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ANALYSIS OF PROBLEM SOLVING SKILLS BASED ON AUTHENTIC PROBLEMS ASSISTED BY E-MODULE ON SOUND WAVE MATERIAL

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ABSTRACT

Problem solving is one of the 21st century skills that need to be trained through the education process. One of the subjects that can train students' problem solving is physics. Problems in physics learning should be presented as authentic problems in students' daily lives. The purpose of this study is to determine the effect and improvement of students' problem solving due to the effect of the application of e-modules based on authentic problems and conventional learning on the subject matter of sound waves in class XI. This research is a quasi experiment with pre-test and post-test control group design. The results obtained are the percentage of validation assessment results of media experts 88% and material experts 81.25% with valid categories. Based on the results of hypothesis testing to determine differences in problem solving skills based on authentic problems, it is found that z_{count} 6.936. *Furthermore, by comparing* z_{count} *and* z_{table} *it is found that 6.936 > 1.96. This means the null hypothesis is rejected and the alternative hypothesis is accepted which states that there is an effect of problem solving skills based on authentic problems assisted by e-module on sound wave material. The increase in problem solving skills with the N-gain test of experimental and control class students is 80% and 40% in the high and medium categories.*

Keywords: *e-module, authentic problem, problem solving, sound waves*

INTRODUCTION

Human civilization has entered the 21st century which is characterized by easy access to information and a significant influence on human life. As time goes by, humans realize that it is important to prepare the younger generation in order to meet 21st century skills. Binkley et al. (2012) categorized 21st century skills into four parts, namely *ways of thinking, ways of working, tools of working,* and *living in the world*. *Ways of thinking* are thinking skills that 21st century students must have, including creativity and innovation, *critical thinking* skills, *problem solving*, *decision making,* and *metacognition*. *Ways of working* is the expertise in working with the global world and the digital world including communication and collaboration skills. 21st century students must have good communication skills as well as collaboration and cooperation. *Tools of working* are skills to master *Information and Communication Technology* (ICT) and information literacy. In addition, *living in the world is* a skill in survival in the 21st century, namely citizenship skills, career life and personal and social care.

Problem solving is one of the 21st century skills that need to be trained through the education process. This is supported by Kay & Greenhill (2011) who state that every aspect of the education system standards, assessment, professional development, curriculum and instruction, and learning environment must be aligned with 21st century skills. Skills such as problem solving, critical thinking, communication, collaboration, creativity and innovation should be more clearly integrated. Problem solving skills are the ability to find new combinations of a number of rules that can be applied to overcome new situations or make several elements into one whole (Wena, 2014). Problem solving is understood as the cognitive, affective, and behavioral process of an individual in identifying or finding a solution to a problem (Cong & My, 2020).

One of the subjects that can train students problem solving is physics. Problems in physics learning should be presented is an *authentic problem* (*authentic problem*) in the daily lives of students, this is important because by presenting authentic problems students are more familiar with the application of physics in the surrounding environment. The problem given can increase student enthusiasm and want to know more about the details of the problem being studied. According to Rahim et al. (2021) authentic problems as *ill-structured problems* or *open-ended problems* are problems that do not only have one kind of solution, problems that involve various disciplines / studies, and in the form of problems that provoke thinking to find alternative formulations and solutions. This is supported by Wulandari (2021) who states that physics trains students to solve physics problems by connecting natural phenomena through problems that occur in everyday life. This is in line with the results of research by Putri et al. (2019) which found that problem solving is one of the main objectives of physics learning.

The approach used in the learning process is to make students the center of education (*student center*) and teachers only as a guide in the learning process. This is supported by the results of Abidin's research (2014) which states that physics learning in schools has a central role in preparing 21st century skills to students.

The learning objectives of physics as stated in the 2013 curriculum concept are mastering the concepts and principles of physics, having the skills to develop knowledge and a confident attitude as a provision for continuing education, as well as a provision for backing up science and science and technology. According to Puspitasari (2019) the implementation of the 2013 curriculum encourages and challenges physics teachers to be creative in facilitating students to understand physics theories and concepts and be able to apply them in solving physics problems.

