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Development of an Integrated Physics Problem-Solving Model in Virtual Media for Class XI Students

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ABSTRACT

This research and development aims to determine the feasibility of developing problem-solving-based learning tools assisted by virtual media. The type of research used is Research and Development (R&D) with the ADDIE model (analysis, design, development, implement, evaluate), which is only carried out up to the development stage. The subjects of this research were physics teachers and students of class XI IA MAN 1 Sumbawa for the 2022/2023 academic year. The research instrument uses a questionnaire for material experts, media, practitioners, and students. The instruments used were validation questionnaire sheets and student response questionnaires to determine the feasibility of problem-solving-based learning tools assisted by virtual media. Based on the results of expert validation and product trials, it shows that the product quality has reached the appropriate standards for learning media. Material expert validation obtained an average percentage result of 96.67% with the criteria "very feasible". Media expert validation obtained an average percentage result of 95.14% with the criteria "very feasible". The teacher practitioner test obtained an average percentage result of 100% with the criteria "very good". The limited trials obtained an average percentage result of 88.22% with "very good" criteria. The results of the effectiveness test obtained an average percentage of 90.45% with the criteria "very good". Based on the results of the description above, the product developed, namely a problem-solving-based learning device assisted by virtual media, is said to be suitable for use in learning in Class XI IA.

Introduction

Physics is a subject that students find very difficult because they still think this subject is difficult to understand and understand (Hermansyah, Yahya, Fitriyanto, et al., 2022). This is because physics subjects have many similarities, resulting in limited student abilities. This statement is supported by the results of research conducted by Negoro et al. (2018), 33% of students answered that physics was a difficult subject, and 51% of students answered that physics was difficult to understand.

Teaching and learning activities that take place in the classroom have a significant impact on the skills developed by students. Observations carried out at MAN 1 Sumbawa show that learning using the lecture method carried out by teachers is still widely used in a teacher-centered manner, which should be student-centered. Students write and answer questions given by the teacher, making students remain passive in the learning process in class. Teachers should act as facilitators in this process so that the resulting learning is only student-centered (Sari, I.K., Yushardi, 2015). Research conducted by Kariawan et al. (2015) regarding the learning methods most often used in the classroom, 70% of the lecture

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method is used, 10% of the experimental method, 10% of discussion, and 10% of practical skills. Students play a passive role in learning because students are not involved in this type of learning. In short, learning can encourage students to build and apply knowledge in their minds (Ependi, 2018).

In addition to using learning methods in class, it is felt that there is a need to use media as a support that can help facilitate the process of conveying information during teaching and learning. Because what supports the teaching and learning process in the classroom is learning media. In the learning process, they still use media that do not meet existing learning standards, one of which is still using media that can only be read, such as printed books (Wahyuni et al., 2017). Things like this are not fun for students to learn, and therefore make the learning process boring. Based on this, it is necessary to use more interesting learning media so that the learning process takes place more effectively. So innovation is needed in learning media so that it is used more effectively and efficiently in the classroom (Mulyati & Evendi, 2020; Rahmawati & Atmojo, 2021; Salsabila et al., 2020). In the process of learning physics in class, teachers are still unable to choose to use creative and innovative learning media. The use of learning models and media that are less appropriate to the conditions in the classroom by teachers will be an inhibiting factor in teaching and learning activities in the classroom, especially for students (Parasamya & Wahyuni, 2017).

This problem has an impact on students' lack of motivation because students have difficulty understanding physics lessons due to their lack of active involvement in the teaching and learning process in class. This is confirmed by the research conducted Sari, I. K, Yushardi (2015) According to facts in the field, it was found that the problem of students' lack of seriousness in studying in class and in answering questions or questions given by the teacher, students looked indifferent, paid little attention to the questions given and usually some students did not answer the questions because they were not sure about their answers and did not even complete them. The learning model chosen is the main problem in the teaching and learning process in the classroom, which must be planned by the teacher in a structured manner before the teaching and learning process in the classroom is carried out. The teacher's ability is one of the important factors that is needed in developing a systematic learning model so that it is more effective in creating learning that is able to train or construct students' skills/abilities in solving problems (Kadarisman, 2020).

The reality in the field is that the limitations of media in the learning process are an inhibiting factor for students in learning activities in class, so that this can make the knowledge produced by students less complex (Yuliani & Herlina, 2015). Apart from that, physics practical activities are also rarely held. This is because much of the equipment for conducting experiments/trials in schools is unfit for use or damaged. For example, in the harmonic motion material, the equipment used is in the form of springs and other equipment that is still small equipment, so it will be an obstacle in activities related to trials/experiments on this material. Experiments on the concept of static electricity, sub-chapter on abstract electrical charges, the teacher only conveys the material to students without any proof of theory, so that students do not understand the related material. The learning process that is not optimal for this problem has an impact on students' problem-solving abilities in experimental activities, which are still relatively low. Another impact on students is their lack of interest in learning, which affects their critical thinking abilities. Students' lack of willingness to complete assignments given by the teacher in class also becomes an obstacle in learning activities (Delyana et al., 2021); therefore, in physics subjects, the achievements obtained by students are relatively minimal (Hotman et al., 2018).

