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CONTENTS

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FACILITATING PHYSICS PROBLEM-SOLVING SKILLS WITH GEOMETRY OPTICS E-MODULE FLIPBOOK VIEW: A RELIABILITY TEST

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ABSTRACT

Students' physics problem-solving skill is still low, especially in physics problems related to everyday life, not simple quantitative problems. This is because the learning modules used today still do not invite students to solve real problems around them related to physics. This study aims to test the feasibility of the E-Module with a flipbook view which was developed to improve students' problem-solving skills on the material of reflection and refraction of light. The research method used is Research and Development (R&D) with a 4-D development model. The stages of E-Module development in this research are only the define, design, and development stages. The research instrument was in the form of an E-Module feasibility test questionnaire via google form which was tested by 50 prospective physics teacher students. The results showed that the feasibility level of the developed E-Module was within the very feasible criteria. Thus, the developed E-Module is very feasible to improve students' problem-solving skills and can proceed to the broad trial stages.

INTISARI

Kemampuan pemecahan masalah fisika siswa masih rendah, khususnya pada permasalahan fisika yang berkaitan dengan kehidupan sehari-hari, bukan pada permasalahan kuantitatif sederhana. Hal ini dikarenakan modul pembelajaran yang digunakan saat ini masih kurang mengajak siswa untuk memecahkan permasalahan nyata di sekitarnya terkait fisika. Penelitian ini bertujuan untuk menguji kelayakan dari E-Modul dengan tampilan *flipbook* yang dikembangkan untuk meningkatkan kemampuan pemecahan masalah siswa pada materi pemantulan dan pembiasan cahaya. Metode penelitian yang digunakan yaitu Penelitian dan Pengembangan (R&D) dengan model pengembangan 4-D. Tahapan pengembangan E-Modul dalam penelitian ini hanya pada tahap *define*, *design*, dan *develop*. Instrumen penelitian berupa angket uji kelayakan E-Modul melalui google form yang diuji oleh 50 mahasiswa calon guru fisika. Hasil penelitian menunjukkan bahwa tingkat kelayakan E-Modul yang dikembangkan berada pada kriteria sangat layak. Dengan demikian, E-Modul yang dikembangkan sangat layak untuk meningkatkan kemampuan pemecahan masalah siswa dan dapat dilanjutkan ke tahap uji coba luas.

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A. Introduction

The problem-solving skill becomes one of the 21st-century skills to master by learners in this era. The skill suggests the learners actively participate, learn, find, and seek information individually so that they can solve problems [1]. Problem-solving skill is important for high-order thinking skill to manage real and complex problems in the world [2], [3]. Therefore, problem-solving skill is important for learners to train continuously.

One of the activities to improve the problem-solving skill is - a learning process. The problem-solving process should consider the learners' problem-solving skills instead of learners' conceptual understandings and their capabilities of constructing new knowledge [4], [5]. The physics learning process in the class seems to emphasize conceptual mastery instead of physics problem-solving skills. This matter causes the learners to have lower physics problems when they encounter real physics problems [5]. Most students could solve simple quantitative problems but they could not solve more complex problems. Most students had difficulties in solving physics problems because the teachers only taught the learners to solve problems with mathematical calculation. This matter makes the learners only recognize and memorize the given formula without realizing the qualitative and conceptual meaning of the formula [6], [7]. Thus, most learners had difficulties when they encountered a complex physics problem.

Many scholars studied the problems of physics problem-solving. Mulhayatiah, et al [8] found that most learners could not solve physics questions with daily problems. Azizah, Yulia, and Latifah [6] also found that learners tended to apply mathematical methods while working on physics questions without analyzing the questions. Thus, the students could not think complexly and had difficulties solving complex problems. The findings showed that learners' problem-solving skills were low and not optimum. Thus, they had to improve their skills.

The accurate method to improve the learners' problem-solving skills is to apply problem-solving skill stages in a learning process. Polya [9] explains four problem-solving stages. They are: (1) recognizing and understanding the problems; (2) planning the problem-solving strategy; (3) solving the problems based on the plan, and (4) checking and evaluating the steps. These steps could improve the learners' problem-solving skills.

Many learning processes encountered difficulties due to a lack of learning resources because the process mostly applied presentations with *PowerPoint* and textbooks downloaded from the Internet [10] [11]. These actions made the learners lazy to learn and inactive. The other factor of lower problem-solving skills was - a huge amount of materials to deliver. This matter made physics teachers could not deliver all materials. From these findings, a learning process requires a learning source in the form of a learning module. A learning module has specific and different characteristics from other learning resources: (1) *Self-instructional* refers to a

characteristic that allows learners to learn autonomously, (2) *self-contained* refers to the capability of the module to cover all required materials for the learners; (3) *stand-alone* refers to the dependency feature of a module; (4) *adaptive* refers to the high adaptability of a module with the current development of science and technology and applicability, and (5) *User-friendly* refers to the convenience while using the module [12]. Therefore, the existence of a learning module facilitates the learners' needs.

Developing a learning module requires some aspects to consider, for example, the completeness of the content, the applied language, the display of the cover, the layout arrangement, etc. The other component to provide is - the key answer to the evaluative questions. This component facilitates learners to check their success while understanding a material [13]. The applied language in a module should be adjusted to PUEBI, General Guidelines for Indonesian Spelling. Depdiknas, the Department of National Education [14], explains that all teaching materials must consider the language components, such as the language reliability to facilitate learners in understanding the learning materials. The other aspect to consider is the tidiness of the module, including the cover. A cover of a module is important to describe the materials and the applied learning approach [15]. Daryanto [16] also explains that the combination of colors, figures, shapes, and letters should be harmonious to realize an attractive cover of a module. A module with a tidy layout will attract learners to read the module. Ramadhani and Mahardika [17] explain the graphic aspects of developing a module, such as the size or module format, the layout, the design, and the tidiness of the content. Thus, developing a module must consider those elements to ensure an optimum and useful module for learners.

Some learners may assume that physics is a difficult lesson. Suyoso and Nurohman [18] explain that physics is a difficult lesson so the lesson needs a creative approach and follows the learners' learning styles. The implementation of a printed book may not be practical because the printed module is not interesting for learners. Moreover, the printed module cannot provide materials in the form of figures and videos [12]. Learners need creative and attractive physics modules that do not make them difficult to learn.

One of the efforts to realize the ideal module is - applying digital technology with E-Module, the electronic module. E-Module has some benefits. They are (a) content of materials and various questions supported with figures and videos, and (b) accessibility and facilitation for learners based on their material interest. One of the E-Module innovations is E-Module with Flipbook display. The strong points of E-Module with Flipbook display are (1) providing the flip effect as if the readers were reading real books; (2) providing facility to use, and (3) providing figures, sounds, and videos [19]. On the other hand, E-Module also has some drawbacks, such as a lack of learning device supports found on a computer or other electronic devices [20]. Although E-Module has some drawbacks, E-Module still has more superiority over the printed module.

A commonly printed module could not invite the learners to solve physics problems. The cause of this problem was the linear feature of a printed module. The physics learning module mostly presents principles and concepts, examples of the questions, exercise questions, and discussions of the answers. However, they lack real problems from the learners' surrounding environment [5]. These situations do not provide learners with adequate opportunity to develop their problem-formulating skills, problem-solving skills, and understanding. Therefore, a physics module that could improve learners' problem-solving skills is important.

The development of a physics module to improve problem-solving skills is important, especially for the materials of reflection and refraction. The materials are observable from the surrounding areas and many learners encounter these phenomena [21]. However, many learners could not understand the concept and could not connect the phenomena in their learning. Azizah, Yuliati & Latifah [6] and Saputri & Nurussaniah [22] found that learners encountered difficulties in solving problems related to optics material, especially about the refraction of light within two mediums with different refraction indexes. These difficulties could be managed by E-Module with the problem-solving model on refraction and reflection of light.

From the explanations, the teachers must use supportive learning sources to improve the learners' problem-solving skills [23]. The learning source is an E-Module with a flipbook display. Hermawati [24], explains that an electronic module with a flipbook display could be a solution to manage the poor problem-solving skills of the learners. The content of an E-Module with *a flipbook* look had to consider the problem-solving skills of the learners. In this research, the researchers determined the reliability of the physics E-Module with *a flipbook* display to improve the learners' problem-solving skills about the materials of light reflection and refraction.

B. Method

In this research, the researchers applied Research & Development model proposed by Thiagarajan. Thiagarajan [25] proposed a 4D model to develop a product, starting from defining, designing, developing, and disseminating. The researchers selected this model to develop the E-Module because the model had clear procedural stages. The stages were clear, complete, understandable, and systematic. In this research, the stages of developing the E-Module began with defining, designing, and developing. Then, in this research, the researchers excluded the dissemination stage because the current research aimed to test the reliability of the developed E-Module. Thus, the researchers stopped the process in the development stage since this stage represented the objective of the research.

In the beginning, the researchers promoted the defining stage. The researchers did this stage by reviewing the works of literature and the published articles from journals as references to design the developed E-Module. The researchers conducted the literature study by collecting and analyzing the problems from various journal

articles. Then, the researchers analyzed the need for E-Module as an alternative to the printed module since the printed module was considered less practical. Then, the researchers did the final step by analyzing the material of geometric optic for the developed E-Module.

In the designing stage, the researchers applied some steps. The researchers initially designed the E-Module with *canvas* and *web.issuu.com.* In this step, the researchers also chose references to create materials about the reflection and refraction of light. In this step, the researchers made the questionnaire on the developed E-Module reliability.

Then, the researchers stopped the process in the development stage because this stage was the last stage of this research. In this stage, the researchers promoted a validity test and revised the developed product based on criticisms and suggestions of the validators. The tested reliability aspect included the content, language, and display aspects. The reliability aspect includes four indicators to assess. They are: (1) the requirement and the order of the materials, for the reflection and refraction of light, designed in the E-Module; (2) the clarity of each explained problem solution stated in the guideline of E-Module implementation, and (3) the relevance of the questions in the E-Module to improve problem-solving skills; and (4) the relevance of the E-Module with daily life problems presented in the E-Module within the materials of light reflection and refraction. The language aspects include four indicators to assess. They are: (1) the relevance of the applied language in the E-Module and the General Guideline of Indonesian Language Spelling, PUEBI; and (2) the applied communicative and informative language in the module The presentation aspect includes four indicators to assess. They are: (1) the relevance of the E-Module's cover design and the presented materials; (2) the appropriateness of the font options, the layouts between the explanation and the figures about the materials; (3) the relevance, the accuracy, and the clarity of figures and videos presented in the E-Module about the materials; and (4) the accessibility of the E-Module's link containing the materials of light reflection and refraction.

The applied instrument was a reliability questionnaire shared via *Google Form.* The researchers determined the quality of the developed E-Module based on the assessments and suggestions from the examiners. In this research, the examiners consisted of 50 physics teacher candidates. With this procedure, the researchers expected to determine the reliability of the developed product. Thus, the researchers needed the physics teachers candidates because they were aware of the materials so they could determine the reliability of the E-Module. The researchers considered the E-Module reliable if the examiners shared their assessment, very excellent. In this case, the examiners could also share their expectations, criticisms, and reasons for further reference to revise the product. Thus, the product will be more effective to improve the learners' problem-solving skills.

The data from the reliability test were ordinal. Then, the researchers converted the data into interval data so that the researchers could analyze the data statistically. The researchers converted the ordinal data into interval data with *Microsoft Excel*. The applied criteria for the research instrument were based on the conversion formula proposed by Djemari [26]. The converted data results were quantitative into qualitative data with the modified 4-scale as shown in Table 1.

Table 1. Assessment Criteria

Quantitative Score Interval	Category
$X \geq M_i + 1{,}5SB_i$	Very reliable
$M_i \leq X < M_i + 1{,}5SB_i$	Reliable
$M_i - 1{,}5SB_i \leq X < M_i$	Fairly Reliable
$X < M_i - 1{,}5SB_i$	Unreliable

Remarks:

X = Final mean

M_i = The ideal mean calculated with the formula

$$M_i = \frac{1}{2}(skor\ maksimum\ ideal + skor\ minimum\ ideal)$$

SB_i = The ideal standard of deviation calculated with the formula

$$SB_i = \frac{1}{6}(skor\ maksimum\ ideal - skor\ minimum\ ideal)$$

C. Results and Discussion

The undergoing stages in this development were *defining*, *designing*, and *developing*. The defining stage revealed the problems about learners' problem-solving skills, the physics module, and the materials of light reflection and refraction. From the works of literature, the researchers determined the problem-solving skill level of the learners. The skills were very low, especially in physics lessons [5]. The analysis results, based on the literature, showed that the module applied to the learners was not practical. Most modules were non-electronic modules and only contained exercise questions without any problem-solving stages [27]. From the literature, the researchers found that the materials of reflection and reflection were mostly encountered by learners in their daily life, moreover for Senior High School learners. However, they still had difficulties solving problems dealing with the materials [21], [22].

In the designing stage, the initial design of the E-Module consisted of a cover; preface; table of content; the objective of the lesson; conceptual map; introduction; material explanation, such as *did you know*, *information corner*, *let's exercise*, and *tips & trick;* Polya-based problem-solving questions [9], a column for asking questions; bibliography; and identity of the authors. The researchers developed the E-Module by

considering the learning components, starting from the texts, figures, videos, and evaluative questions. Here are the figures in the E-Module.

Figure 1. The Example of the E-Module Content

In the development, the package of the E-Module presented material explanation by considering the learners' problem-solving skills. The E-Module explains the materials about refraction and reflection of lights in daily life. These materials

facilitated the learners to develop their problem-solving skills, such as formulating problems, solving problems, and constructing their knowledge. Most modules did not provide adequate opportunities for learners to develop their problem-solving skills [5]. In this research, the researchers expected the implementation of the E-Module could improve the learners' physics problem-solving skills.