Curriculum changes are always accompanied by changes in the quality of teaching tools used. These teaching tools include textbooks, teaching modules, educational unit operational curriculum, learning videos, and other forms. Educators and students can use a variety of teaching tools from various sources, one of which is teaching

materials. Teaching materials are tools used by teachers or students to facilitate the learning process. Teaching materials have the content of learning materials, skills, and attitudes that students must achieve with the competencies that have been compiled, the aim is to facilitate understanding of a number of materials or subject matter that has been previously determined. Teaching materials can be in the form of modules or e-modules, reading books, student worksheets (Kosasih, 2021).

E-modules are electronic teaching materials that combine printed modules with technology, creating an interesting and interactive learning experience. Students can develop problem-solving skills as they are presented systematically and provide problem-based activities within the e-module. In addition, e-modules also bring authentic problems into learning, provide relevant and meaningful experiences for students, and help connect theory with practice so that students can apply their skills in everyday life situations. According to Ramadayanty et al. (2021) e-modules are teaching materials that contain material, methods, limitations and ways to evaluate which are systematically and interestingly designed to achieve the expected competencies according to the level of complexity electronically.

The results of the initial test given to 36 students showed that the average score of 23.21 students' problem solving was low. Based on further observation in the classroom, one of the causes of low student problem solving is because the learning process is still *teacher centered*. The limited use of teaching materials by teachers and the lack of media utilization cause students to tend to get bored with physics learning and lack of exploring student problem solving.

One of the physics materials in the 2013 curriculum class XI SMA semester II is sound waves which are mechanical waves in its propagation requires a medium. The benefits of sound waves in everyday life are measuring the depth of sea water, detecting fetuses in the uterus, detecting cracks, loudspeakers, facilitating communication, determining the distance from a place, breaking rocks in the intestines, detecting tumors, and many more. The results of the teacher interview on sound waves material stated that sound waves material is a difficult material for students to learn because there are many conceptual errors in understanding the equations and too many equations, increasing the chances of misconceptions.

To overcome this problem, teachers should use learning that actively involves students, increases student curiosity, and trains problem solving. students. To facilitate this, teachers should use e-modules based on *authentic problems* in the problem-based learning (PBL) learning model on sound waves material to train students' problem solving. The integration of *authentic problems* in the PBL model with independent-based teaching materials in the form of e-modules has the potential to support student problem solving and can produce creative and innovative teaching material products and train students' skills, namely (1) skills to analyze physical phenomena including knowledge, principles and mathematical reasoning, (2) skills to conduct scientific investigations using experimental methods, (3) problem solving skills, (4) skills to apply physics knowledge to problems in the real world, (5) skills to work in teams, (6) skills to communicate based on written reports, presentations, and direct explanations and (7) skills to use information technology. This is supported by Panggabean and Sembiring (2022) who state that e-modules are teaching materials that utilize technology and are interactive in nature which can help students understand the material, and solve problems according to the directions or instructions available in the e-module. In line with Rahmadila et al. (2022) PBL-based learning tools assisted by e-modules effectively improve students' problem solving skills.

E-modules play a crucial role in the development of problem-solving skills by introducing authentic problems and applying PBL. Through electronic format and interactive technology, e-modules allow students to access and understand content independently. When presented with authentic problems, students become more engaged in learning and apply

their problem-solving skills to real-world challenges. PBL in e-modules encourages students to think critically, collaborate and develop innovative solutions to authentic problems.

Previous research Aji et al. (2017) PBL-based physics learning modules can improve students' physics problem solving skills. Aripin et al. (2021) stated that physics learning tools based on PBL models are effective and efficient for improving students' problem solving skills. In line with Hidayatulah et al. (2020) the application of PBL has an effect on students' problem solving skills.

Making e-modules using *Kvisoft flipbook software* supports interactive teaching materials, fostering student curiosity. The utilization of kvisoft flipbook software application in making e-modules has several advantages, namely, it can input motion animation, video, and audio in e-modules (Susanti, 2015). Based on the description above, this study aims to analyze of problem solving skills based on authentic problems assisted by e-modules on sound wave material at SMA Negeri 1 Uluan, in the even semester of T.A. 2022/2023.