Therefore, an appropriate solution is needed to solve this problem, namely by developing problem-solving model learning tools assisted by virtual media. This learning model allows students to participate more actively in the learning process, so that students are able to solve problems given, which allows their problem-solving abilities to increase (Asfar & Nur, 2018). This strategy can make students understand and understand more about the problems they will face during learning and think about the information they need to solve them in order to get the correct problem-solving solution (Manurung et al., 2023). Problem-solving has advantages, one of which is the concept taught by demanding problem-solving from students, which makes them more active in learning, their thinking skills are more developed, and they can apply the knowledge they have gained (Devi et al., 2020).

Methods

This development research used two classes as a field trial. The place where the virtual media-assisted problem-solving model learning tools were tested was at MAN 1 Sumbawa. Class XI IA students who are currently taking the second semester of the

2022/2023 academic year were used as samples in the research. The class samples chosen have gone through consideration, namely, using positive sampling. This research uses the ADDIE development research design developed by Dick & Carry (1996) in Putri Fauziah Yazmin & Risda Amini (2023), with the first being analysis, the second design, the third development, the fourth implementation, and the fifth evaluation.

The stages of the analysis stage include: (1) analysis carried out from start to finish, (2) research subject analysis, (3) task analysis and concept analysis, and (4) narrowing down learning objectives. The planning (design) stage consists of 2 steps, namely: (1) preparing learning tools, (2) data collection instruments. The development stage includes: (1) validation by experts regarding content and media, (2) revision I. The implementation stage includes (1) limited trials, (2) revision II, (3) effectiveness testing, and (4) revision III. The Evaluation Stage includes: (1) Final Product, (2) Evaluation Steps.

This development research uses an instrument consisting of material and media validation questionnaires, teacher and student practitioner response questionnaires. Data collection uses interviews, questionnaires, and documentation methods. There were two experts as validators from Samawa University, Practitioner Response Questionnaire, and one Physics Teacher and 10 Class XII students at MAN 1 Sumbawa. The product of this research development is a learning tool based on problem-solving assisted by virtual media at MAN 1 Sumbawa. This device is also equipped with a learning implementation plan, student worksheet, and teaching materials, which are expected to help students be more active in the learning process.

The research data obtained were analyzed using quantitative descriptive analysis. Each validator provides the average value of the indicators determined based on data from analysis regarding problem-solving-based physics learning tools assisted by virtual media. The average value of each aspect is determined based on the average indicator value. The average value of each aspect of the assessor is used to determine the average value of the total aspect. To calculate the percentage of practitioner responses analyzed and the validity of the learning tools assessed. You can use percentage calculations like the following Equation 1.

$$p = \frac{Total\ Score\ Obtained}{Maximum\ Total\ Score}\ x\ 100\% \qquad (1)$$

The percentage can conclude the level of validity of the product developed using the analysis results criteria, as in Table 1. Table 2 shows the level of effectiveness of the learning media developed.

Table 1
Learning Device Validity Criteria

No	Percentage (%)	Validity Criteria
1	0 ≤ P ≤ 20	Very Invalid
2	21 ≤ P ≤ 40	Invalid
3	41 ≤ P ≤ 60	Fairly Valid
4	61 ≤ P ≤ 80	Valid
5	81 ≤ P ≤ 100	Very Valid

Table 2
Criteria for Practicality and Effectiveness of Learning Tools

No	Percentage (%)	Criteria
1	0 ≤ P ≤ 20	Very Not Good
2	21 ≤ P ≤ 40	Not Good
3	41 ≤ P ≤ 60	Pretty Good
4	61 ≤ P ≤ 80	Good
5	81 ≤ P ≤ 100	Very Good

Result and Discussions

The development stage in this research was carried out in 5 systematic stages: analysis, design, development, implementation, and evaluation. The first stage is analysis. At this stage, the researcher makes observations at the school that will be used as a research site to obtain important information regarding problems at the school. Information regarding the teaching and learning process on physics material in schools, the use of media as a tool to convey information is still rarely used by teachers because it is not time-efficient and is very tiring in the process of creating learning media. The analysis stage is divided into two types, namely task analysis and concept analysis. To determine the material you want to use in research, you first need a task analysis. A task analysis is carried out to write broad details of the material. So the class XI light wave material will be developed in this research, which will be carried out at MAN 1 Sumbawa. Next is concept analysis, in which the researcher systematically compiles the main concepts of the light wave material that will be taken. Task analysis and concept analysis result from the specification of learning objectives, which convert the objectives of the two types of analysis. Curriculum planning is carried out to develop goals and indicators for achieving learning outcomes based on the core competencies listed in the curriculum.