Figure 2 shows the descriptions of the E-Module related to the reflection and refraction of lights and the surrounding problems and phenomena. One of them was material about light reflection. In this research, the researchers connected the material, light reflection, rearview mirrors, and convex mirrors on the roads. These examples made the learners think about the phenomena and inquired how the phenomena happened. Mulhayatiah, et al [8] found that most learners could not solve physics questions with daily problems. The E-Module also explains the materials and their connections with daily life problems. Thus, the learners could improve their skills in solving daily physics problems.

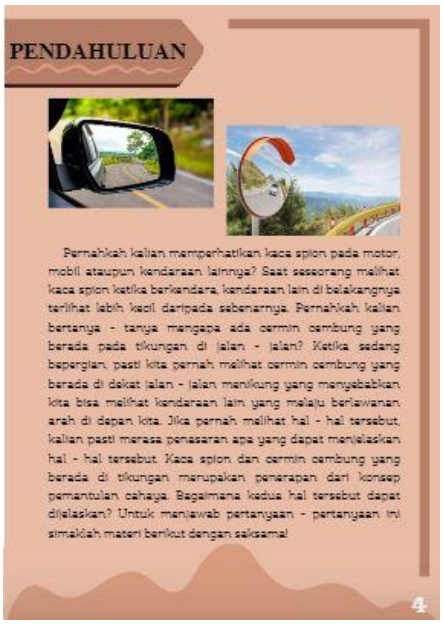

Figure 2. The Researchers Connected the Content of the Materials with the Surrounding Phenomena.

Besides the material explanation related to daily life problems, the developed E-Module also presented questions based on Polya's problem-solving stage guideline [9]. Thus, learners could not only solve quantitative problems or mathematical calculations with formulas, but they could solve more complex problems. Azizah, Yuliati, and Latifah [6] explain that learners must receive complex physics questions to train their problem-solving skills. Therefore, with the developed E-Module, the researchers expected the learners could manage their difficulties to solve complex physics problems in daily life.

One example of the question is observable in Figure 3. The figure shows the content of the E-Module titled "Ayo Memecahkan Permasalahan." This section consisted of questions with materials of light reflection based on a real phenomenon, the rearview mirror of a car. The learners had to work on this question based on Polya's problem-solving stages [9]. In the beginning, the learners had to identify the problems based on the concepts. Then, they had to determine the most relevant concept to solve the problem. In the third step, the learners had to explain the problem-solution based on the selected concept. The last stage was - inviting the learners to recheck the appropriateness of the concept to solve the problems. The questions made the learners think carefully about the answer. They had to answer with a systematic step. From this activity, the learners could improve their problem-solving skills.

Figure 3. The Problem-Solving Questions

The developed E-Module was based on the module characteristics as suggested by Daryanto [16], especially in terms of adaptive and user-friendly characteristics. The developed E-Module had high adaptability toward the science and technology development in which learners mostly used their handphones and laptop computers rather than their books. The preference of the learners made this E-Module suitable for the learners. Then, the module could be accessed via handphone or laptop.

The E-Module also had a flipbook display as an effort to develop creative, interesting, and unique teaching materials. The strength points of the E-Module's flipbook display were the figures, the gift animations, and the videos that were accessible via YouTube. Thus, the module could make the learners' understanding

better. Besides that, the flipbook display also had animations that made the learners experience the sensation of flipping real books. Asini explains the strong points of E-Module with Flipbook display are (1) providing the flip effect as if the readers were reading real books; (2) providing facility to use, and (3) providing figures, sounds, and videos [19]. Thus, the use of a flipbook would be a new thing for the learners. This new matter became the additional value of the developed E-Module because the module was accessible anytime and anywhere with an interesting display. The researchers expected the E-Module could improve the learners' interest to learn physics.

Figure 4. The Flipbook Display of the E-Module

After designing the modules with some excellent features, the next step was - the developing stage. In this stage, the researchers examined the reliability of the E-Module by involving 50 examiners to judge the content, language, and display aspects. The developed E-Module was categorized as very valid if the mean score of each variable was $\geq 3{,}25$. The reliability test results of the content, language, and display are observable in these figures.

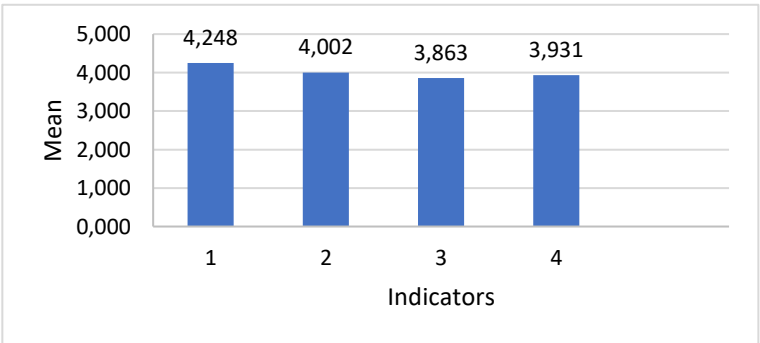

Figure 5. The Reliability Test Results on Content Aspect

Generally, the examiners found the content aspect of the developed E-Module was very reliable. The evidence was the obtained mean score of each indicator, higher

than 3.25. In this aspect, the highest score was observable from the first indicator, the completeness and the material order of light reflection and refraction presented in the E-Module. The score indicated that the presented material in the E-Module accommodated all materials about refraction and reflection of light. In this case, the researchers designed the materials orderly based on the core competence, basic competence, indicator, and learning objective. The completeness of the module fulfilled a characteristic of a module, *self-contained.* Thus, the developed E-Module contained all materials needed by the learners [16]. The module package was complete and started from the clear objectives and material summary.

In the content aspect, the researchers found an indicator with a lower score, the third indicator. This indicator dealt with the relevance of the questions to improve learners' problem-solving skills. Although the third indicator was categorized as very reliable, the experts provided some suggestions. One of them was - the need for key answers to facilitate learners measuring and evaluating their problem-solving skills. Auliya and Kosim [13] found that key answers could facilitate learners to check their achievements in understanding certain materials.

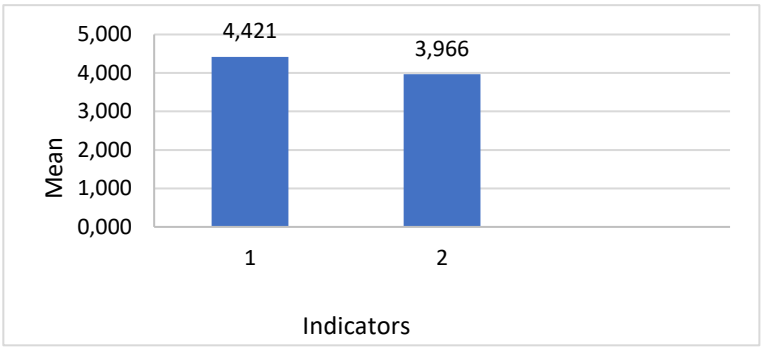

Figure 6. The Reliability Test Results on Language Aspect

Generally, the examiners found the language aspect of the developed E-Module was very reliable. In this aspect, the first indicator, the relevance of the applied language in the E-Module, based on the General Guideline of Indonesian Language Spelling, obtained a higher mean than the second indicator. The score shows that the applied language was relevant to the General Guideline of Indonesian Language Spelling. The relevance of the PUEBI, the General Guideline of Indonesian Language Spelling, could prevent ambiguity and improve the readability of the text. Thus, readers would understand the content. Depdiknas, the Department of National Education [14], explains that all teaching materials must consider the language components, such as the language reliability to facilitate learners in understanding the learning materials.

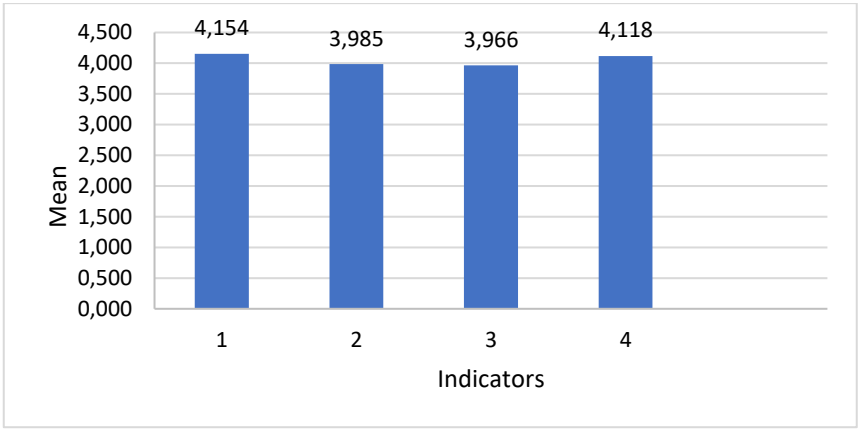

Figure 7. The Reliability Test Results on Display Aspect

Generally, the examiners stated the display aspect of the E-Module was very reliable. In this aspect, the first and the second indicators obtain similar results. The first indicator, the relevance of the E-Module design with the presented materials, indicated that the materials were excellently presented in the module. In this case, the presented materials were the geometrical optics in terms of reflection and refraction. The relevance of the cover design of the presented material would make the learners an initial portrayal of the contained materials. Thus, they would read the content. A cover of a module is important to describe the materials and the applied learning approach [15]. Daryanto [16] also explains that the combination of colors, figures, shapes, and letters should be harmonious to realize an attractive cover of a module.

The second and the third indicators obtained similar results. These indicators had lower scores than the other indicators. For the third indicator, dealing with relevance, accuracy, and clarity of the figures and videos in the module with the materials, the results showed a very reliable category. However, the results also suggested some revisions. The suggestions were to put the layout of the figures above the page border. Thus, the layout would be tidier and the distance between paragraphs could be enlarged. These layouts would allow readers to read easily. Ramadhani and Mahardika [17] explains that tidiness is important. They also explain some graphic aspects while developing a module, such as the size, the format, the layout, the design, and the content.

Based on the reliability test results, the developed E-Module was categorized as very excellent. However, there were some revisions to do based on the suggestions. One of them was to tidy up the figures on each page border. Here is the figure for the pre-revised module (left) and the post-revised module (right).

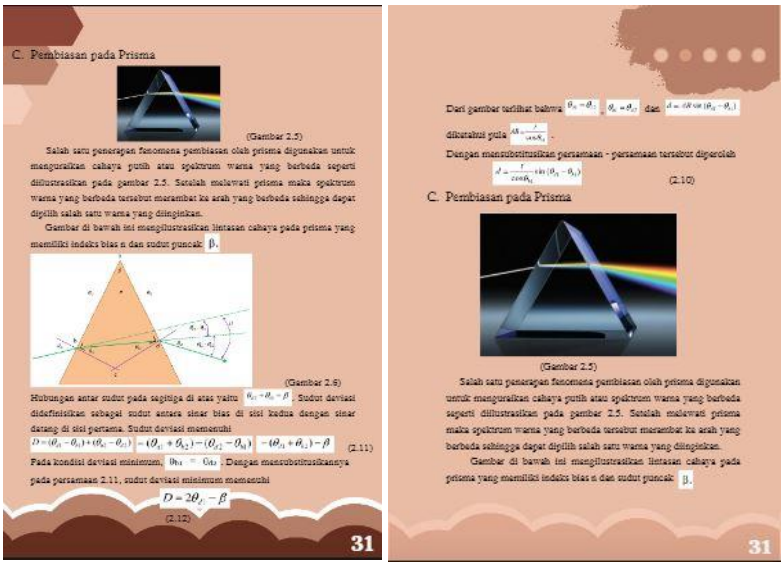

Figure 8: The Revision based on the Experts' Suggestions

Based on the explanations, the developed E-Module was categorized as excellent. Therefore, the developed module could proceed to the next stage, the field test by involving students. This test would be useful to determine the effectiveness of the module in improving the problem-solving skills of learners, especially within the materials of light reflection and refraction. Eventually, if the field test of the developed module was effective to improve the problem-solving skills, then the module could be developed for other materials.

D. Conclusion

From the research results and discussion, the researchers concluded that the E-Module could improve the problem-solving skills of the learners on the materials of light reflection and refraction with the developed *flipbook* display. The product was also reliable to use. The reliability was observable from the material, language, and media assessment. These three aspects obtained a score higher than 3.25, categorized as very excellent. Therefore, the developed module could be tested for a wider field to determine the effectiveness and improve the quality of learners' problem-solving skills.

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Increasing Students' Interest and Learning Outcomes with the Make a Match Learning Model in Junior High School Physics Science Learning

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ABSTRACT

Science education can build knowledge, add insight, think creatively, and critically. Science also contains abstract concepts, so that students' interest and learning outcomes in science learning are not optimal. Teachers have not varied in using learning models, causing students to feel bored and less active in participating in learning. This study aims to increase the students' interest and learning outcomes in the substance pressure and its application in everyday life using the Make a Match learning model. A total 34 students of VIII grade participate in this study. The research method uses a classroom action research design which consists of two cycles, namely cycle I and cycle II. Each cycle consists of four stages, namely 1) planning, 2) implementation, 3) observation, and 4) reflection. The research subjects were students of class VIII H of SMP Negeri 2 Majenang. Data collection techniques using cognitive tests, observation, documentation, and field notes. Quantitative data were analyzed using quantitative data analysis techniques and qualitative data were analyzed using qualitative data analysis techniques. The results of the first cycle research showed that 68% of students' interest in learning meant that they had not reached the success criteria, 71% of students' learning outcomes had not reached the KKM and 29% of the subjects had reached the KKM, which meant that they had not reached the success criteria. Cycle II shows that 75% of the students' interest in learning means that they have reached the success criteria, 78% of the students' learning outcomes have reached the KKM, which means they have reached the success criteria. The conclusion of the study shows that the application of the Make a Match learning model can increase the interest and learning outcomes of students in learning science on substance stress and its application in everyday life for class VIII SMP.