RESEARCH METHODS

This research was conducted at SMA Negeri 1 Uluan, in the even semester of T.A. 2022/2023 on sound waves. The research time was carried out for four months from December 2022 - April 2023. The curriculum used in class XI SMA Negeri 1 Uluan is the 2013 revised curriculum 2017. The population in this study were students of class XI MIA SMA Negeri 1 Uluan consisting of 3 classes T.A .2022/2023 namely XI MIA 1, XI MIA 2, XI MIA 3. The sample in the study consisted of two classes representing the population with the same characteristics namely XI MIA 2 and XI MIA 3 totaling 70 people. Sampling and class determination in this study were carried out using simple random sampling techniques. The samples selected amounted to 2 classes, namely the experimental class and the control class. The experimental class samples were treated with the application of *authentic problem-based* e-modules and the control class was treated with conventional learning.

This research is a *quasi experiment* research. According to Arikunto (2021) quasi experiment is a study involving two classes with the same characteristics, the first class as an experimental class and the second class as a control class. According to Sugiyono (2019) this research aims to examine the effect of a treatment on the symptoms of another group that is given a different treatment, by comparing one or more experimental groups that are given treatment by comparing one or more comparison groups that are not given treatment.

The form of quasi experiment design used in this research is *Pre-test-Post-test* control group design. This research involves two sample classes that are given different treatments. The experimental class will be given treatment, namely e-modules based on *authentic problems*, while the control class is given treatment with conventional learning. These two sample classes will be given treatment by giving a *pre-test* at the beginning of learning and a posttest at the end of learning. These two sample classes will be tested with the same measuring instrument and become experimental data. The design of this study can be seen in Table 1.

Table 1. *Pre-test and Post-test Control Group Design*

Sample Class	*Pre-test*	Treatment	Posttest
Experiment Class	O_1	X_1	O_2
Control Class	O_3	X_2	O_4

Description:

O_1 : *Pre-test* results of experimental class problem solving test.

O_2 : Experimental class problem solving *posttest* results.

O_3 : *Pre-test* results of the control class

problem solving test.

O_4 : Control class problem solving *posttest* results.

X_1 : *E-module* treatment based on *authentic problem*.

X_2 : Conventional learning treatment.

The research instrument is a problem-solving test question consisting of 8 questions in the form of descriptions, the questions used refer to various sources of physics textbooks by developing indicators of students' analytical skills. The indicators used in this test are indicators of problem solving by Young & Freedman (2012). The data collection and data analysis techniques used can be seen in Figure 1.

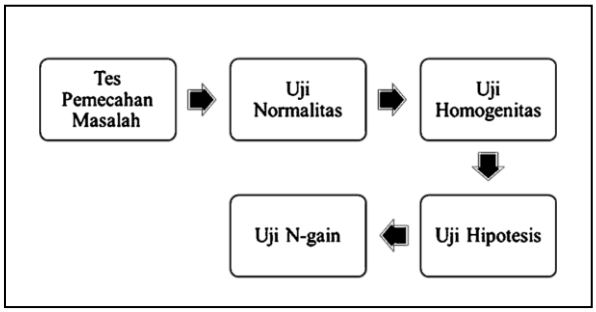
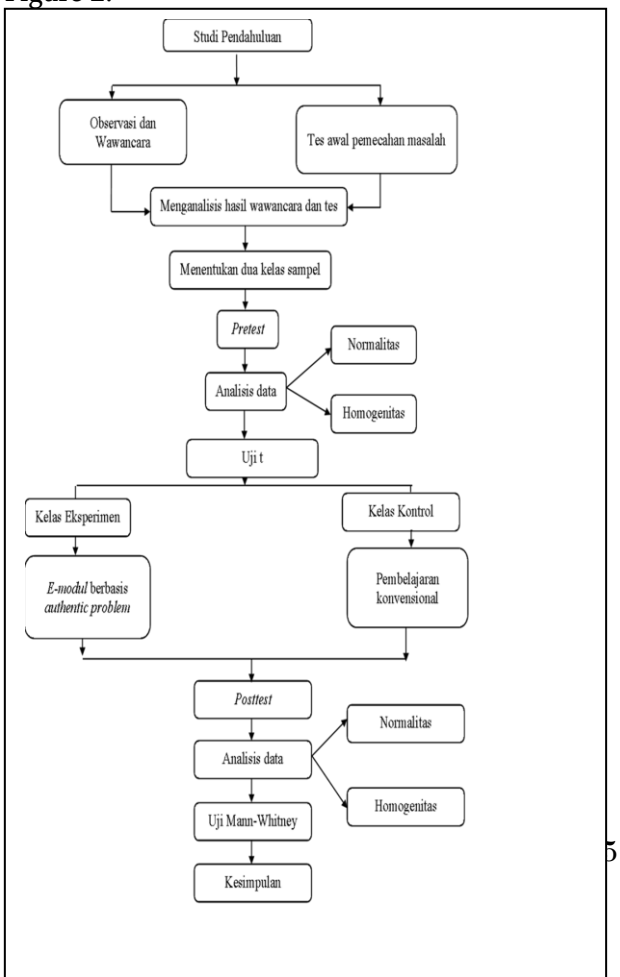


