rahmawati, 2020). In addition, holograms utilize the properties of light reflection, so you can see images and images projected on the projection screen from various angles and make them look realistic (Sari, 2020). Holograms have several advantages and disadvantages (Setiawan et al., 2023), namely (1) although hologram-based media produces visual elements that cannot interact, these visual elements can resemble their original form; (2) realistic visualization makes it easier for students to absorb and understand information, but they also need advanced supporting tools to create good visualizations; (3) visualizations produced by hologram-based media can be further explored for use but require capable, complete, and complex multimedia (Rahmawati, 2020). Thus, it can be concluded that audio-visual media is a media that can help students understand the material (Setiawan et al., 2023).

Science is not only a product of knowledge about nature in the form of concepts, laws, facts, or principles, but also a method for understanding natural phenomena and efforts to foster a scientific attitude (Lestari, 2015). However, there are some students who find it difficult to learn science learning (Sunarno, 2018). There are internal and external factors that cause junior high school students to have difficulty understanding science lessons. The learning disability factor from internal factors of students is in the form of aspects of interest, intelligence, talent, and motivation. School facilities and infrastructure, teachers, and school activities can be external factors (Haqiqi, 2018). Science learning consists of many concepts that are generally abstract. The difficulty faced by most students is interpreting various science concepts.

One of the science materials that experiences obstacles in direct observation is the material on light and optics, with the topic on the formation of shadows in mirrors (Mulyadi, 2018). The material on light and optics is classified as quite abstract if it is not supported by adequate teaching media (Dewa Made Dwicky Putra Nugraha, 2022). This is supported by previous research, where most students still find difficulty in understanding optics material (Endah Atitya, Muhamad Firdaus, 2018). The results of previous research also show that students still have misconceptions about mirror material. The total level of misconception among female students is 12.5% and among male students 20% (Capriani, 2016). So learning media regarding science lessons, especially for the topic of image formation in mirrors, is needed in the learning process.

The learning media on light and optics has been developed in various form, such as e-module, interactive multimedia, crossword puzzle, and optical kit. For example, Hakim et al developed an e-module to facilitate students in learning light and optics at home (Nur Hakim et al., 2020); Suniati et al developed interactive multimedia for students in decreasing misconception on light and optics (Suniati et al., 2013); Ariyanti developed crossword puzzle in increasing student learning outcome of light and optic material (Ariyanti, 2019); and Wibowo & Marzuki developed an optical kit to elevate science process skill of student in learning light and optics (Tri Wibowo et al., 2022). These media also developed in various purpose of teaching by researchers or teachers.

However, media with hologram spesification has never been done, and it provides a novelty to carry out this research.

This study aims to analyze the validity and feasibility of the handbook of light properties and reflection material for 1-side hologram learning media for middle school students. The limitation of this study focuses on the validity and feasibility of the handbook, and not focuses on the effectivity of the handbook in the classroom. In addition, this handbook is integrated for 1-side hologram media only and not integrated for all kinds of hologram media. The novelty of this study lies in 2 things, namely the material of light and reflection, and the type of hologram media integrated in the handbook. According to the results of the literature review, hologram media has previously been developed on the material of the solar system, sound, and layers of the earth (Andini & Setiawan, 2022; Muhtar et al., 2023; Nawang et al., 2023). These hologram media were applied of the hologram pyramid type and 3-side hologram.

2. METHOD

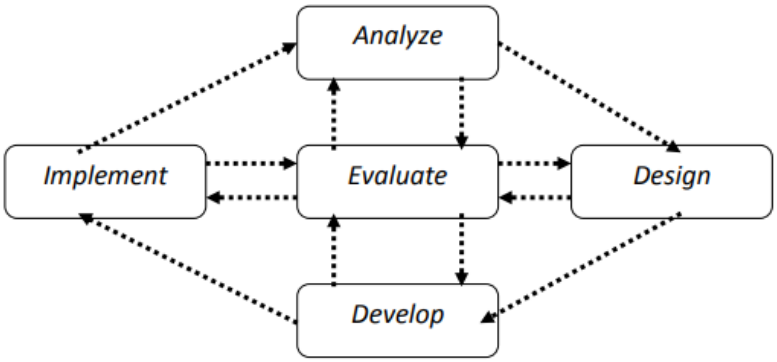


Figure 1. The diagram of ADDIE

This study was a research and development type to create a handbook on the properties of light and reflection material integrated with 1-Side hologram for middle school students. To develop the product, we used the ADDIE (Analysis, Design, Develop, Implement, Evaluate) model created by Branch, and it consisted of 4 stages and evaluations at each stage. The evaluation results from the previous stage will be used as input in the next ADDIE stage (Cahyadi, 2019). The flow in the ADDIE model is presented in Figure 1, while the details of the activities of each stage are shown in Table 1.