INTISARI

Pendidikan sains dapat membangun pengetahuan, menambah wawasan, berpikir kreatif, dan kritis. Sains juga memuat konsep yang abstrak, sehingga minat dan hasil belajar peserta didik dalam pembelajaran IPA belum maksimal. Guru belum bervariasi dalam menggunakan model pembelajaran menyebabkan peserta didik merasa bosan dan kurang aktif mengikuti pembelajaran. Penelitian ini bertujuan untuk meningkatkan minat dan hasil belajar peserta didik pada materi tekanan zat dan penerapannya dalam kehidupan sehari-hari pada 34 siswa kelas VIII dengan menggunakan model pembelajaran Make a Match. Metode penelitian menggunakan desain penelitian tindakan kelas yang terdiri dari dua

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siklus, yaitu siklus I dan siklus II. Setiap siklus terdiri dari empat tahapan, yaitu 1) perencanaan, 2) pelaksanaan, 3) observasi, dan 4) refleksi. Subjek penelitian adalah siswa kelas VIII H SMP Negeri 2 Majenang. Teknik pengambilan data menggunakan tes kognitif, observasi, dokumentasi dan catatan lapangan. Data kuantitatif dianalisis menggunakan teknik analisis data kuantitatif dan data kualitatif dianalisis menggunakan teknik analisis data kualitatif. Hasil penelitian tahap siklus I menunjukkan bahwa minat belajar peserta didik sebesar 68% berarti belum mencapai kriteria keberhasilan, hasil belajar peserta didik sejumlah 71% subjek belum mencapai KKM dan 29% subjek telah mencapai KKM berarti belum mencapai kriteria keberhasilan. Siklus II menunjukkan bahwa minat belajar peserta didik sebesar 75% berarti telah mencapai kriteria keberhasilan, hasil belajar peserta didik sejumlah 78% subjek telah mencapai KKM berarti mencapai kriteria keberhasilan. Simpulan penelitian menunjukkan bahwa penerapan model pembelajaran Make a Match dapat meningkatkan minat dan hasil belajar peserta didik dalam pembelajaran IPA materi tekanan zat dan penerapannya dalam kehidupan sehari-hari kelas VIII SMP.

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A. Introduction

Science education can construct students' knowledge build knowledge, even though it contains abstract concepts. In order to discover a scientific fact, science is a dynamic way [1]. Science lesson is one of the subjects that students find bored and difficult. The learning process will be optimal if the teacher is able to plan the implementation up to the evaluation [2].

Students' interest in learning and the results of grade VIII science scores are not satisfactory based on data from schools in the last two years. Interest in learning can be seen in the lack of enthusiasm of students when participating in learning in class. As for learning outcomes, it can be seen from the average results of the general test for the last 2 years, namely the 2016/2017 academic year (6.74) and the 2017/2018 academic year (6.67). This average is still below the specified KKM (Minimum Completeness Criteria) (7.00). The low score can be caused by the teacher not motivating students maximally, the use of learning models is less precise or still using teacher-centered learning models. Therefore, innovation and variation in the learning process are needed to eliminate the saturation of students in the classroom. The learning process must invite students to be more active, creative, and fun. Many learning models can be chosen and made varied for each meeting. One of the learning models that contribute to activities is the use of the Make a Match model.

Teachers must interact in class during learning. The Make a Match learning model is one of cooperative learning. The learning process occurs thanks to students getting something that is in the surrounding environment [3]. The application of the Make a Match learning model can be used to improve student learning outcomes in science learning [4].

Basic natural sciences are very necessary in instilling a scientific attitude in students. Basic sciences such as physics and biology began to be considered and

developed more deeply in junior high school (SMP). Basic sciences are very important to master, because mastering the concept correctly will be very meaningful to support and develop an application. The development of western countries in mastering science and technology by prioritizing research centers.

Science learning in elementary schools is not only taught conventionally but also through various practices where students can understand the changes that occur in the surrounding environment so as to increase student interest in learning [5]. This learning model provides opportunities for students to share ideas and consider the most appropriate answers. This appropriate learning model makes the class more conducive and students are more enthusiastic and interested in learning, so that satisfactory learning outcomes are obtained [1]. The Make a Match learning model is a teaching and learning model by looking for partners where students look for partners while learning about a concept or topic in a pleasant atmosphere [6].

Considering the concepts, principles and laws of science, both Physics, Biology, and Chemistry, are produced from the results of observations, experiments and measurements in the learning process. These activities require the active role of students so that students can find their own ideas, ideas and concepts that are carried out. The science learning process requires a learning model that involves the activeness of students such as cooperative methods with Make a Match learning models, simulations, discussions, discovery learning, inquiry, and others. Learning activities must be carried out differently so that students do not get bored. The use of the model in the learning process is very necessary so that the transfer of messages is easier for students to accept [7].

Cooperative learning is a learning strategy that involves the participation of students in small groups to interact with each other. Cooperative learning accommodates students to work in groups, group goals are common goals [7]. The make and match model is a learning model in which the teacher prepares cards containing questions or problems and prepares answer cards, then students look for pairs of cards [8]. The make and match learning model are one of cooperative learning. The cooperative learning model is based on the philosophy of homo homini socius, this philosophy emphasizes that humans are social creatures [9]. The make and match model trains students to have good social attitudes and trains the ability of students to work together and train the speed of thinking.

The challenge for science teachers in particular is not in the changes that occur in nature, but the curriculum changes that occur in Indonesia at this time, which previously used the 2006 curriculum or KTSP, now changes to the 2013 curriculum (K-13) and has even been revised several times every year. The latest curriculum (K-13) uses a learning process that requires most teachers to be active, creative and innovative in implementing classroom learning to make students more active. The learning process used is made centered on the learner.

Learning outcomes are changes in overall behaviour and abilities possessed by students after learning, in the form of cognitive, affective and psychomotor abilities (not just one aspect of potential) caused by experience [2]. Improving student learning outcomes can use one of the Make a Match learning models that are applied to science learning in junior high school physics [10].

Ideally, a learning process requires appropriate strategies, methods, media, especially in science learning which have been designed to develop knowledge, understanding, and analytical skills of the surrounding natural conditions. The optimal science learning process can invite students to know firsthand the surrounding natural conditions that occur in everyday life. Learning must be able to provide provisions for students to think critically, logically, analytically, systematically, and creatively. This can be realized if the science learning process in the classroom is innovative, interesting and fun for students. Students can think of science subjects as subjects that only listen, take notes, count, and memorize so that it makes them bored and boring.

Based on observations made at SMP Negeri 2 Majenang, especially in class VIII in science lessons, students tend to be quiet and less active in participating in learning. This is possible because teachers are less varied in the use of facilities and infrastructure in the learning process in the classroom, also due to environmental factors. Students sometimes ask for other learning models that are more interesting because they feel bored with the learning process carried out and students feel bored in following the lesson.

If such conditions continue to occur, the goal of education will be farther to be achieved. This can be overcome by developing more interesting learning strategies, so that students can be interested in participating in the learning process. They are not only interested but also can play an active role in the learning process in the classroom. The teacher's task is to create and design learning so that students are more interested and play an active role in the learning process. One way of learning that is considered suitable to solve the above problems is to use the Make a Match learning model. This model can be used as a good and fun learning medium without losing the essence of ongoing learning. The active learning model can be used to overcome problems that occur in science subjects for class VIII at SMP Negeri 2 Majenang. The purpose of this study was to find out the Increase in Interest and Learning Outcomes of Students with the Make a Match Learning Model on the Material Pressure of Substances in everyday life science material for class VIII SMP Semester 1 for the 2019/2020 academic year.

B. Method

This research uses Classroom Action Research consisting of two cycles. Each cycle is carried out once face-to-face, a total 34 students of VIII H grade at SMP Negeri 2 Majenang with two observations, using an observation instrument containing indicators about learning that encourage students to dare to ask questions and have

opinions. This research contains the stages: planning, action implementation, observation and reflection.

The Action Plan using classroom action research procedures consists of 2 cycles, namely cycle 1 and cycle 2, each cycle consisting of 4 stages, namely planning, implementation, observation and reflection. These stages can be described as follows:

1. Cycle I
   a. Planning Stage
      1) Determine the class as the research subject, namely class VIII H SMP Negeri 2 Majenang.
      2) Determine the learning model, namely Make A Match.
      3) Make a Learning Implementation Plan (RPP) which includes competency standards, basic competencies, indicators and learning steps according to the syllabus.
      4) Assign observers as members and photographers.
      5) Make an observation sheet as a means of collecting qualitative data and make pretest and posttest questions as a means of collecting and quantitative.
      6) Determine the date of the research implementation.
   b. Implementation Stage
      1) Implementation of pretest
      2) Implementation of the learning process with the Make a Match learning model with the stages.
      3) Implementation of posttest.
   c. Observation Stage

      The observation stage is carried out simultaneously with the learning process taking place. Observations were assisted by two observers as members of the research team and one person as a photographer to obtain optimal results. Observers bring observation sheets and record the implementation of activities during the learning process
   d. Reflection stage

      The learning process is evaluated to be discussed with observers regarding the weaknesses that arise.
2. Cycle 2

Cycle 2 is carried out after there are reflections from cycle 1, so that the implementation of the learning process in cycle 2 is an improvement from the weaknesses in the implementation of the learning process in cycle 1. The flowcart of this research can be seen in Figure 1.

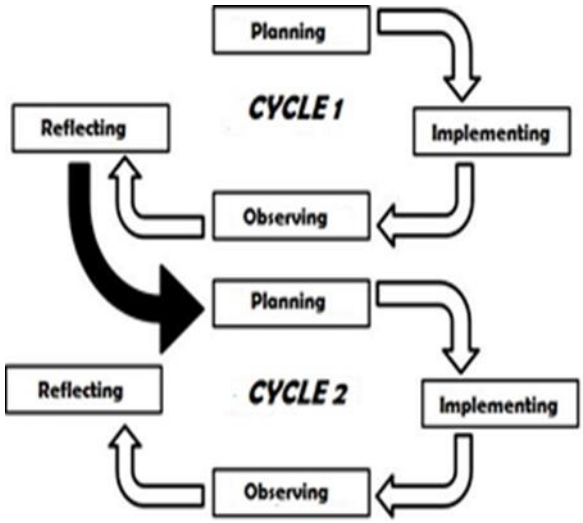

Figure 1. Flowchart of Research Implementation

The research instruments used were observation sheets, documentation, and field notes. There are two data analysis techniques used. The first analysis technique is using qualitative data analysis with the steps of data reduction, data presentation, and drawing conclusions. The second data analysis technique is quantitative data analysis so as to provide an overview of learning outcomes and student interest in learning.

C. Result and Discussion

The results of the initial conditions of learning science regarding the material pressure of substances and its application in everyday life in class VIII SMP Negeri 2 Majenang can be said to still not show maximum results. Based on the observations of researchers in the teaching and learning process there are still misconceptions, besides that the learning interaction is still unidirectional, namely the teacher to the students, there has not been a three-way learning interaction, namely the teacher to the students, the students to the teacher, and the students to the students. This has an impact on the learning process and student learning outcomes in the classroom. Where the learning process is monotonous, students only become passive listeners so that the material presented by the teacher is not conveyed to students optimally. Prove from the results of the formative tests conducted by the teacher that the level of mastery of the material being taught shows a low level of mastery of the material being taught, from a total of 34 students only 16 students (47.06%) reach the minimum completeness criteria (KKM) 70, and 18 students (52.94 %) is still below the KKM.

The implementation of learning in each cycle can run smoothly, increasing student learning activities so that student learning outcomes increase, using the following learning actions (scenarios).

a) The teacher prepares learning media
b) The teacher ensures that students are ready to learn
c) The teacher creates a conducive learning atmosphere

d) The teacher conveys the main material to be discussed
e) The teacher conveys the learning objectives to be achieved
f) The teacher asks questions to students about the material
g) The teacher conveys a little material at a glance
h) The teacher and students conclude the subject matter
i) The teacher carries out the assessment task
j) The teacher carries out follow-up in learning
k) The teacher closes the learning activity

Table 1. Results of Observation of Student Interest in Cycle I

No	Aspect	Indicator	Percentage	Average Percentage Indicator	Success Criteria
1	Attention	Paying attention to the teacher during the learning process	68%	68%	75%
2	Curiosity	Asking material that you don't understand	66%		
3	Desire	Answering and responding to teacher questions	65%		
4	Pleasure	Doing assignments from the teacher	73%		

Calculation of the average percentage of indicators of student interest in learning cycle I as in Table 1 as follows:

$$NP = \frac{R}{SM}\ x\ 100\%$$

$$NP = \frac{R}{SM}\ x\ 100\% = 68\%$$

Based on Table 1, it can be seen that in the first cycle the average percentage of students' interest in learning indicators has not been optimal or has not reached the specified success criteria, which is 75%. The average percentage of indicators of student interest in learning in the first cycle only reached 68%. The percentage of each indicator of student interest in learning in the first cycle is 68% attention, 66% curiosity, 65% desire, and 73% pleasure.

Table 2. Group Learning Outcomes of each Student Cycle I

Score	Total Student Score	Total Students	Percentage	Success Criteria
≤ 70	24	34	100%	71%
≥ 70	10	34	100%	29%

Based on Table 2, it can be seen that the number of students who achieved the KKM score in the first cycle was 10 out of 34 students or only reached the percentage of 29%. Therefore, it has not succeeded in achieving the success criteria set, namely 75%. While 71% of people who have not reached the KKM there are as many as 24 students.