Figure 1: Data Analysis Technique

The steps in the implementation of the research can be seen in the research procedure chart in Figure 2.



RESULTS

Before the learning process, a *pre-test* was conducted to obtain the initial skills of the students. The researcher illustrated the *pre-test* results of the experimental class and control class in a frequency distribution diagram and is shown in Figure 3.

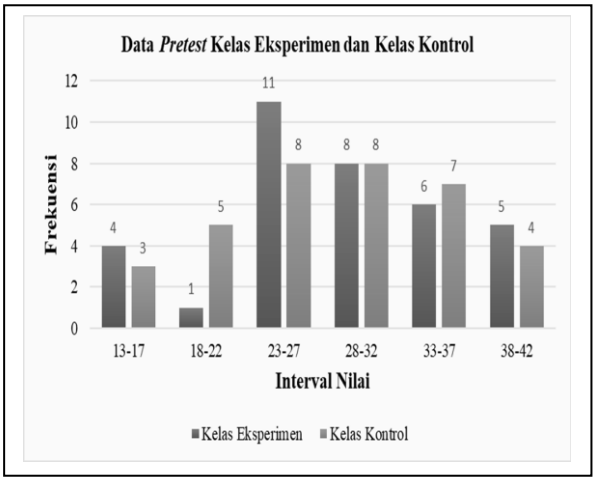


Figure 3. Distribution Diagram of *Pre-test*

After the learning process is complete, a *post-test* is conducted in the experimental class to determine the final results after using the *authentic problem-based e-module*. The control class *post-test* was conducted to see the final results after using a conventional learning model. Researchers describe the *post-test* results of the experimental class and control class in the distribution diagram shown in Figure 4.

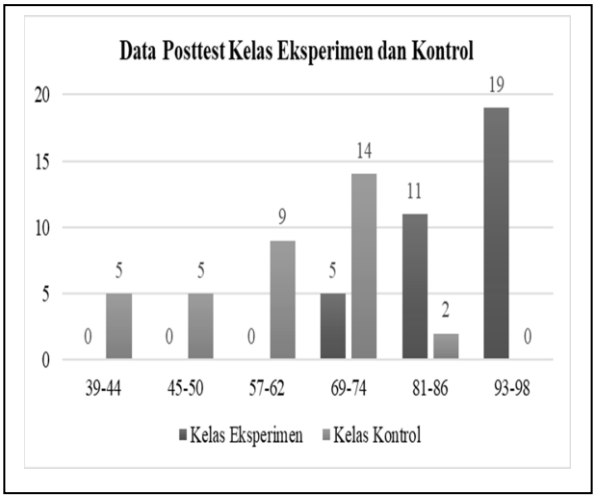


Figure 4. Distribution Diagram of *Post-test*

The calculation of normal distribution determines whether the data obtained from the population is normally distributed or not. Calculation of normal measurements using Kolmogorov-Smirnov and Shapiro-Wilk with a significance level of α = 0.05, and a total of 70 people using SPSS 25. The results of the *pre-test* normality test calculation are shown in Table 2.

Table 2. *Pre-test* Normality Test

Statistical Data	*Pre-test*	
	Experiment	Control
Kolmogorov-Smirnov	0.200	0.200
Shapiro-Wilk	0.134	0.192
Conclusion	Normal	Normal

The results of the *post-test* normal test calculation are shown in Table 3.

Table 3. *Post-test* Normality Test

Statistical Data	*Post-test*	
	Experiment	Control
Kolmogorov-Smirnov	0.001	0.006
Shapiro-Wilk	0.003	0.022
Conclusion	Not normal	Not normal

After the normality test was carried out on the research class, the next step was to find the homogeneity score. The homogeneity test was conducted using the F test using SPSS 25.0 to determine whether the two samples came from a homogeneous population or not. The results of the homogeneity test of the two classes are shown in Table 4.