In general, the instruments used consist of 3 types. First, the needs analysis instrument, namely the interview sheet for science teachers and the questionnaire sheet for junior high school students. Second, the validation instrument, namely the validity test sheet for the material and media expert validator. Third, the feasibility instrument, namely the feasibility test sheet for science teachers and junior high school students. The expert validators here are 2 lecturers from the Department of Science Education, Universitas Negeri Malang (UM), while the respondents for science teachers are 2 people, and the junior high school students who participated are 31 people. This research was conducted at SMPN 1 Malang City, East Java, Indonesia.

This study used descriptive analysis techniques, with qualitative and quantitative data types. Qualitative data were obtained from interview results and suggestions from validators and respondents, while quantitative data were obtained through questionnaire results and validity and feasibility test sheets. The measurement scale used was the Likert scale, with four assessment

scales, namely a score of 4 means "Strongly agree / Very good"; a score of 3 means "Agree / Good"; a score of 2 means "Disagree / Not good" and a score of 1 means "Strongly disagree / Very bad" (Djanuar, 2005). Meanwhile, the indicators of conceptual truth of the material used the Guttman scale, namely a score of 1 with the statement "Correct" and a score of 0 with the statement "False" (Oktaviara & Pahlevi, 2019).

Table 1. The stage of development product

Stage	Activity
Analyze	- Interview with science teachers for the first need analysis - Distributing questionnaires to middle school students for the second need analysis
Design	- Determining the topics presented in the handbook related to the properties of light and reflection - Determining the type and number of holographic videos from the material - Designing the storyboard and layout of the handbook
Develop	- Developing the content of the materials and videos in the handbook - Determining the output format of the handbook - Creating the validity and feasibility instruments
Implement	- Conducting validity tests from expert validators - Conducting feasibility tests from science teachers and middle school students
Evaluate	- Evaluating the results of the first and second needs analysis - Evaluating the handbook design - Evaluating the validity and feasibility instruments - Evaluating the results of validity and feasibility tests

The equation 1 is used to calculate the percentage of data, where P is percentage, ∑xi is the numbers of achieved score, and ∑x is the numbers of maximum score (Riduwan, 2012).

$$P = \frac{\sum xi}{\sum x} \times 100\% \quad (1)$$

Next, the percentage of scores obtained is interpreted using table 2 with valid or feasible criteria. (Arikunto, 2010).

Table 2. The criteria of validity/feasibiliy levels

Precentage (%)	Criteria
76 – 100	Valid/Feasible
51 – 75	Quite Valid/Feasible
26 – 50	Less Valid/Feasible
0 – 25	Not Valid/Feasible

3. RESULTS AND DISCUSSION

3.1. Analyze stage

The analyze stage is carried out by analyzing needs by interviewing science teachers and distributing questionnaires to students to find out the actual conditions in the learning process that occurs. The results of interviews with science teachers obtained data that learning activities are mostly lecture methods with question-and-answer methods and reinforcement at the end of learning. Learning media that are often used by students are printed books and videos from YouTube. While hologram-based learning media and supporting books that support these media have never been used. Then, the results of the questionnaire to students obtained data that 83% of students stated that science lessons were difficult and as many as 66% of students still had difficulty understanding light and optics material, where 71% of the difficulties were focused on the sub-material on the formation of shadows in mirrors. In addition, as many as 75% of students like learning that utilizes videos from printed books that are often used. Based on the results of this needs analysis, teaching materials are needed that integrate videos into learning. To make this teaching material more innovative, hologram -based learning media can be applied in the classroom. Therefore, we designed teaching materials in the form of handbooks on the material on properties of light and reflection to support Hologram -based learning media at the junior high school level.