At the beginning to the middle of the learning process, the attention of the Make a Match learning model was not fully focused on the subject matter. Students still do not understand the applied learning model. The enthusiasm of students is still lacking. The application of the Make a Match learning model in the first cycle has not been fully implemented optimally. Based on observations, the average percentage of indicators of student interest in learning in the first cycle has not reached the predetermined success criteria, which is 75%. The average percentage of students' interest in learning indicators in the first cycle is 68%. Some of the obstacles found in cycle I include:

a) The teacher is not optimal in explaining and conditioning learning with the Make a Match learning model.
b) The teacher has not been able to control the class properly when applying the Make a Match learning model.
c) The teacher has not been able to use time optimally and effectively during class learning.
d) The average percentage of indicators of interest in learning has not yet reached the criteria for the success of the action because it has only reached 68%.

Observations on students' interest in learning in participating in learning activities can be said to have increased from cycle I. The average percentage of indicators of student interest in learning in cycle II has also reached the predetermined success criteria, although it is right on the threshold. This is proven as Table 3.

Table 3. Results of Observation of Student Interest in Cycle II

No	Aspect	Indicator	Percentage	Average Percentage Indicator	Success Criteria
1	Attention	Paying attention to the teacher during the learning process	68%	75%	75%
2	Curiosity	Asking material that you don't understand	77%		
3	Desire	Answering and responding to teacher questions	84%		
4	Pleasure	Doing assignments from the teacher	70%		

The calculation of the average percentage of students' learning interest indicators in cycle II is in Table 3 as follows:

$$NP = \frac{R}{SM}\ x\ 100\%$$

$$NP = \frac{R}{SM}\ x\ 100\% = 75\%$$

Based on Table 3, it can be seen that in the second cycle the average percentage of indicators of student interest in learning is optimal even though it only reaches the minimum success criteria set, which is 75%. The percentage of each indicator of student interest in learning in cycle II is 68% attention, 77% curiosity, 84% desire and 70% pleasure.

Table 4 explains the group learning outcomes of students after the implementation of the Make a Match learning model added with pictures in cycle II.

Table 4. Group Learning Outcomes of each Student Cycle II

Score	Total Student Score	Total Students	Percentage	Success Criteria
≤ 70	7	34	100%	22%
≥ 70	27	34	100%	78%

Based on Table 4, it can be seen that the number of students who achieved the KKM score in cycle II was 25 students from 34 students who reached a percentage of 78%. Therefore, it has not succeeded in achieving the success criteria set, namely 75%. While 22% of students who have not reached the KKM there are 7 students.

Efforts to increase students' interest in learning by applying the Make a Match learning model in class VIII H SMP Negeri 2 Majenang in cycle II have succeeded in achieving the predetermined success criteria of 75% and there is an increase in the percentage from cycle I. This is evidenced by the average the percentage of indicators of student interest in learning which increased by 7% from the first cycle to 75%. The increase in the percentage of interest indicators also has an effect on increasing the percentage of learning outcomes indicators for groups of students who increase.

The increase occurred after the Make a Match learning model was applied by adding pictures in the question or answer sheet to make it more interesting as motivation and to attract the attention of students. In addition, because the teacher was able to explain and organize learning with the Make a Match learning model better than cycle I. Some actions that resulted in less than optimal even though it had been going well were as follows: 1) Some students were still busy at the time of learning at class; 2) Only a few students dare to ask and respond to questions from the teacher.

Observations on the activities of students in the classroom in cycle II showed that the teacher was able to carry out learning activities well. Students are no longer only objects of learning but as subjects of learning. The classroom management carried out by the teacher in the second cycle is much better than the first cycle. The teacher is able to explain and organize learning with the Make a Match learning model well. In

addition, the teacher also encourages students to play an active role in the classroom. The Make a Match learning model can help students to be active in learning activities, both in groups and individually. Besides, the Make a Match makes the learning process student centered so that it is no longer teacher centered and the teacher is only a facilitator and motivator. Junior high school students will be more enthusiastic about participating in learning by playing like the Make a Match learning model applied at SMP Negeri 2 Majenang. The Make a Match learning model can have a positive effect on student learning outcomes [11].

Students seem more interested in participating in the learning process in class. Students look happy and very excited [12] that the Make a Match learning model can be used as a good and fun learning strategy without losing the ongoing learning focus. In addition, students are also more daring to ask questions and respond to the teacher questions. The students in the previous cycle looked passive and had started to be active. In the final activity, students play an active role in concluding the subject matter together with the teacher. The results of the research conducted showed that there was a significant difference between the science learning outcomes of students using the Make a Match type of cooperative learning model and the learning model commonly used in junior high schools [13]. The Make a Match learning model can make students active during learning so that it can affect learning outcomes, if students feel happy, enthusiastic, active during learning, it will affect learning outcomes [14]. The Make a Match learning is an alternative teaching and learning model that emphasizes shared attitudes or behavior in working or helping among others in an organized structure of cooperation in groups [15]. This learning model can be used as an alternative learning method. This learning model can be adapted to other science materials by matching cards and making other types of game cards [16].

D. Conclusion

Based on the results of the description and data exposure, it can be conlude that The application of the Make A Match learning model can increase students' interest and learning outcomes in science learning in VIII grade of junior high school. This is evidenced by an increase in the average percentage of indicators of student interest in learning each cycle. In the first cycle the average percentage of students' interest in learning indicators was 68% and increased in the second cycle to 75% or an increase of 7%. This means that the average percentage of indicators of student interest in learning has exceeded the criteria for the success of the action set, which is 75%. The application of the Make A Match learning model also can improve student learning outcomes. This is showed by the percentage of students who achieve the KKM score in the first cycle of 28%, increasing to 78% in the second cycle. This means that the number of students who achieve the KKM score (70) has exceeded the established success criteria of 75%.

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Implementation of The Problem-Based Learning which Combined with Group Investigation in Physics to Improve the Student's Learning Outcomes

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ABSTRACT

This research is a pre-experimental study which aims to determine the physics learning outcomes of class XI students at public high school 1 Bantaeng using Problem-Based Learning method combined with the Group Investigation Method. We obtained the data through pretest and posttest. The sample in this study was selected using purposive sampling. where the sample consists of one class with 15 people. The results of the descriptive research indicate that there is an increase in student learning outcomes after the method has been implemented. This is proved by the t-test which shows obtained result to be 22,031 where the t table obtained is 1.7613.

INTISARI

Penelitian bersifat pra-eksperimen yang bertujuan untuk mendapatkan hasil belajar fisika dari kelas XI di SMA Negeri 1 Bantaeng menggunakan metode Problem-Based Learning yang dikombinasikan dengan metode Group Investigation. Data yang didapatkan dalam penelitian ini berasal dari pretes dan postes. Sampel dari penelitian ini berjumlah 15 orang. Hasil dari penelitian deskriptif ini adalah adanya peningkatan hasil belajar fisika setelah pemberian methode tersebut. Ini dibuktikan dari uji hipotesis dari t-test yaitu 22.031 sedangkan t-table terhitung 1.7613.

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A. Introduction

Learning outcomes are defined by the improvement of mental growth [1]. The learning outcomes can be investigated from the result of the evaluation test. These outcomes strongly depend on the teaching method, curriculum, relation between teacher and students, and discipline implemented by the school [1].

To improve the learning outcomes, many methods have been developed. One of the famous methods is Problem-Based Learning (PBL). The basic idea of PBL is developing the problem which can be used as the starting point to obtain the

knowledge [2]. This model encourages students to learn based on daily problems connected with the upcoming knowledge. However, the other research found that in PBL, students tend to get lazy to solve problems by themselves [3]. Hence, the PBL method should be combined with another method called Group Investigation (GI) to enhance the process. The challenge with this method is the combination needs cooperation between students [4] Thus, the key to this method lies in how students cooperate. For further discussion, we will call this combination between PBL and GI to be PBL-GI to simplify.

In PBL-GI, each task should be pointed out to give a chance for a group's member to show their contribution. It is possible that learning outcomes for each group member are obtained once the group obtained its outcomes [5], [6]. This way, the student's growth can be improved through collaborative work inside the group.

The preliminary observation has been done in Public High School 1 Bantaeng, South Sulawesi, Indonesia. In this observation, we obtain some problems corresponding to the learning outcome of the students. With a lack of motivation to study on their own resulting in them being mostly below the minimum score, it is better to resolve the problem by constructing a method that allows the students to learn in a group. Thus, it is understandable that GI is favoured by such conditions. Also, PBL is necessary to attract the student to work in a group.

B. Method

This research uses Pre-Experiment Design method also it is designed to be one group pretest-posttest with twice observations that have been used. Both observations occur at the pretest and the other is by posttest. Between pretest and posttest, there is some kind of treatment where PBL-GI occurs. In this research, we observed 15 samples in one of class XI. PBL-GI is applied here by using observation sheets for both teacher and students to observe the conditions during the class. The indicators for teachers on the observation sheets consist of the syntax of the learning method/model, the utilization of teaching media, learning source, scoring, and languages used in the teaching. For students' observation sheets consist of the implementation of the model/method and the utilization of teaching sources.

The descriptive analysis technique has been used in this paper. Thus, describing and giving some clues about the object based on the sample or population and deriving them into general cases [7]. We also describe the score of all variables in this research by using the descriptive analysis technique. Lastly, we used preliminary tests which consist of normality, variance homogeneity, and hypothesis tests.

C. Result and Discussion

The research has been done to get the result on the implication of the PBL-GI model. In the preliminary, we obtain the frequency distribution test on the student. We obtain the data of descriptive analysis which purposely gives the learning

outcome. It contains the highest score, lowest score, average score, standard deviation, and variance. One can see Table 1 for details.

Table 1. The Frequency Distribution of Pretest Before Imbued by PBL-GI

Score (X_i)	***Frequents (f_i)***
38	1
40	1
45	1
46	1
53	2
55	1
57	1
60	1
65	1
70	1
71	1
74	1
75	1
Total	*15*

Data from Table 1 became the reference for the descriptive analysis of the data. Therefor the descriptive analysis of Table 1 could be seen in Table 2.

Table 2. Data of the learning outcomes of the class before PBL-GI is applied.

Descriptive analysis	Pretest
Number of Sample	15
Max	75.00
Min	38.00
Mean	55.400
Range	37.00
Standard Deviation	12.14672
Variance	147.543

Based on Table 2, the maximum score obtained during the pretest is 75.00, with a minimum of 38.00 and a range of 37. The average value obtained based on the scores is 55.40 with a standard deviation of 12.14672 and a variance of 147.543. The learning output categories with their range we put in this research can be seen in Table 3.

Table 3. The Learning Output Categories After Pretest

No.	Range	F	%	Category
1.	85 – 100	0	0	Very High
2.	65 - 84	5	33.4	High
3.	55 - 64	4	26.6	Medium
4.	35 – 54	6	40	Low
5.	0 – 34	0	0	Very Low
	Total	15	100	

In the pretest we obtain the data corresponding scores which are depicted in Figure 1. In Figure 1 the pretest score in category "high" is obtained by 5 students, "medium" for 4 students, and 6 more students obtain "low" result.

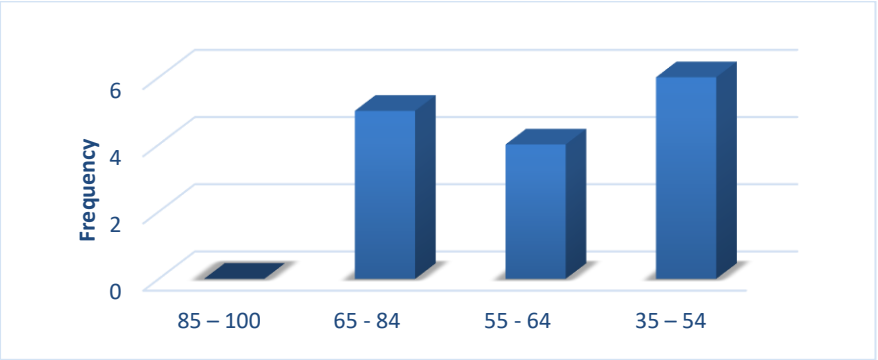

Figure 1. Histogram of Pretest Categorization of Learning Outcomes

After PBL-GI is applied to the students, we obtain some data based on the post-test. The result could be presented in Table 4.

Table 4. Frequency distribution after posttest which is implemented by the PBL-GI method

Score (X_i)	***Frequents (f_i)***
79	2
80	1
83	1
84	1
85	4
87	1
88	2
90	**3**
Total	**15**

For further information, we obtain the data corresponding to the scores on the post-test result from the students. We describe the result in Table 5. There are some improvements which are depicted in the results. Especially on the minimum result which is enhanced so much compared to the pretest score.

Table 5. Data of the post-test result after implementation of PBL-GI

Descriptive analysis	**Pretest**
Number of Sample	15
Max	90.00
Min	79.00
Mean	85.2000
Range	11.00
Standard Deviation	3.76450
Variance	14.171

We also categorize the scores after the post-test which can be shown in Table 6. The range of those scores has been improved with no student obtaining the "low" result. Also, 10 students could achieve the "very high" result with a range of 85-100.

Table 6. The learning output categories after posttest

No.	Range	F	%	Category
1.	85 – 100	10	66.6	Very High
2.	65 - 84	5	33.4	High
3.	55 - 64	0	0	Medium
4.	35 – 54	0	0	Low
5.	0 – 34	0	0	Very Low
	Total	**15**	**100**	

In Figure 2 we clearly show the corresponding result on the histogram. This way we can compare the result from Figure 1.