Table 4. *Pre-test* Homogeneity Test

Levene Statistic	Significance	Conclusion
0.097	0.756	Homogeneous

The results of the homogeneity test for both classes are presented in Table 5.

Table 5. *Post-test* Homogeneity Test

Levene Statistic	Significance	Conclusion
0.509	0.478	Homogeneous

The t-test was used to determine the similarity of students' initial abilities in the two sample groups. The hypothesis tested is in the form of :

$$H_o = \mu_1 = \mu_2$$
$$H_a = \mu_1 \neq \mu_2$$

Description:

$\mu_1 = \mu_2$: The average initial ability of students in the experimental class is the same as the initial ability of students in the control class

$\mu_1 \neq \mu_2$: The average initial ability of students in the experimental class is not the same as the initial ability of students in the control class

Testing criteria H_o accepted if $t_{count} < t_{table}$. The results of hypothesis testing can be seen in Table 6.

Table 6. Summary of *Pre-test t-test* Calculation

t_{hitung}	t_{tabel}	Sig.(*2-tailed*)	Conclusion
0.032	1.99	0.974	H_o Retrieved

The results of statistical calculations on the *post-test data* above obtained data are not normally distributed and homogeneous data, then non-parametric statistical tests are carried out for the final hypothesis test using the Mann-Whitney test to determine the effect of e-modules based on *authentic problems* in this study. The hypothesis tested is in the form of

$$H_o = \mu_1 = \mu_2$$
$$H_a = \mu_1 \neq \mu_2$$

Description:

$\mu_1 = \mu_2$: There is no effect of *authentic problem-based e-module* on problem solving on sound waves material in class XI.

$\mu_1 \neq \mu_2$: There is an effect of *authentic*

problem-based e-module on problem solving on sound waves material in class XI.

Testing criteria H_0 rejected and H_a accepted if $z_{count} > z_{table}$, the asymp. Sig. (*2-tailed*)<0.05. The results of hypothesis testing can be seen in Table 7.

Table 7. Summary of Mann-Whitney U Test

z_{count}	z_{table}	Sig. (*2-tailed*)	Conclusion
|6,936|	1,96	0,000	H_a Retrieved

After carrying out two data tests, then the data is calculated for the N-gain test which is useful for knowing the increase in student problem solving by comparing the *pre-test* and *post-test* values of the two classes. The N-gain percentage of the experimental class is 80% in the high category and then in the control class the N-gain percentage is 40% in the medium category. Each problem consists of 8 questions that contain indicators of problem solving skills, namely *identify, set up, execute, evaluate*. Based on the calculation of each indicator, the average student and N-gain for each indicator of problem solving for experimental and control classes can be seen in Table 8.

Table 8. N-gain of Problem Solving Stagesj

Problem Solving Stage	Experiment		N-gain (%)	Criteria	Control		N-gain (%)	Criteria
	Pre-test	*Post-test*			*Pre-test*	*Post-test*		
Identify	10	22	86	High	8	15	44	Medium
Set Up	8	20	75	High	6	13	39	Medium
Execute	5	14	82	High	4	10	50	Medium
Evaluate	4	14	83	High	4	8	33	Medium

DISCUSSION

Researchers introduced and explained about the use of e-modules based on *authentic problems* with the link https://bit.ly/3K2xfi4 to provide learning materials that students will study independently. Learning materials and learning videos have been provided before learning begins through e-modules based on *authentic problems* are found in Figure 5.

Figure 5. Learning Activities On E-modules

This study was conducted to determine the effect and improvement of student problem solving due to the application of e-modules based on *authentic problems and* conventional learning on the subject matter of sound waves in class XI semester II SMA Negeri 1 Uluan with 35 experimental class students and 35 control class students. Based on the hypothesis tested in this study, there is an effect of e-modules based on *authentic problems on* problem solving on the subject matter of sound waves in class XI.