The next stage is the design stage, at this stage, the researcher prepares the learning support that he wants to develop, such as tools, and adapts it to the results of the analysis in the first stage. The format chosen by researchers at this stage is adapted to the

devices and media they want to develop. In this research, the researcher wants to develop learning tools that are arranged systematically, the process of which begins with an initial design in creating learning tools that will be used, such as lesson plans, student worksheets, and teaching materials.

The third stage, namely the development stage. At this stage, the researcher produces a product that was designed in the previous stage. The product that the researchers have developed, namely a problem-solving model learning tool assisted by virtual media, was validated by experts. Products that have been given grades and given input by experts are then revised according to criticism and suggestions from material validators and the media. After the revision has been completed, the device is tested. The learning devices that will be tested meet the valid criteria according to the validation results. Validation results are presented in Tables 3 and Table 4.

Table 3
Material Expert Validation

No	Device Validation	Validate Each Aspect	Expert Validation (%)	Category
1	Construction			
	a. Learning Tool Cover	4	100	VV
	b. Use of pictures and design of learning devices	3	75	V
	c. Use of font type and size in learning devices	4	100	VV
	d. Ease of use of physics learning tools	4	100	VV
	e. The attractive appearance of physics learning tools	3	75	V
	Average	3,6	90	VV
2	Contents			
	a. Suitability of material to Basic Competencies	4	100	VV
	b. Compliance of material with indicators	4	100	VV
	c. Suitability of the material to the facts of daily life	4	100	VV
	Average	4	100	VV
3	Language			
	a. Using standard words	4	100	VV
	b. The language used is easy to digest and understand	4	100	VV
	Average	4	100	VV
Average (%) (1+2+3)			96,67	VV

The product developed is tested after carrying out revisions by following every input and criticism made from the validation results. Learning device development requires representation in product testing. So it takes 10 class XII IA students and 1 physics teacher as representatives for limited product testing to find out the practicality of the learning device. Respondents were asked to fill out a questionnaire and be able to assess the tools that researchers had developed. The effectiveness test was also carried out by class XI IA students. Student and teacher practitioner results can be seen in Figure 1.

The students selected were class XII students who had received lessons on light waves. Data from student response results were obtained from limited trials. The virtual media-assisted problem-solving model learning tool (draft II) was revised from the results of limited trials to obtain draft III.

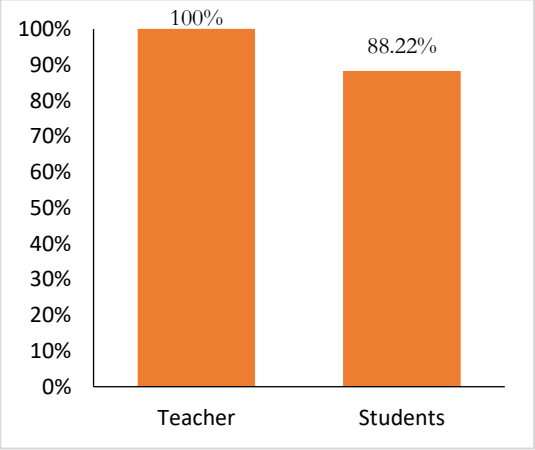
Learning using problem-solving model learning tools assisted by virtual media can be assessed based on student responses. This assessment received a score of 4, because when using this learning tool students understand more easily, it is easy for students to use, in terms of attractive appearance such as the colors used, appropriate font size, plus pictures that are attractive to students, written rules, punctuation that is in accordance with correct writing rules and the use of problem solving-based learning tools assisted by virtual media can make students more active, enthusiastic in class and very influential in the process of student activity in class so that the level of student seriousness in solving problems and thinking critically students will improve.