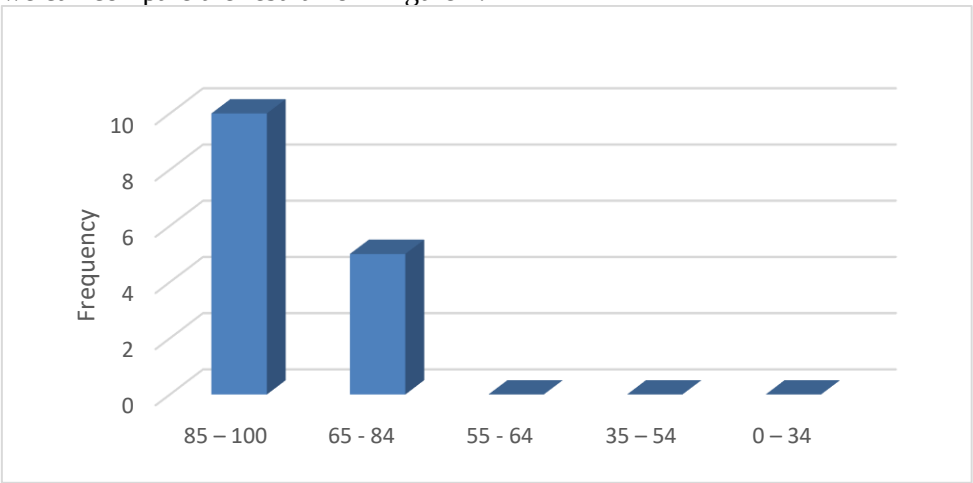

Figure 2. Histogram of Posttest Categorization of Learning Outcomes

We see the difference between pre-test and post-test. In addition, we obtain the result based on the t-test which is 20.031, and sig(2-tailed) under 0.05 which is 0.00. It means we can use PBL-GI on the subject.

On the statistical inference, we used normality, homogeneity, and hypothesis tests which we presented as follows.

Normality test

a. Normality test before PBL-GI implementation

Table 7. Normality test before PBL-GI implementation with SPSS

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Score	.114	15	.200*	.947	15	.473

One could also be seen in Figure 3 for further information corresponding to the result.

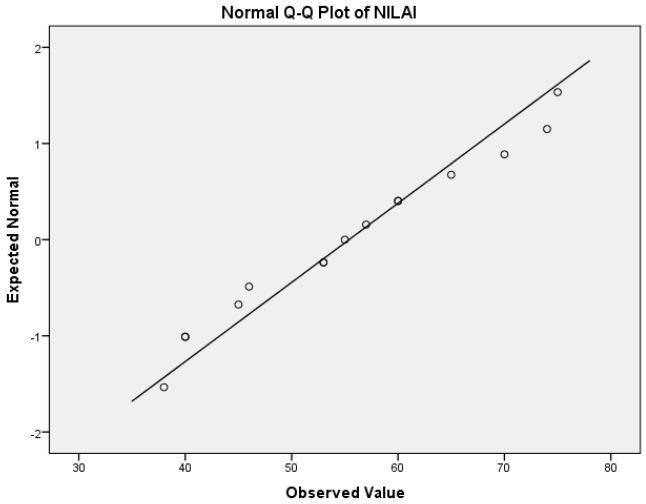

Figure 3. The normal QQ plot of the pretest

b. The Normality test after posttest

Table 8. Normality test after posttest

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
NIL AI	.145	15	.200*	.912	15	.146

One could also see the in Figure 4 for further information corresponding to the result.

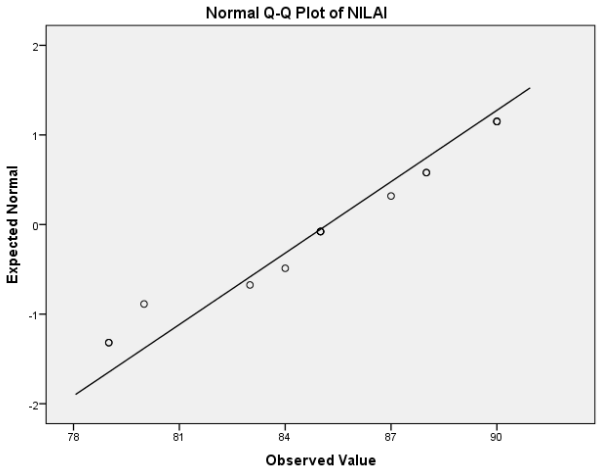

Figure 4. The normal QQ plot of the posttest

Homogeneity test

The homogeneity in this research is using SPSS with *Lavene Statistic* with significant $\alpha = 0{,}05$ with variation analysis before and after PBL-GI. If the significant score is more than 0,05, the variance for every sample is the same. Thus, our sample is shown to be homogenous based on the test, see Table 9 for further information.

Table 9. Result of the homogeneity test.

Levene Statistic	df1	df2	Sig.
13.923	1	28	.067

Hypothesis Test

Even if our result shows an improvement in post-test from the pre-test result. A hypothesis test is needed to confirm that there is an improvement after the PBL-GI method. With the normality test shown to be "normal" and with the homogeneity test the sample shown to be "homogenous", we can use paired t-test to do the hypothesis test.

Table 10. t-test result

	Paired Differences					t	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
PRE TEST-POSTTEST	68.80	17.10495	3.12292	62.41291	75.18709	22.031	29	.000

Based on the hypothesis result we obtain t=22.031 which is much larger than ttable = 1.7613, which means H0 is refused and H1 is accepted. Thus, PBL-GI can be considered to make an impact on the improvement of learning outcomes.

We investigated, based on the result and also the progress during the implementation of PBL-GI, there is a major impact on this model. By aligning the students into the group, the students' growth of knowledge can be improved together since there is a collaboration between the students when learning. They learn how to solve the problem together and actively make a decision together by sharing their opinions. This is also the advantage of the GI method. In addition, giving the problem to students also could enhance their ability to the critically thinking which is the characteristic of PBL. This combined method: PBL-GI is shown to be effective in improving the students' learning outcomes.

Despite the advantages of this model, there are some difficulties when applying this model. First, teachers should be more effort to make a creative problem-solving with their students. Second, we found the students themselves should be at least capable to understand the problem. Third, we also found every student who implemented this model should be able to communicate with other students. Fourth, extra time is needed, thus the teacher should accommodate such difficulties. However, based on the three problems we mentioned, the teacher should make sure that the class is ready to be implemented by PBL-GI model.

D. Conclusion

The research of the PBL-GI model in public high school of class XI Bantaeng, South Sulawesi, Indonesia has been done. We have shown that PBL-GI could give the improvement on the students' learning outcomes. The improvement of the students' outcomes could be identified by the improvement of students' results by group. It means the corresponding group's result could improve each member's result. This improvement has been tested by the t-test to show the effect of PBL-GI on the implementation of the learning.

During the research, we found that PBL-GI came with a great challenge for both teachers and students. in teachers, it would make more burden teachers, since extra creativity is needed to perform PBL-GI. Also, cooperation between students plays a crucial role. Lastly, this PBL-GI is time-consuming, thus finally it strongly depends on the teacher to perform such a method.

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Development of E-Module Physics Based on Local Wisdom of Lampung Written Batik on Temperature and Heat Materials

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ABSTRACT

Students still think learning physics is boring. For this reason, educators are expected to be able to develop fun physics learning in various ways. This study aims to develop a module based on the local wisdom of Lampung written batik on temperature and heat. The research method used is research and development (R&D) with a Borg and Gall development model design. This research resulted in a product in the form of an e-module based on local wisdom of Lampung written batik on temperature and heat material with 90% media validation results, 91% material experts, and 82% IT experts. The percentages generated in the study indicate that the category is very feasible. Very feasible means that the developed module can be tested and applied to the next process. The trial was divided into two, namely a small trial of students who obtained 86% results in the very interesting category and field trials with teachers in three schools getting 89% results, and field trials of students getting 82% results. From the results of the small test percentage and field trials, the percentage is obtained in a very attractive category. The very interesting category means that the modules developed are well responded to and accepted by students and teachers. This research concludes that an e-module based on local wisdom of Lampung written batik has been developed on the material of temperature and heat.

INTISARI

Siswa masih menganggap bahwa belajar fisika itu membosankan. Untuk itu, pendidik diharapkan dapat mengembangkan kegiatan pembelajaran jasmani yang menyenangkan dengan berbagai cara. Penelitian ini bertujuan untuk mengembangkan modul berbasis kearifan lokal batik tulis Lampung pada materi temperatur dan panas. Metode penelitian yang digunakan Research and Development (R&D). Ini menggunakan desain model pengembangan Borg dan Gall. Penelitian ini menghasilkan sebuah produk berupa e-modul berbasis kearifan lokal batik tulis Lampung pada materi temperatur dan panas. Didapatkan 90% hasil validasi media, 91% ahli materi, dan 82% ahli IT. Persentase yang dihasilkan dalam penelitian menunjukkan bahwa kategori sangat layak. Modul yang dikembangkan sangat layak untuk diuji dan diterapkan pada proses selanjutnya. Uji coba dibagi menjadi dua yaitu uji coba kecil siswa yang memperoleh hasil 86% dalam kategori sangat menarik; uji coba lapangan dengan guru di tiga sekolah mendapatkan hasil 89%; dan uji coba lapangan siswa mendapatkan hasil 82%. Hasil persentase uji kecil dan uji coba lapangan diperoleh dalam kategori sangat menarik. Kategori sangat menarik artinya modul yang dikembangkan diterima dan diterima dengan baik oleh siswa dan guru. Penelitian ini menyimpulkan bahwa telah dikembangkan e-modul berbasis kearifan lokal batik tulis Lampung pada materi suhu dan kalor.

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A. Introduction

Various impacts occurred due to the coronavirus pandemic [1]. This pandemic has certainly disrupted and changed the way we socialize, work, and study. Many human activities have been transferred online, including in the world of education [2]. Nowadays, teachers have been using technology a lot as a way to keep interacting with students. This shows the need for technology or distance learning social networking tools [3].

Based on the results of the pre-research conducted in three schools during the post-pandemic period, the researchers concluded that the results of filling out student questionnaires in the form of learning physics at school were still enough to make students bored with learning physics because of the monotonous use of learning media. The teacher also had never applied local wisdom-based physics learning. In addition, the results of the pre-research conducted with the teachers found that the teachers strongly agreed with local wisdom-based learning media. And these teachers had never used learning media, especially e-modules related to local wisdom.

E-modules with local wisdom are one of the learning media listed in Law No. 20 of 2003, namely Article 36 paragraph d concerning the curriculum based on the diversity of regional and environmental potentials. This law requires every school to implement an education model based on local excellence and potential. It can be found in each region as a means to better introduce students to their environment. Therefore, each school can acquire skills that are defined by the potential of their respective regions. This is following the results of Dwi Cahyani's research regarding ethnoscience learning to support the environment. The results of a phenomenon that develops in society can be linked to science (physics). So that, students can more easily master learning because they can see and feel it directly [5].

From some of the backgrounds above, it is necessary to innovate learning by developing e-modules according to the stages of manufacture. The following studies are research that reflects the type of research (R & D) on physics e-modules based on local wisdom according to their respective regions. Research conducted by Mustika regarding the development of e-modules based on local wisdom takes the theme of making dodol cages [6], Nur Laily's research takes the theme of traditional games [7], and Rizki's research takes the themes of traditional medicine, blacksmithing, lemang bamboo, and coffee culture. 8]. Thus, there has been no development of e-modules based on local wisdom that focuses on one field and in the form of written batik. The researcher took the theme of local wisdom in the form of Lampung's written batik because no one had ever researched the theme, so it gave rise to novelty in research.

The developed e-module will be packaged in the form of images, videos, and text descriptions. This e-module was created through an application called Flip PDF Corporation. It is equipped with a formative test so that it is more interactive and interesting. This study aims to produce an e-module of physics-based on local wisdom in the form of Lampung batik on temperature and heat material. In addition, this study aims to test the feasibility and know the responses of students and teachers. The benefits of this research are in the form of the ability to develop a concept of temperature and heat. It is integrated into the local wisdom of Lampung written batik so that it can foster a love for written batik. It is starting to be rare to develop and know the process of making batik itself.

B. Method

The method used in this study was Research and Development methods (R&D). This method generally focused on the process of developing and validating educational products [9]. The model used in developing the physics e-module based on local wisdom is Borg and Gall's model with 10 stages. But, the researchers limited it to the product revision stage after the trial. It is because the purpose of this study is to determine the feasibility and attractiveness of e-module learning media based on local wisdom. And it was developed taking into account the limitations of time and resources owned by researchers, and to determine the responses of students. The following are the steps of the complete Borg and Gall's research model as shown in Figure 1.

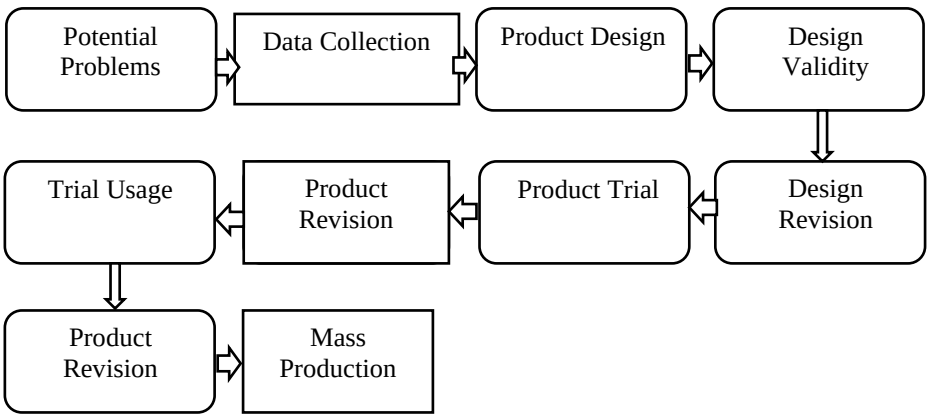

Figure 1. The steps of the Borg and Gall research model

The research locations were held in three schools, namely SMA Negeri 1 Bandar Sribhawono, SMA Negeri 1 Sekampung Udik, and SMA Ma'arif 3 Sekampung Udik. The research was conducted from September-October 2021. The subjects in this study were validators with 3 experts, namely media experts, material experts, and IT experts. They consist of 2 validators. The trial subjects were carried out in two stages, namely small group trials and field trials. It was carried out by teachers of each school and students, with a total of 78 subjects for small group trials and field trials. Sampling

in a small trial was carried out purposively. The technique selection is based on students who have known Lampung batik before. Sampling in the large trial was carried out by simple random sampling. This technique was chosen because the students of these three schools are large.