3.2. Design stage

At the design stage, the sub-materials in the chapter on the properties of light and reflection are arranged so that they can be displayed in the form of holographic videos on the hologram kit in the Science Education Laboratory, FMIPA UM. The hologram kit is a tool used to project holographic videos in class. Holographic video content is embedded in the handbook in the form of a link or barcode that can be accessed by readers via a smartphone or tablet. In general, the designed handbook contains instructions on how to use the hologram kit, materials, and sub-materials on light and reflection, holographic videos in the form of links/barcodes, and is also equipped with questions to help students' understanding.

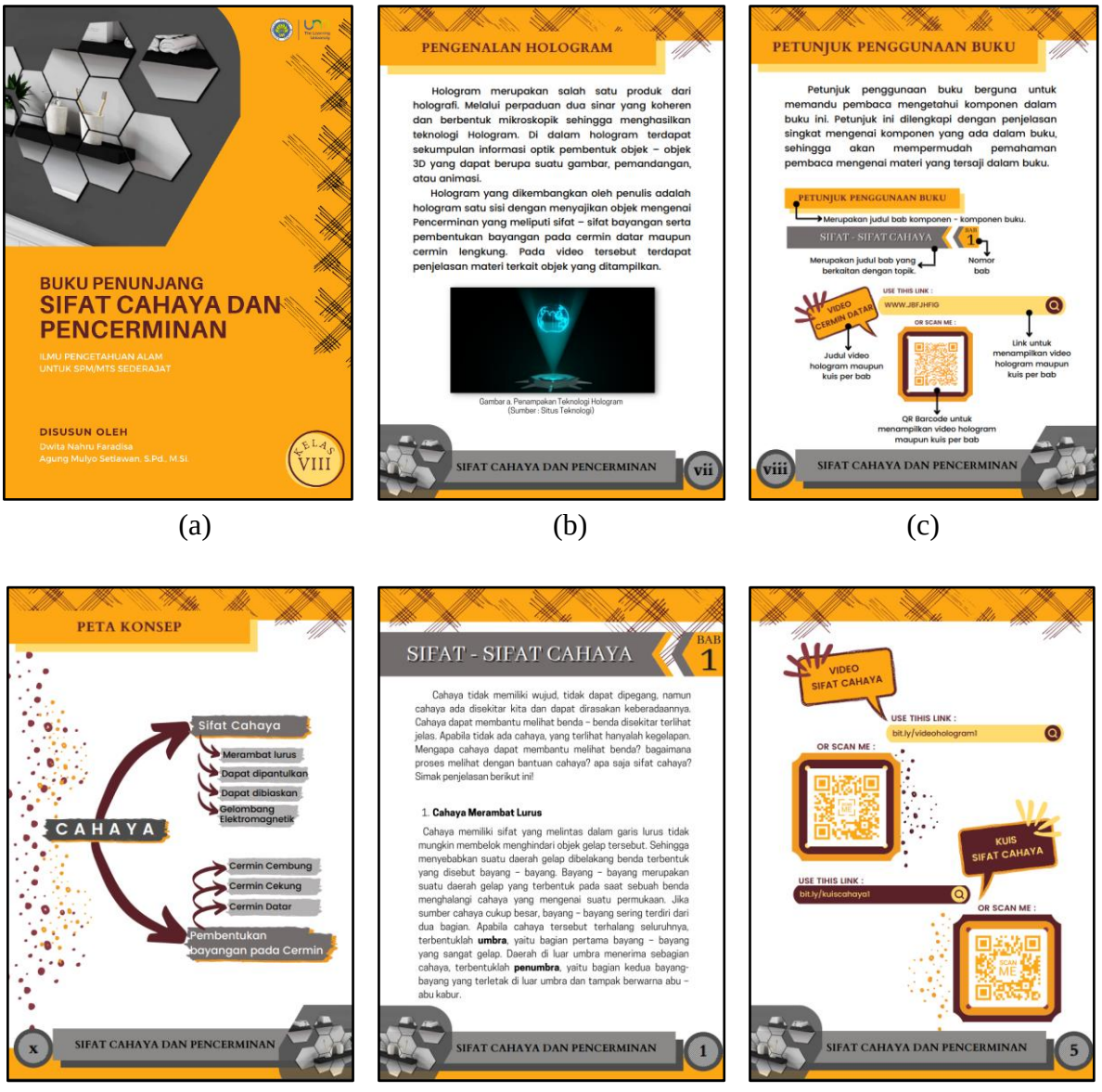
3.3. Development stage

After making the design, the handbook is then made in detail with the following sequence, namely cover and identity components, inner cover, foreword, table of contents, list of images, basic competencies, basic competency achievement indicators, learning objectives, introduction to holograms as a learning media, instructions for using the handbook, material on light and shadow formation on mirrors, practice questions, author profile, glossary, and bibliography. The results of the development stage are shown in Figure 2.