Table 4
Media Expert Validation

No	Device Validation	Validate Each Aspect	Expert Validation (%)	Category
1	Material Aspects			
	a. Suitability of material to Basic Competencies	4	100	VV
	b. Compliance of material with indicators	4	100	VV
	c. Suitability of material to learning objectives	4	100	VV
	d. Clarity of learning topics	4	100	VV
	e. Sequence of materials	4	100	VV
	f. Material coverage	4	100	VV
	g. Material completeness	4	100	VV
	h. Interesting presentation of material	4	100	VV
	Average	4	100	VV
2.	Language Aspects			
	a. Accuracy of the terms used and in accordance with the field of physics	4	100	VV
	b. The use of language is easy to digest and understand	4	100	VV
	c. The use of language is polite and does not reduce the value of education	4	100	VV
	d. Suitability of images and illustrations	3	75	V
	Average	3,75	93,75	VV
3.	Presentation Aspects			
	a. The presentation of material encourages students to be actively involved in learning	4	100	VV
	b. The image presentation is attractive and easy to understand	3	75	VV
	c. Accuracy of presentation of image illustrations in the material	4	100	VV
	Average	3,67	91,67	VV
Average (%) (1+2+3)			95,14	VV

Obtaining a score of 3 states that the problem-solving-based learning device assisted by virtual media is considered to have met the standards as a device used in the learning process other than ordinary textbooks, because this device is in accordance with the wishes and characteristics of students, so that it can make it easier for students to understand the material presented interactively. Systematic. Data regarding student responses was obtained from limited trials that had been carried out. The media-assisted problem-solving-based learning tool (draft II) was revised from the trial results, and the virtual media-assisted problem-solving-based learning tool (draft III) produced a percentage of 88.22% which was categorized as very good. After using problem-solving-based learning tools assisted by virtual media, comments and suggestions will be given according to the results of limited trials that have been carried out by students on student response questionnaires. Student response questionnaires given via Google Form can obtain student practitioner response results.

Figure 1
Practitioner Test Results of Learning Tools



The assessment of the teacher's response in using virtual media-assisted problem-solving-based learning tools received a score of 4, giving reasons that virtual media-assisted problem-solving-based learning tools can achieve the effective learning that teachers want, which makes students more enthusiastic and active in

class, and the text written on the device can adapt to the student's attitude and character. The results of the teacher practitioner responses obtained a percentage of 100% which is in the very good criteria.

In Figure 2 presented it can be stated that the results of student effectiveness are 90.45, including effective criteria. So it can be concluded that the effectiveness of student learning falls into the criteria of being very effective. Data on positive student responses were obtained from the effectiveness questionnaire, which was distributed and filled in by 53 students in class XI IA 1 and IA 2 who were the research subjects.

There were 13 statements in the questionnaire distributed, with 4 options, namely "agree", "strongly agree", "strongly disagree", and "no". Each questionnaire contains statements related to the learning process that uses problem-solving-based learning tools assisted by virtual media on sound wave material.

Judging from each statement, of the 13 aspects, the aspect that received the most "Strongly Agree" answers compared to other aspects was aspect number 1, where this aspect contains students' opinions regarding the effectiveness of virtual media-assisted problem-solving-based learning tools in learning. Based on the four existing criteria, namely (1) students respond to the material provided in learning (2) students respond after using problem solving-based learning tools assisted by virtual media, (3) students respond to learning materials through problem solving-based learning tools assisted by virtual media, (4) students' positive responses to the learning atmosphere and by looking at the average percentage of all aspects of students' positive responses, namely 90.45%, it can be said that learning using problem solving-based learning tools assisted by virtual media is classified as effective.

The effectiveness of the learning process carried out cannot be separated from the application of problem-solving model tools and the use of virtual media, which is integrated in the learning process as a learning medium for students. The use of virtual media can make the learning process easier for students because the features presented in it make it very easy for students to understand the theory/material being studied. The research results of Hermansyah et al (2021) state that the use of virtual media can improve the learning process because of its ease of using it. The use of virtual media as a learning medium also has a big impact on students' motivation in studying the physics concepts or material being taught, which will indirectly influence their learning outcomes (Hermansyah, Yahya, Fitriyanto, et al., 2022). The use of virtual media in problem-based learning also overcomes the problem of the lack of media or practicum tools available in schools so that practicums or experiments cannot be carried out optimally (Hermansyah et al., 2023; Hermansyah, Yahya, Yulianci, et al., 2022).

Conclusions

It can be concluded that the use of problem-solving-based learning tools assisted by virtual media has been validated through validation tests, such as material, media, and practitioner validation tests carried out by 1 physics teacher, limited trials with 10 students, and effectiveness tests. In accordance with the results of validation by experts and product trials, the product is said to be feasible. Obtaining an average percentage of material expert validation of 96.67% received the "very feasible" category. The average percentage of validation from media experts was 95.14% in the "very appropriate" category. The average percentage of teacher practitioner tests is 100% in the "very good" category. The average percentage of limited trials of 88.22% received the "very good" category. The average percentage results of the effectiveness test were 90.45% in the very good category. So it can be concluded that the product developed, namely the development of problem-solving-based learning tools assisted by virtual media, is said to be suitable for use, in accordance with the results carried out in class XI IA.

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