PBL supported by e-modules and authentic problems in learning sound waves has a significant impact on the development of students' problem solving skills. PBL encourages students to formulate solutions through independent exploration, combined with e-modules that present material interactively and authentic problems relevant to everyday life, encouraging students to think critically, analyze information, and design creative and innovative solution strategies. E-modules as a tool provide flexibility in accessing materials and independent learning, allowing students to master concepts in depth and adapt to their own learning pace. In line with the research of Aji et al. (2017), Suryaningtyas et al. (2020), and Rahmadila et al. (2022) that physics learning tools based on PBL models are effective and efficient for improving problem solving.

Problem solving is measured using a description-based test containing eight questions that are valid and have met the learning indicators. The results showed an increase in student problem solving by using e-modules based on *authentic problems*. This is supported by the difference in problem solving

test results between the experimental and control classes.

Based on the results of the problem solving test conducted, the researchers analyzed the problem solving skills of the experimental and control classes that:

Identify

The N-gain test results showed that the percentage of experimental class students was 86% with a high category. The N-gain test results showing a high percentage of experimental class students in this category indicate that the use of *authentic problem-based e-modules* implemented in this study is effective in improving students' abilities in the identify stage. Students are given modules specifically designed to assist them in identifying problems and understanding basic concepts related to the problem. Meanwhile, the percentage of control class students was 44% with a moderate category. This shows that the teaching materials commonly used in schools are not fully effective in helping students in the *identify* stage. In line with the research of Prastyaningrum and Handhika (2017) *e-modules* made focusing on problem solving skills can improve students' analytical skills in solving physics problems. This is also supported by Hidayatulah et al (2019) *e-modules* that contain PBL can improve students' problem solving skills.

Set Up

The results of the N-gain test showed that the percentage of experimental class students was 75% with a high category. At the Set Up stage, students in the experimental class had a fairly high percentage in problem solving skills. This shows that learning using *e-modules* based on *authentic problems* can help improve students' ability to understand concepts and apply them in solving problems. Young & Freedman (2012) suggested that in the context of physics learning, the *Set Up* stage is the stage where students identify basic concepts and principles relevant to the current problem. They then build appropriate mathematical relationships to describe the current situation. This is also supported by a study by Sahin & Sezer (2019) that e-modules based on authentic problems using PBL models can help students to better understand physics concepts by applying them in real and contextual situations, thus strengthening their understanding of fundamental physics concepts and principles.

Execute

The N-gain test results showed that the percentage of experimental class students who scored high was 82%. At the implementation stage, experimental class students have a high percentage of problem solving skills. Students in the experimental class can substitute the value of known quantities into the equation, perform calculations using the selected equation. This shows that learning using authentic math-based modules can help improve students' ability to apply physics concepts in real-world contextual situations. According to Young & Freedman (2012) in the context of physics learning, the implementation stage is the stage where students apply the physics concepts and principles they have learned to solve a given problem.

Evaluate

The results of the N-gain test showed that the percentage of experimental class students was 83% with a high category. This means that students are able to evaluate the solutions they have found well and critically. Evaluation is done by identifying the advantages and disadvantages of the solution found, as well as providing justification or reasons why the solution was chosen. In line with Young & Freedman (2012) in the context of physics learning, the *evaluate* stage is the stage where students check the unit and conformity with the concept. Problem solving is a basic skill that needs to be mastered by students. It is even reflected in the concept of competency-based curriculum. The demand for problem solving skills is explicitly emphasized in the curriculum, namely, as a basic competency that must be developed and integrated in a number of appropriate materials. The four stages of the problem are hierarchical, so that if one stage cannot be resolved by students, it will make it difficult at the next stage.

CONCLUSIONS AND RECOMMENDATIONS

There is an effect of students' problem solving skills due to the application of authentic problem-based e-modules on the subject matter of sound waves in class XI. There is an increase in problem solving due to the application of e-modules based on authentic problems on the subject matter of sound waves in class XI with a high category. Based on the results of the study, there are obstacles in carrying out the research, namely students are not used to new ways of learning so that researchers provide explanations again so that students understand the learning process using e-modules based on authentic problems. In addition, researchers provide suggestions, namely students at the set up and evaluate stages are lower than other stages so that the e-modules prepared are better prepared and interesting by paying attention to the reasons students choose the appropriate concepts to solve problems. Therefore, future researchers can make variations of e-modules used in addition to learning videos.

BIBLIOGRAPHY

Abidin. (2014). *Learning System Design in the Context of the 2013 Curriculum*. Bandung: Refika Aditama.