The developed holographic video can be accessed via barcode and link consisting of four videos with the following details. The first video is about the properties of light, the second video is about the formation of shadows on a flat mirror, the third video is about the formation of shadows on a concave mirror, and the fourth video is about the formation of shadows on a convex mirror.

All videos aim to help students visualize in understand the concepts of light and reflection in the hologram kit. The form of the hologram kit and the projection of the holographic video in the handbook are shown in Figure 3.

In the validation process by the expert validator, there are revisions that need to be made. In the handbook, videos and quizzes related to the properties of light were previously only embedded in the handbook in the form of barcodes. However, the expert validator suggested adding a link related to the video next to the existing barcode. This is done to anticipate the barcode no longer being valid and to make it easier for users to access the video in another way, namely a link. The results of the handbook after the improvements can be seen in Figure 2(f). In addition, the expert validator also suggested that 'words' containing definitions/terms can be written in another format, for example in bold. The results of this improvement are shown in Figure 2(e).



(a) (b) (c)

(d) (e) (f)

Figure 2. The design of handbook

(a) (b)

Figure 3. The form of hologram kit and hologram video looks when the kit used

3.4. Implementation stage

The implementation stages are carried out in the form of validation tests and feasibility tests. The validation test was carried out by two expert validators to determine the validity of the handbook based on media and material aspects. Meanwhile, the feasibility test was carried out by science teachers and students at a junior high school in Malang who had received this material. The results of these two tests can be seen in Table 3 and Table 4, while the results of the analysis are in Figure 4.

Table 3. The result of validity test

Aspect	Indicators	Percentage (%)	Criteria
Media	Size of handbook	100	Valid
	Cover and layout handbook	92,5	Valid
	The holographic video in a handbook	93,7	Valid
	The compatibility with 1-side hologram kit	92,2	Valid
Material	The truth of the concept in the material	83,3	Valid
	The suitability of material with standar competence	81,2	Valid
	The accurate of the material	75,0	Quite valid
	The breakdown of the material	75,0	Quite valid
	The update of material	100	Valid
	The linguistics of the material	75,0	Quite valid

Table 4. The result of feasibility test

Respondent	Indicators	Percentage (%)	Criteria
Science teacher	Practicality	90,0	Feasible
	Suitability	95,0	Feasible
	Benefit	93,7	Feasible
Middle school students	Forms and looks	79,6	Feasible
	Presentation	80,4	Feasible
	Benefit	84,1	Feasible