The types of data obtained in this study consisted of 2 types, namely qualitative data and quantitative data. Qualitative data obtained from the results of initial observations, criticisms, and suggestions from media experts, material experts, teachers, and students were analyzed. Some suggestions are used for product improvement at the revision stage. Quantitative data were gathered through the completion of assessment questionnaires by validators, teachers, and students. The goal is to find out whether the product is feasible to be used for testing or is interesting to use as a learning medium. The research instruments consisted of interview instruments, questionnaires, and documentation.

Data analysis to determine the feasibility of the product developed by the validators using a Likert scale questionnaire. The response questionnaire to this feasibility has 5 stages of answers according to the questions, namely: "very feasible", "decent", "fair enough", "not feasible", and "very inappropriate" [11]. Each has a different score that indicates its level of conformity. The total scoring score can be searched using the formula (1):

$$I = \frac{\sum T}{\sum M} \quad (1)$$

Notes:

I : Interpretation of Score Percentage Rating [10].

$\sum J$: Score

$\sum M$: Maximum Score

From the results, the criteria for the percentage of validation are sought. The validator criteria can be seen in Table 1 below.

Table 1. Criteria for the Percentage of Validators.

Score	Achievement Level	Qualification
5	80% < x ≤ 100%	Very Feasible
4	60%< x ≤ 80%	Decent
3	40% < x ≤ 60 %	Fair Enough
2	20% < x ≤ 40 %	Not Feasible
1	0% ≤ x ≤ 20%	Very Inappropriate

Data analysis to determine the attractiveness of the product that has been developed is aimed at teachers and students. The response questionnaire to this attractiveness has 5 stages of answers according to the questions, namely: "very interesting", "interesting", "quite interesting", "not interesting", and "very unattractive" [12]. Each has a different score that indicates its level of conformity. The total score can be found using equation (1) above.

From the percentage results that have been obtained, the next step is to change the average score into a feasibility value that matches the criteria, which can be seen in Table 2.

Table 2. The Scale of Learning Media Attractiveness.

Score	Questionnaire Score	Criteria
5	80% < x ≤ 100%	Very interesting
4	60%< x ≤ 80%	Interesting
3	40% < x ≤ 60 %	Quite attractive
2	20% < x ≤ 40 %	Not Interesting
1	0% ≤ x ≤ 20%	Very Unattractive

C. Result and Discussion

Research Result

The results of the development research conducted by the researchers produced a product in the form of an e-module based on Lampung local wisdom. Researchers collected the data from SMA Negeri 1 Bandar Sribhawono, SMA Negeri 1 Sekampung Udik and SMA Ma'arif 3 Sekampung Udik. Analysis and small group trials were carried out with 15 students, while the field trials were conducted with a total of 60 students in class XI MIA and 3 teachers in physics.

Before conducting the research, the researcher conducted pre-research by administering questionnaires to teachers and students to determine the importance of holding learning media. The results of interviews with several students showed, that when learning physics, students felt bored. While interviews with several teachers showed that they need learning media in the form of E-modules. Teachers had never linked learning with local wisdom, and they argued that it was necessary to develop e-modules based on Lampung batik local wisdom. The results of each stage of this procedure produced potential problems in data collection, product design, design validation, design revision, product testing, and product revision. Before conducting the trial, the researcher was first validated by validators from media, materials, and IT experts.

Expert validation uses a questionnaire sheet that has been provided by the researcher. Then the validator assesses the aspects that have been provided in the questionnaire. The results obtained for the validation of media, material, and IT experts are as follows.

Table 3. Media Expert Validation Results

No	Skill Aspect	Percentage Score (%)	Criteria
1	Visual Display	90%	Very Feasible
2	Use of Letters	85%	Very Feasible
3	Physical Criteria	87%	Very Feasible
4	Voice	90%	Very Feasible
5	Ease of Use	100%	Very Feasible
The average number of aspects		89%	Very Feasible

Table 4. Material Expert Validation Results

No	Skill Aspect	Percentage Score (%)	Criteria
1	Presentation	93%	Very Feasible
2	Content	92%	Very Feasible
3	Language	87%	Very Feasible
4	Scientific Approach	93%	Very Feasible
The average number of aspects		91%	Very Feasible

Table 5. IT Expert Validation Results

No	Skill Aspect	Percentage Score (%)	Criteria
1	Screen design effectiveness	87%	Very Feasible
2	Ease of operation	80%	Very Feasible
3	Consistency	80%	Very Feasible
4	Animation	80%	Very Feasible
The average number of aspects		82%	Very Feasible

So that the overall validation results can be seen in Figure (2) below:

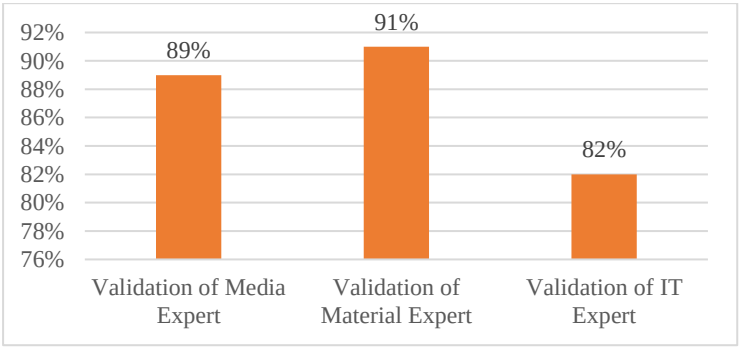

Figure 2. Validator Overall Validation Results

According to the graph, the material expert is the one who gets the highest validation results. This means that the product developed is very feasible for further use in trials in terms of feasibility, content, language, and scientific approach. Because the average skill aspect receives an average of 80% from the aspects of ease of operation, consistency, and animation. The result of validation from IT experts yields got lower than the validation of both. This was deemed very feasible by the three validators for further trials to be conducted.

Following the validation results from the validators, the next step is to test the product's attractiveness. The trials were split into two categories: small group trials and field trials.

Table 6. Field Trial Results

No	Skill Aspect	Percentage Score (%)	Criteria
1	Interest	86%	Very Interesting
2	Material	87%	Very Interesting
3	Language	89%	Very Interesting
4	Benefit	86%	Very Interesting

5	Graphic	88%	Very Interesting
The average number of aspects		87%	Very Interesting

The following are the results of the small group trial in graphic form as shown in Figure 3 below.

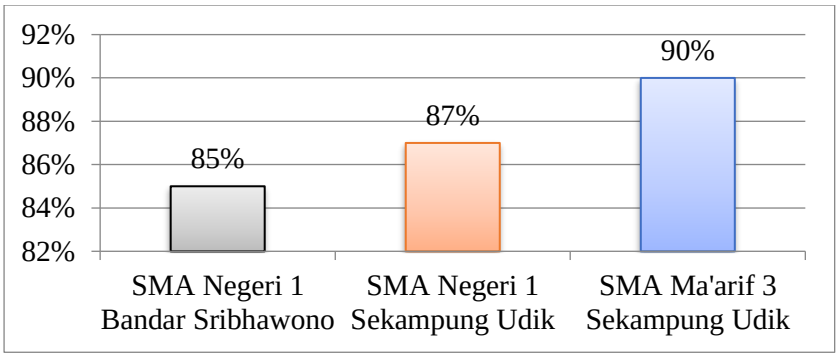

Figure 3. Small Group Trial Results

Based on the graph, it can be seen that the graph that has the highest percentage is in the SMA Ma'arif 3 Sekampung Udik. It is based on the high level of interest in students at the school. They rarely find diverse learning media. So when the e-module learning media is introduced, students feel interested in learning. SMA Negeri 1 Bandar Sribhawono got the lowest attractiveness of the three because the school has often used interactive learning media. But, no one has ever linked local wisdom with learning. After this small group trial, the students considered that the e-module was very interesting to use under some of the suggestions.

The field trial used an instrument in the form of a Likert scale questionnaire filled out by students via Google form. The assessment aspect consists of attractiveness, material, language, usefulness, and graphic aspects. The results of student responses in field trials will be presented in Table 7 below:

Table 7. Students' Field Trial Results

No	**Skill Aspect**	**Percentage Score (%)**	**Criteria**
1	Attractiveness	82%	Very Interesting
2	Material	82%	Very Interesting
3	Language	84%	Very Interesting
4	Usefulness	80%	Very Interesting
5	Graphic	83%	Very Interesting
The average number of aspects		82%	Very Interesting

Based on the results of field trials in 3 schools, the average was obtained as follows:

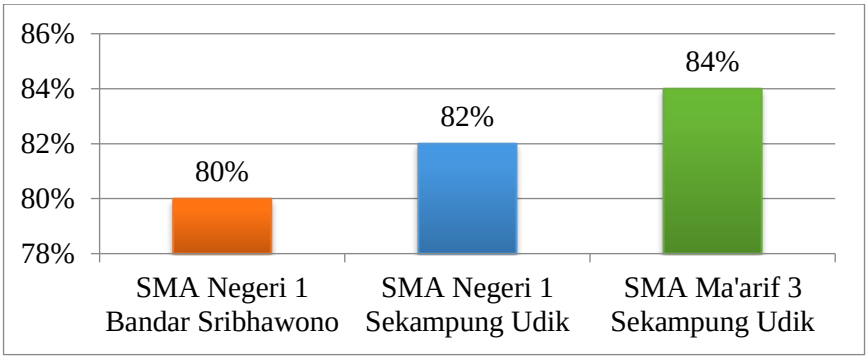

Figure 4. The results of the students' field trials

Based on the graph, SMA Ma'arif 3 Sekampung Udik still has the highest percentage of the attractiveness of the product that the researchers made among the other schools. After the product was tested in small groups, the percentage value was not too much different because it had been revised according to the suggestions from students. The product can be said as very attractive.

The results of the teacher assessment were carried out on three physics subject teachers at SMA Negeri 1 Bandar Sribhawono, SMA Negeri 1 Sekampung Udik, and SMA Ma'arif 3 Sekampung Udik. The following is the teacher assessment data in Table 8.

Table 8. Teacher's Field Trial Results

No	Skill Aspect	Percentage Score (%)	Criteria
1	Content Quality and Purpose	88%	Very interesting
2	Instructional Quality	92%	Very interesting
3	Technical Quality	88%	Very interesting
The average number of aspects		89%	Very interesting

The following are the results of the field trials in the form of graphs that were tested on teachers of each school.

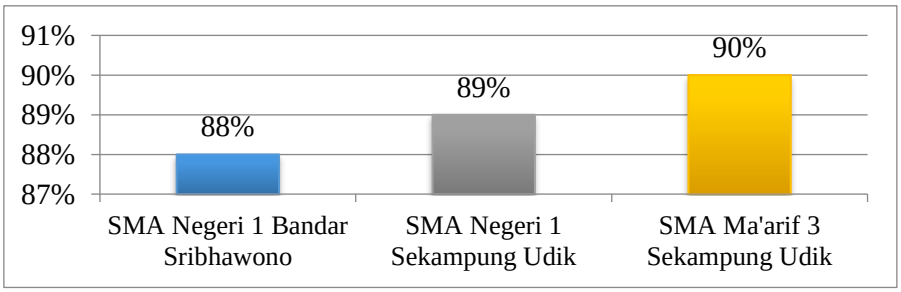

Figure 5. The Results of the Teacher's Field Trial

Based on the graph, it can be seen that the highest graph is in the teacher of SMA Ma'arif 3 Sekampung Udik. The teacher is very enthusiastic about the research. It is because it can add references for teachers to make effective learning media, especially based on local wisdom. So far, the teacher admits that he has not used varied learning media for teaching. The lowest graph is at SMA Negeri 1 Bandar Sribhawono.

Teachers are also interested in the product that researchers have developed, only some assessment indicators that are still lacking. All teachers consider that the product developed is very interesting to use in learning.

Discussion

The learning media developed is in the form of e-modules based on local wisdom in the form of Lampung written batik. It can be accessed via the internet (online). This is intended for the use of technology in an increasingly advanced era. Learning is not done face-to-face, it requires teachers to do innovative things for learning. So that, the knowledge provided is still conveyed properly. According to Tyas' research, the appropriate learning media during this pandemic is using e-modules. One of the characteristics of this e-module can be used for independent study [13]. This also supports the researchers' use of e-module learning media because it has advantages according to its characteristics of it. Researchers also chose local wisdom to tell them that there is a culture in Lampung. And, we must protect and preserve through learning.

This development is carried out by conducting a literature study to find out the needs for this research. Field studies were conducted at SMA Negeri 1 Bandar Sribhawono, SMA Negeri 1 Sekampung Udik, and SMA Ma'arif 3 Sekampung Udik to determine the state of learning in schools. There are differences in the number of schools used in previous studies. In the research and development conducted by Rini Mujizah [14] and Yaspin Yolanda [15], they only used one school in their research. While Stefanni Viga [16] used three schools in his research. The researcher considers the number of schools and looks at the researcher's ability.

The results of the field study revealed that the three schools were the object of the research. They needed learning media that allowed students to learn independently during online activities. So far, there are no teachers who use e-modules based on local wisdom as learning resources. They do not forget the culture and nature around them. According to Mustika Wati's research, the existence of e-modules containing local wisdom is appropriate for use in research. Huda's research on physics learning with local wisdom also said that it is effective for improving student learning outcomes [17]. This research concludes that the physics e-module based on local wisdom in the form of Lampung batik is considered very feasible and very interesting to be used as a medium for learning physics.