Aji, S. D., Hudha, M. N. & Rismawati, A. (2017). Development of Physics *Learning* Module Based on *Problem Based Learning* to Improve Physics Problem Solving Skills. *Science Education Journal*, *1*(1): 36-51.

Arikunto, S. (2021). *Basics of Educational Evaluation*. Jakarta: Bumi Aksara.

Aripin, W. A., Sahidu, H. & Makhrus, M. (2021). Effectiveness of Physics Learning Tools Based on Problem Based Learning Model to Improve Problem Solving Skills and Critical Thinking Skills of Students. *Indonesian Journal of Physics Research and Learning*, *3*(1): 19-23.

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M. & Rumble, M. (2012). *Assessment and teaching of 21st century skills*. Singapore: Springer.

Cong, K. N. & My, L. N. T. (2020). Development and psychometric properties of a social *problem solving* test for adolescents. *Journal of Rational-Emotive and Cognitive-Behavior Therapy*, *38*(1): 76-95.

Hidayatulah, H. N., Suprapto, N., Mubarok, H. & Wulandari, D. (2020). Implementation of problem based learning to train physics students' problem solving skills. *Journal of Physics: Conference Series*, 1491 (1): 1-7.

Kay, K. & Greenhill, V. (2011). *Bringing schools into the 21st century*. Singapore: Springer.

Kosasih, E. (2021). *Teaching Material Development*. Jakarta: Bumi Aksara.

Panggabean, D. D. & Sembiring, S. S. (2022). Making Physics *E-modules* Based on Problem Based Learning on Effort and Energy Material. *Journal of Physics Education*, *11*(2): 116-121.

Puspitasari, A. D. (2019). Application of physics learning media using printed modules and electronic modules for high school students. *Journal of Physics Education, State Islamic University of Alauddin Makassar*, *7*(1): 17-25.

Putri, C. S., Sesunan, F. & Wahyudi, I. (2019). The Effect of Implementing Creative Problem Solving Learning Model to Improve Creative Thinking Skills in Physics Problem Solving in High School Students. *Journal of Physics Education*, *State Islamic University of Alauddin Makassar*, *7*(2): 149-155.

Rahim, R., Gumelar, G. R., Chabibah, N., Ritonga, M. W., Musyadad, V. F., Komalasari, D. & Haris, A. (2021). *Teacher learning approach*. Jakarta: Yayasan Kita Tulis.

Rahmadila, R., Permana, D. & Musdi, E. (2022). Development of Learning Tools Based on Problem Based Learning Assisted by *E-modules* to Improve Mathematics Problem Solving Skills. *JIPM (Scientific Journal of Mathematics Education)*, *11*(1): 26-37.

Ramadayanty, M., Sutarno, S. & Risdianto, E. (2021). Development of Physics *E-modules* Based on Multiple Reprsentation to Train Students' Problem Solving Skills. *Journal of Physics Coils,* 4(1): 17-24.

Sahin, A., & Sezer, B. (2019). Effects of problem-based learning on students' achievement, attitude and retention in science education. *International Journal of Environmental and Science Education*, 14(9), 509-525.

Sugiyono. (2019). *Educational Research Methods.* Bandung: Alfabeta.

Suryaningtyas, A., Kimianti, F. & Prasetyo, Z. K. (2020). Developing science electronic module based on problem-based learning and guided discovery learning to increase critical thinking and problem-solving skills. *International Conference on Educational Research and Innovation (ICERI 2019),* 401(1): 65-70.

Susanti, F. (2015). *Development of E-Modules with Kvisoft Flipbook Maker Application on the Subject of Static Fluid for Class X SMA / MA Learners*. Repository UIN Sunan Kalijaga Yogyakarta.

Wena, M. (2014). *Contemporary Innovative Learning Strategies: An Operational Conceptual Review*. Jakarta: Bumi Aksara.

Wulandari, S. (2021). Literature Study on the Use of Video-Based PBL to Improve Problem Solving Skills. *Journal of Physics Education*, *State Islamic University of Alauddin Makassar*, 9 (1): 7-17.

Young, H.D. & Freedman, R.A. (2012). *Sear's and Zemansky's University Physics: with Modern Physics*. San Francisco: Pearson Education.