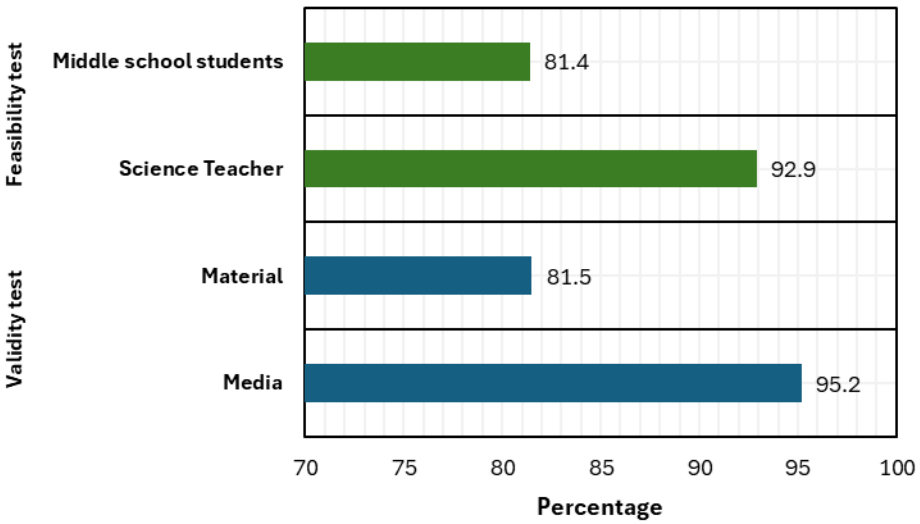


Figure 4. The average result of validity test and feasibility test

Based on the analysis of the results of the media expert validation in Figure 4, an average of 95,2% was obtained with valid criteria. This shows that the size, cover, layout, and holographic video in the handbook are good as a medium such as the data in Table 3. The validator's suggestion regarding this media is that there are still some typos that need to be fixed and some foreign language writing that must be italicized. Meanwhile, the results of the validation of the material in the handbook in Figure 4, obtained an average of 81,5% with a valid category. This means that the content in the handbook in Table 4 includes the truth of the concept, material, and language is valid and can be used in the classroom. Therefore, it can be concluded that this handbook has passed the validity test and is ready to be used in class VIII of junior high school.

In Figure 4, it appears that the feasibility test by students obtained a percentage of 81,4% with the criteria of being feasible. According to students who have received this material before, this handbook is very innovative because it supports hologram-based learning media that have never been used in schools. Students can also make a simple hologram kit prototype using tools and materials in everyday life to display holographic videos in the handbook. However, there are also comments from several students where the images or text on the video are still not clearly visible. Students argue that the room lighting should be adjusted during learning. Next, the results of the feasibility test according to the science teacher also obtained a feasible criterion with a percentage of 92,9%. However, there are suggestions from teachers that the addition of questions in the handbook is increased in number to facilitate students to learn outside of class hours or outside of effective days. From these data, it can be interpreted that the handbook on the material on the properties of light and reflection passed the feasibility test and can be applied in the classroom. These results were linear with similar studies in the development of a handbook of hologram media, as seen in the following references (Andini & Setiawan, 2022; Nurulita & Setiawan, 2024; Sertalp, 2024).

Hologram is an interference imaging technology of light wave which enables the creation of images in three dimensions with genuine depth without any other optical aids (Roslan & Ahmad, 2017). It reconstructs the light wavefront of a recorded object and enables viewing it more precisely than in two dimensions. In science instruction, particularly in the case of light and optical instruments, hologram is a significant advantage in visualizing intricate physical principles, such as the wave-particle character of light, formation of images with lenses and mirrors, and other

optical phenomena difficult to visualize by conventional methods. In studying light, hologram may be employed in order to display various optical phenomena interactively and dynamically (Walker, 2013). For instance, to learn about the law of refraction and reflection in light and optics, students can merely observe how light waves curve as they pass over the boundary of two media whose refractive indices are not the same (Bhattacharjee, 2021).

Holograms can also demonstrate light interference and diffraction, which are basic principles in physical optics. This interactive visualization extends students' intuitive understanding beyond the limits of static textbook diagrams (Barkhaya et al., 2018). Moreover, in the study of optical instruments such as microscopes, telescopes, and cameras, hologram helps visualize inner structures and operating mechanisms more vividly. For example, students can see for themselves how convex and concave lenses form images depending on the location of the object, releasing the constraints of physical experiments that depend on equipment availability (Bhattacharjee, 2018). Furthermore, in the study of optical instruments such as microscopes, telescopes, and cameras, hologram enables a clearer visualization of internal structures and operational mechanisms. For example, students can observe in real-time how convex and concave lenses form images depending on the object's position, eliminating the constraints associated with physical experiments that may be limited by equipment availability. Holograms can also simulate light refraction in various complex lens designs, aiding in the comprehension of optical principles applied in modern technology. By providing precise spatial representations, hologram serves as an effective educational tool to enhance students' conceptual understanding of optics (Roslan & Ahmad, 2017; Tyng et al., 2023).

4. CONCLUSION

This study aims to produce a valid and feasible 1-side hologram handbook product on the material of light properties and reflection at the junior high school/Islamic junior high school level. The method used to make the handbook is the ADDIE model which is then analyzed descriptively. Based on the results of the validity test, the material and media aspects of the handbook obtained a percentage of 81,5% and 95,2% respectively. While the results of the feasibility test on junior high school students and science teachers obtained a percentage of 81,4% and 92,9%. Therefore, these two results indicate that the 1-Side hologram media handbook on the material of light properties and reflection is declared valid and feasible to be used in schools. Suggestions for further researchers, it is necessary to conduct an effectiveness test on this handbook to determine its effectiveness on student learning outcomes. In addition, learning with this handbook can be integrated with the Project Based Learning (PjBL) model to facilitate student creativity with the holographic videos in the handbook.

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