D. Conclusion

This study concludes that researchers have succeeded in making an e-module learning media based on the local wisdom of Lampung written batik on temperature and heat material. The result has very feasible validation and the field trials are very interesting. The advantage of the product (local wisdom-based e-module) is an online media can be accessed using hardware such as cellphones, laptops, and so on. It also

can be accessed anytime and anywhere with the condition that it is connected to an internet connection. This e-module is the latest variation in learning to find out local wisdom while studying physics material. It is equipped with pictures and interactive videos so students do not feel bored when studying the material. The disadvantages of this product are, that it must be connected to the internet to access this e-module, the material used is still limited to temperature and heat material; and the local wisdom used for the object of research is also limited to the local wisdom of the Lampung Batik art and culture. The Suggestions from researchers for further research, need to develop other local wisdom-based e-modules with different materials and topics of local wisdom.

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The Instagram Comics as Learning Media Alternative to Improve Learning Materials on Light Refraction during the COVID-19 Pandemic

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ABSTRACT

In the era of the Covid-19 pandemic, teaching and learning processes were not allowed to be carried out directly or face to face but could be carried out indirectly or remotely. This requires teachers to be able to use existing technology along with the times. One trend that is currently emerging is the use of social media as a learning medium. This study develops one of the learning media using comics with the help of social media, Instagram. This study aims to determine the level of feasibility of Instagram comic-based learning media as an alternative to learning during the Covid-19 pandemic to increase students' learning motivation on light refraction material. The research method used is the research and development method with the 4D model method. The findings of this study are that Instagram comics can be used as an alternative learning media during the covid-19 pandemic to increase students' learning motivation on light refraction material. Based on the stages that have been carried out, the results of the feasibility test of the Instagram comic learning media product are declared very feasibly.

INTISARI

Pada era pandemi covid-19 proses belajar mengajar tidak diizinkan dilaksanakan secara langsung atau tatap muka, melainkan harus dilakukan secara tidak langsung atau jarak jauh. Hal ini menuntut para guru untuk dapat menggunakan teknologi yang ada seiring dengan perkembangan zaman. Salah satu tren yang sedang muncul saat ini adalah pemanfaatan media sosial sebagai media pembelajaran. Penelitian ini mengembangkan salah satu media pembelajaran menggunakan komik dengan bantuan sosial media instagram. Penelitian ini bertujuan untuk mengetahui tingkat kelayakan media pembelajaran berbasis komik Instagram sebagai alternatif pembelajaran di masa pandemi Covid-19 untuk meningkatkan motivasi belajar siswa pada materi pembiasan cahaya. Metode penelitian yang digunakan adalah metode penelitian pengembangan (Research and Development) dengan metode 4D model. Temuan dalam penelitian ini adalah komik instagram dapat digunakan sebagai alternatif media pembelajaran di masa pandemi covid-19 untuk meningkatkan motivasi belajar siswa pada materi pembiasan cahaya. Berdasarkan tahapan-tahapan yang telah dilakukan, hasil uji kelayakan produk media pembelajaran komik instagram ini dinyatakan sangat layak.

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A. Introduction

The COVID-19 outbreak put the world in a heightened state of condition. The World Health Organization, WHO explains that COVID-19 is a communicable disease due to the novel Coronavirus. Most people infected by the virus suffer from mild to moderate respiratory problems. These people can fully recover without specific care treatments. The COVID-19 pandemic insists humans apply physical distancing in the effort to minimize the COVID-19 virus transmission. The pandemic influences all human life aspects, including education. Based on Letter Number 4 the Year 2020 about the Promotion of Educational Policy during the emergency state of COVID-19 virus spread, the Ministry of Education and Culture instructed all educational levels to change their learning process with the online learning process or distant learning.

Online learning or distant learning refers to interactive model learning with the implementation of the Internet and Learning Management System, LMS. Online learning requires an online network to cover massive and broader targets [1]. Wulansari & Manoy [2] explains that distant learning, online learning, or e-learning is a learning approach without direct face-to-face offline classroom meeting. Thus, all learning processes will be different from face-to-face classroom learning. This matter becomes a significant challenge for educators.

In this COVID-19 pandemic, the most important matter to consider is - the learners' motivations. Sutrisno [3] explains that online learning during the pandemic lowers the learning motivation of learners. Thus, their learning results also get lower. Lin et al [4] explain that learning motivation refers to the effort to guide learners to learn and struggle to reach the applied learning objectives by the teachers in the learning process. Saptono [5] explains the influential factor in learners' learning success is - motivation. Motivation significantly influences learning outcomes both directly and indirectly. Naibaho et al. [6] the fluctuation of learning motivation hinders learning development and threats learning advancement. Thus, accurate management is important to handle learning motivation fluctuation. In this case, teachers have the role to improve learning motivation and learning outcomes by preparing the materials in the form of interesting learning media.

Learning media is important to support learners' learning activities. The applied learning media is useful to mediate the targeted materials. thus, the learners could understand the materials excellently. Umar [7] explains that learning media refer to any applied method and technique as communication media among teachers and learners. Thus, communication and interaction during the learning would be more effective. The media implementation could improve the achievements and motivations of the learners [8]. They are explained that learning media could make learning more interesting, improve learning motivation, and facilitate learners' understanding. Thus, learning media facilitates the learning process to reach the learning objectives.

In this era, social media can be a learning medium. Irwandi [9] found that a percentage of 98% of learners at schools in Bandar Lampung had social media accounts, such as Facebook, Twitter, and Instagram. Then, a percentage of 94% of learners always used the Internet to work on their school assignments. Veygid et al. [10] found that the Instagram application could be an online biology learning because Instagram was a familiar application for the millennial generation, especially Senior High School learners. Rohim [11] explains that Instagram-assisted learning could improve learning motivation and results.

Ahmad Fadillah [12] developed comic learning media to motivate learners to study mathematics. The Research &Development showed that the developed media was reliable and applicable to use as teaching material. In this research, the researchers developed a learning media, comics, for physics. Based on the explanations, the researchers determined the Instagram-based comic learning media's reliability as the alternative of learning media during COVID-19 to improve the learners' learning motivation about light refraction material.

B. Method

This Research & Development study produced a certain product, a learning instrument, with the 4D model. The 4D model has four main stages. They are defining, designing, developing, and disseminating. The applied model was useful to produce an Instagram comic media. In the defining stage, the researchers conducted the pre and post-analysis; the analyses of materials, students, and tasks; and the specifications of learning objectives. From the pre-analysis, the researchers found a lack of learning motivation in the students on light refraction materials during this COVID-19 pandemic. This situation occurred due to the applied online learning and lack of interesting learning methods. In the second stage, the designing stage designed the learning instrument blueprint. The researchers designed the plant or the blueprint in the form of an Instagram-assisted comic. This comic contained materials about light refraction. Then, the researchers would package the comic attractively and upload it via an Instagram account. The third stage, the development stage, dealt with creating a related design of the comic with additional captions.

After designing the comic, the researchers examined the reliability of the comic to be used as an alternative during the COVID-19 pandemic and to motivate learners in learning light refraction. The applied method was a survey by distributing the reliability questionnaire to 50 respondents, consisting of 18 learners and 32 students. In this research, the researchers applied an inclusion criterion for the respondents. The researchers only chose learners and students that studied light refraction. The researchers used Google Form to spread the questionnaire and ensured only one respondent got one questionnaire once. The examined aspects were media, motivation indicator, material, and design. Here are the indicators to assess the product.

Table 1. The Reliability Test Indicators

Aspects	Indicators
Media	The reliability of Instagram as a publishing media for the comic
	The reliability of the Instagram comic as the learning media alternative during the COVID-19 pandemic
	The reliability of the Instagram comic to improve learners' learning motivation
The Indicators of Motivation	The improved persistence and tenacity of the learners after reading the developed comic
	The improvement of learners' learning motivation after treading the developed comic
	The cognitive understanding improvement after reading the developed comic
Materials	The relevance of comic content with the light refraction material
Design	The attractiveness of Instagram comics as a learning media with light refraction material
	The assessment of Instagram comic

In this research, the researchers only provided the development of the product at the third stage of the 4D model. The researchers decided to determine the reliability of the Instagram comic design. In this research, reliability refers to content reliability based on the experts' judgment.

The applied reliability analysis for the developed comic was the ideal standard of deviation. Here are the stages.

a. Calculating the mean of the assessed-scoring aspects

$$\bar{X} = \frac{\Sigma x}{n}$$

by:

$\bar{X}$ = mean score

Σx= score total

n= examiners

b. Converting the scores into a 4-scale score

Referring to the 4-scale score conversion by calculating the ideal mean (M_i) obtained from an equation [13].

$$M_i = \frac{1}{2}(ideal\ maximum\ score + ideal\ minimum\ score)$$

After finding the value of M_i, the researchers calculated the ideal standard of deviation with the equation [13].

$$SB_i = \frac{1}{6}(ideal\ maximum\ score - ideal\ minimum\ score)$$

c. Determining the assessment criteria

The applied assessment was based on the calculated standard deviation scores with the given formula on the Table 2.

Table 2. The Quantitative-Qualitative Data Conversion Guidelines

Quantitative Score Interval	Category
$X \geq M_i + 1{,}5SB_i$	Very reliable
$M_i + 1{,}5SB_i \geq X \geq M_i$	Reliable
$M_i > X \geq M_i + 1{,}5SB_i$	Unreliable
$M_i + 1{,}5SB_i > X$	Extremely Unreliable

The researchers converted the equation criteria into a 1-4 scale interval.

$$M_i = \frac{1}{2}(4 + 1) = 2{,}5$$

$$SB_i = \frac{1}{6}(4 - 1) = 0{,}5$$

From the 4-scale assessment criteria, the researchers obtained the research assessment criteria in Table 3.

Table 3. The Quantitative-Qualitative Data Conversion Guidelines for 4-Scale Interval

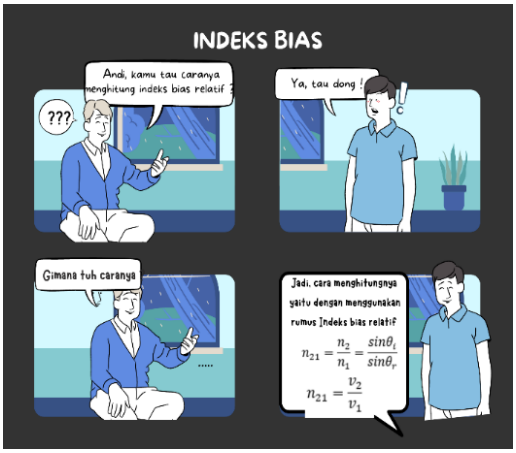
Quantitative Score Interval	Category
$X \geq 3{,}25$	Very reliable
$3{,}25 \geq X \geq 2{,}5$	Reliable
$2{,}5 > X \geq 1{,}75$	Unreliable
$1{,}75 > X$	Extremely Unreliable

C. Result and Discussion

The results of this research dealt with the Instagram comic design. After designing the comic, the researchers prepared the script in the form of conversation shown in figures and dialog bubbles among the characters. The delivered physics-material conversations were about light refraction. Then, the researchers clarified the materials in the comics with some captions. Here is the design of the developed product.

Table 4. The Design of Instagram comic

No	Topics	Comic Design
1	The rainbow phenomenon	 Caption: A Rainbow usually appears after the rain on a sunny day. The rainbow occurs due to sunray dispersion with its polychrome feature. Then, the light is refracted into monochromatic light. This phenomenon occurs because the ray is refracted by the airdrops. The refracted sun ray produces separated light from the sun. Thus, the reflection is seen in seven colors. Each color is refracted differently and separated.
2	The phenomenon of a visible shallow pool	 Caption: The illustration shows the light refraction of a clean and clear shallow pool. When an individual sees the bottom of the pool, the light on the pool goes into our vision. However, the light does not directly go to our vision. The light passes through the water surface so that the light is bent away from the normal line. Thus, human visions catch the refracted light. The extensions of this light

No	Topics	Comic Design
		create an image of the pool's bottom to be more shallow than the actual depth.
3	Bias Indexes	 Caption: The relative bias indexes refer to a ratio of the two absolute bias indexes of two mediums. For example, a light that goes from the air into a glass. These figures mathematically show the relative bias index of air and glass.

In this research, the reliability of the comic design was assessed by 50 respondents. They were students and learners that ever studied light refraction. The examined aspects were media, motivation indicator, material, and design.

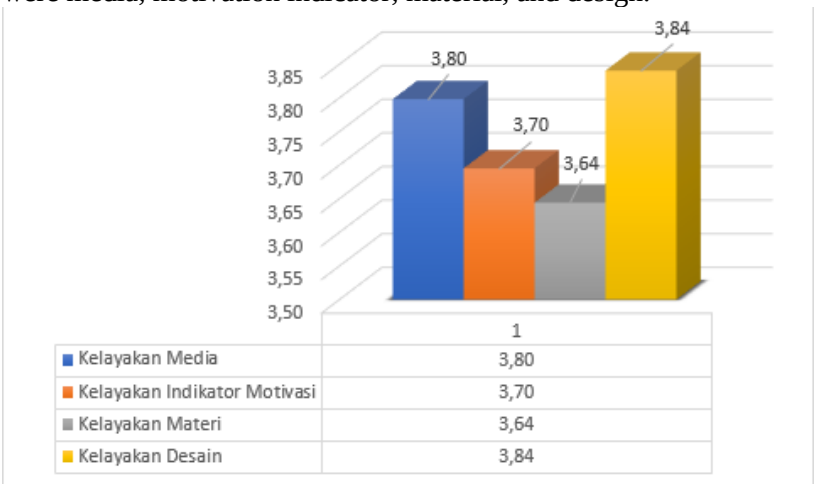


Figure 1. The Graphic of Reliability Result Ratio

Based on the assessment of all aspects, the researchers found the reliability score to be 3.84. The score was based on the examiners' judgment of the developed

product. For the examiners, the developed product was interesting to support the learning process. The other highest aspect was the reliability aspect of the media, 3.80. An examiner explains that the developed product was reliable to be published because many Instagram users were interested in comic content moreover if the content was about education. Fadillah [12] also found that comics were suitable meaning material media. Rohim [11] explains that Instagram-assisted learning could improve learning motivation and results. The third aspect was the motivation with the obtained point of 3.70. The motivation indicator of this aspect consisted of the improved persistence and tenacity of learners after reading the comics about light refraction, the improved learners' learning motivation after reading the developed comic, and the improved understanding after reading the developed comic. Then, the final aspect was material reliability with the obtained point of 3.64.

The examiners suggested the researchers' design materials with many variations. Thus, the researchers revised the design by considering the shadows, the color gradation, the illustration, and many other aspects. In general, the examiners suggested the researchers develop the product design.

The reliability test showed that the Instagram comic as learning media was reliable. Therefore, the researchers continued the production and publication processes in a wider scope. The researchers expect the developed product could be the alternative to improve learners' learning motivation during the COVID-19 pandemic.

D. Conclusion

Based on the results, the researchers concluded the Instagram-based comic learning media was reliable as the alternative of learning media during COVID-19 to improve the learners' learning motivation about light refraction material. The reliability test showed that the product was reliable.

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The Influence of Problem-Based Learning on Elementary School Students' Interest in Science

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ABSTRACT

Elementary school students' problem-solving abilities must be developed so that they are accustomed to formulating solutions. This study aims to determine the effect of problem-based learning on students' interest in science at SD Muhammadiyah Majenang. The nonequivalent control group design was used in this quasi-experimental study. The participants in this study were fourth-grade students from SD Muhammadiyah Pahonjean and SD Muhammadiyah Cilopadang. Student questionnaires and documentation were used to collect data. The data analysis technique used a normality test, homogeneity test, and t-test. The Mann-Whitney test results show that the Asymp Sig. 0.000. This results that the problem-based learning model having an impact on SD Muhammadiyah Majenang students' interest in science. Teachers need to implement science learning using a problem-based learning model.

INTISARI

Kemampuan pemecahan masalah siswa SD harus dikembangkan agar terbiasa merumuskan solusi. Penelitian ini bertujuan untuk mengetahui pengaruh pembelajaran berbasis masalah terhadap minat belajar IPA siswa di SD Muhammadiyah Majenang. Desain kelompok kontrol nonequivalent digunakan dalam penelitian kuasi-eksperimental ini. Partisipan dalam penelitian ini adalah siswa kelas IV SD Muhammadiyah Pahonjean dan SD Muhammadiyah Cilopadang. Kuesioner dan dokumentasi siswa digunakan untuk mengumpulkan data. Teknik analisis data menggunakan uji normalitas, uji homogenitas, dan uji t. Hasil uji Mann Whitney menunjukkan bahwa Asymp Sig. 0,000. Hal ini menunjukkan bahwa model pembelajaran berbasis masalah berpengaruh terhadap minat IPA siswa SD Muhammadiyah Majenang. Guru perlu menerapkan pembelajaran IPA dengan menggunakan model pembelajaran berbasis masalah.

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A. Introduction

Education is one of the important things in life, from toddlers to adults. The learning process requires something interesting to encourage further interest in learning [1]. The low interest in student learning can be caused by internal and external factors. Internal factors come from the students themselves as well as students' motivation and intelligence [2]. External factors that come from the student environment include the learning model used by the teacher in delivering the material [3]. The influence of inappropriate learning models can result in conditions of learning activities such as interest and student learning outcomes that tend to be low and monotonous [4]. Students who prefer to be lectured, few students want to ask questions, few students can answer questions, and students will feel bored, and sleepy during the learning process [5]. In addition, teachers also rarely provide examples of the application of subject matter in everyday life [6].

Sometimes during the learning process, students do not want to ask about their understanding of the natural science material presented by the teacher [7]. This is not only caused by the low interest in learning students but also by the students' self-confidence which is still not formed [8]. In addition to the student factor, the teacher factor also affects the students' low interest in learning about natural science subjects. Teachers mostly convey natural science material to students through a teacher center approach which is carried out using the lecture method only [9]. This of course will make it difficult for students to explore learning interests, scientific argumentation skills, and the ability to express their opinions [10]. In the minds of every student, there will also be unfavorable thoughts about natural science which is one of the theoretical subjects without application in everyday life. Thus, teachers need to modify the implementation of natural science learning by implementing a learning model that is more student-centered, innovative, and able to optimize student interest in learning.

The implementation of learning models that can facilitate students' interest in learning turns out to be closely related to the content of natural science subjects. This is because natural science is a science that seeks to find out about nature systematically [11]. That is, through natural science a person is not only required to be able to master a collection of knowledge in the form of facts, concepts, or principles but also to be able to carry out the discovery process [12]. With the existence of natural science subjects, it is hoped that it can be a vehicle for students to increase interest in studying themselves and their environment. Indeed, the right learning process in natural science subjects is by providing direct experience to develop the competence to explore and understand the environment scientifically [13].

Natural science learning that is carried out using a problem-based learning model can help teachers apply natural science material in everyday life [14]. In the implementation of learning based on the problem learning model, the teacher only

acts as a learning facilitator who provides natural science problems to students to solve them [15]. The application of problem-based learning models in natural science learning can accommodate students who have diverse learning interests [16]. Students who take part in natural science education based on problem learning models can increase their activity in class and their learning interest is more optimal [17]. This is because problem-based learning makes students think and act in a structured manner with a gradual pattern of activities to solve natural science problems [18].

Furthermore, each learning model has its advantages and disadvantages, so in the implementation of learning, it is necessary to vary the implementation of the learning model. This also occurs in the problem-based learning (PBL) model which has several advantages, one of which is being able to motivate students to have the ability to solve problems in real situations [19]. Students can build their knowledge through problem-focused learning and learning activities so that unrelated material does not need to be studied by students [20]. This reduces the burden on students by memorizing or storing information. Scientific activities occur through group work and students are accustomed to using various sources of knowledge [21]. Students can carry out scientific communication in discussion activities or presentations of their work [22]. Thus, this study aims to determine the effect of the problem-based learning model on the learning interest of the students of SD Muhammadiyah in Majenang.

B. Method

This quasi-experimental research was conducted using a nonequivalent control group design. This quasi-experimental research design is almost the same as the pretest-posttest control group design, only in this design the experimental group and control group are not chosen randomly [23]. The nonequivalent control group design used in this study can be shown in Table 1.

Figure 1. Nonequivalent control group design

Group	Pretest	Treatment	Posttest
EG	O	X	O
CG	O	X	O

Based on Table 2, it can be seen that EG is an experimental class. The experimental class in this study was 34 students of SD Muhammadiyah Pahonjean. CG is the control class in this study, namely 24 students of SD Muhammadiyah Cilopadang. X is the treatment given in this study which includes natural science learning that implements a problem-based learning model. Meanwhile, O is the implementation of the pretest and posttest used to determine the students' initial and final interest in natural science learning before and after the learning is implemented using the PBL model. The selection of samples or participants in this study was carried out by implementing a purposive sampling technique. This technique was chosen because students' interest in learning is quite low towards learning natural sciences,

namely students from both schools. The two schools also rarely implement problem-based learning models.

Data collection techniques in this study were through student questionnaires and documentation. The questionnaire compiled in this study contains the main components such as student responses to the learning process before and after applying the problem-based learning model. Students were also asked for their views on the teacher's treatment during the learning process by applying a problem-based learning model. This questionnaire was filled out by fourth-grade students in the experimental class and the control class. Meanwhile, documentation is more focused on student activities during the natural science learning process that applies a problem-based learning model. After getting the data through student questionnaires and documentation, the data is then analyzed using various statistical tests. The statistical tests used to analyze the data in this study include the normality test, homogeneity test, and t-test.

C. Result and Discussion

This study used 2 classes, namely the experimental class and the control class. Research in the experimental class was conducted for two days. On the first day of application of the problem-based learning (PBL) model. Meanwhile, on the second day, questionnaires were distributed to students. The application of the problem-based learning (PBL) learning model at the beginning of the lesson is carried out by the teacher opening with greetings, after that the teacher motivates students so that students are more enthusiastic about learning. In the content section, the teacher provides an introduction to the material studied together as subject matter. Next, the teacher divides students into groups to discuss and present the results of discussing the problems of the learning material being studied. At the end of the lesson, the teacher concludes and closes with greetings.

The control class was conducted for two days, the first-day observing conventional model learning. On the second day distributed questionnaires to students through the application of natural science learning based on conventional learning models. This learning model is a learning model that focuses on the teacher being active or explaining the material and students listening [24]. Meanwhile, the data on student interest in learning natural sciences after learning is done by implementing PBL in the control and experimental classes can be seen in Table 2.

Table 2. The average percentage of students' learning interest questionnaire

Class	Percentage	Category
Control	69,80 %	Low
Experiment	82,30 %	Excellent

Based on the data presented in Table 1, it can be seen that the average percentage of students interested in learning natural sciences after learning implements a

problem-based learning model. In the experimental class, the category is very high (very good) and the control class is in a low category. The average percentage of students' interest in learning questionnaire scores in the experimental class was higher than in the control class. This is by the findings of previous studies which stated that the PBL learning model can increase students' motivation and interest in learning so that the learning model can increase students' interest in learning [25].

Meanwhile, in classes that do not use problem-based learning models, students' interest in learning tends to be lower because there is no variation in learning. This can be the cause of the lack of student interest in learning natural sciences. Furthermore, the data obtained after learning natural science based on the PBL model were then tested. The first test is the normality test. The normality test was conducted to determine whether the data were normally distributed or not. The results of the normality test can be seen in Table 3.

Table 3. The result of the normality test

Class	Result	Description
Control	0,441	Normal
Experiment	0,625	Normal

Based on Table 3, it can be seen that the normality of student interest in learning after natural science learning based on the PBL model in the control class and experimental class is 0.441 and 0.625. Based on these findings, it can be said that students' interest in learning after learning natural science based on the PBL model is normally distributed because >0.05. The next test is the homogeneity test. A homogeneity test was conducted to determine whether the data obtained were homogeneous or not. The results of the homogeneity test can be seen in Table 4.

Table 4. The result of the homogeneity test

Name	Signification	Criteria	Description
Students' learning interest	0,058	> 0,05	Homogenous

Based on Table 4, it can be seen that the results of the homogeneity test on student learning interest data are sig. 0.058. The homogeneity test criterion is if the value of sig. >0.05 then Ha (homogeneous data) is accepted. The data in this study is homogeneous because the significance value is 0.0588 which is greater than 0.05. Thus, based on normality and homogeneity tests, the data in this study were normally distributed and homogeneous. The data on student interest in learning natural sciences based on the PBL model was then tested using a paired t-test. The results of hypothesis testing using paired t-tests can be seen in Table 5.

Table 5. The result of the hypothesis paired- t-test

Class	Signification	Criteria	Description
Control and Experiment	0,000	< 0,05	Changing

Based on the data presented in Table 5, it can be seen that the significance value is 0.000 or <0.05. This shows that there is an effect of the PBL model on students' interest in learning natural sciences. This is a sense of preference and interest in a particular thing or activity, without anyone telling or forcing it [26]. This can also be generated by conducting learning that is more attractive to students. When students feel interested in learning, they will be happier to participate in learning [27].

Students' interest in learning is very important to generate enthusiasm for learning. One way to optimize student interest in learning natural sciences, namely the teacher can provide material in an interesting and not monotonous way, such as by applying the PBL learning model. Having the characteristics of students exploring their knowledge so that students are not fixated on the material given by the teacher [28]. This can make students knowledgeable about problems that are used in real life. In addition, they can easily understand natural science learning delivered by the teacher. This is one of the factors that the PBL learning model can affect students' interest in learning. The findings in this study are by the findings of previous studies which stated that the PBL learning model can increase students' motivation and interest in learning [29]. This is because students can feel the benefits of problem-solving and relate it to real life.

Other research also strengthens the findings of this study that there is an increase in student interest in learning natural science material using a problem-based learning model [30]. The application of the PBL model in learning natural sciences, especially physics, can also increase the effectiveness of student interest in learning so that student learning outcomes in learning also increase [31]. Student learning outcomes in learning natural sciences that implement problem-based learning models and students using conventional learning models have significant differences [32].

The PBL learning model has characteristics that present problems in everyday life and opportunities for students to solve these problems in class discussions [33]. This can increase the attractiveness of students during learning. Furthermore, students can also reconstruct their understanding of the concepts of natural science that they have learned. Meanwhile, interest in learning is very influential on student learning outcomes. These findings can be used as a basis for driving natural science learning to be able to facilitate student activities that are more active and able to solve problems that occur in daily life.

D. Conclusion

This research has been able to provide a new understanding of learning natural sciences. The process of learning natural sciences from basic education and higher education needs to be carried out in various ways, one of which is by implementing a problem-based learning model. This is due to the implementation of the problem-based learning model (PBL) in natural science learning can positively affect students' interest in learning. This finding is evidenced by the results of statistical analysis which shows that the value of the paired t-test hypothesis test has a significant result of 0.000. Through these findings, it is only natural that teachers need to carry out a science learning process that focuses on students as learning subjects. Teachers can also carry out natural science learning by implementing a problem-based learning model. The hope is that students are not only able to understand the concepts of natural science, but they can apply and be able to solve any problems that occur based on the concepts they already have.

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