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STEM-Based E-Module Integrated Local Wisdom of Rice Stem Fertilizers on Students' Critical and Creative Thinking

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Prima Aswirna *)

Universitas Islam Negeri Imam Bonjol
Padang, Indonesia.

Email: primaaswirna@uinib.ac.id

Duski Samad

Universitas Islam Negeri Imam Bonjol
Padang, Indonesia.

E-mail: duskisamad60@gmail.com

Indri Saputri Devi

Universitas Islam Negeri Imam Bonjol
Padang, Indonesia.

E-mail: indrisaputridevi99@gmail.com

Reza Fahmi

Universitas Islam Negeri Imam Bonjol
Padang, Indonesia.

E-mail: rezafahmi@uinib.ac.id

Raudhatul Jannah

Universitas Islam Negeri Imam Bonjol
Padang, Indonesia.

E-mail: raudhatuljannah@uinib.ac.id

*) Corresponding Author

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INTRODUCTION

Learners are prepared for a more complex social and economic life. Learning and renewal skills; emphasize creativity, critical thinking, communication, and collaboration. Learners with this skill can generate creative ideas, analyze and evaluate

their thinking, apply their thinking, try various ways to solve the problems they face, express their thoughts effectively, work effectively and in harmony with others, and share responsibilities. answer (Boyaci, S, 2016)

Understanding of scientific concepts and scientific processes is needed by students to explain the concepts of sound waves and mechanical waves that can be applied in everyday life. This ability can be achieved by including scientific literacy indicators in classroom learning. Scientific literacy covers ethnic, moral, and global issues, and is a very important skill that must be possessed to prepare for the rapid changes of modern science and technology. It is also necessary to compete in the global era. Unfortunately, students around the world still have low scientific literacy skills. (Indrasari et al., 2020)

Physics learning that is following the abilities of students can support the ability of students' creativity in learning that can practice 21st-century skills. This is by STEM (Science, Technology, Engineering, and Mathematics) integrated learning which in this learning links material taught in the realms of Science, Technology, Engineering, and Mathematics. (Aswirna, P., 2020)

Learning objectives with the STEM approach and learning objectives in secondary schools listed in the 2013 Curriculum, it can be concluded that the 2013 Curriculum learning provides opportunities for the development and implementation of STEM. In addition, it can also develop students' critical thinking skills, creativity, innovation, and problem-solving skills as well as the character development of students. In this case, it means that the teaching materials are oriented to the material and practice questions. (Waluyo, R., 2021)

STEM is an approach that integrates various concepts and processes contained in each STEM component into a single unit in the learning process. (Sari, P. M., 2021) This approach is student-centered by offering an intangible process to the problems of life around it, making STEM important to be applied to students, especially to improve literacy.. (Syukri, M., 2021) Ethnopedagogy can be defined as the actualization of learning that is oriented to the cultivation of local wisdom values. Ethnopedology can be said as the actualization of learning-oriented to the cultivation of local wisdom values.

Ethnopedology can be seen as an educational practice based on local wisdom and sourced from the cultural values of an ethnic group and a standard of behavior. Indonesian people generally believe that schools are strong institutions in transforming culture to future generations, even though in reality cultural transformation is more common than social interaction or contact between students and the community outside of school. (Ariyani, F, 2020)

The use of e-modules with the Canva approach that is integrated with STEM is believed to be attractive to students because in STEM there is an integration of science, technology, engineering, and mathematics which will make the e-module more interesting. This e-module includes science that prioritizes the analysis of natural phenomena, the use of technology such as experiments using Phet Simulation which is more practical and easier than laboratory activities, engineering activities such as designing simple tools that can foster conceptual understanding, and critical thinking skills. (Hizhar, D, 2020)

The lack of critical thinking among students is also accompanied by their limited conceptual knowledge and general culture. In recent years, before students start the 'Teaching and Learning Social Sciences' subject, they are tested on general knowledge based on their immediate environment: history, heritage, customs, and traditions of the Minang Kabau (Rivas, P. G, 2017). Local wisdom that is still preserved today in the field of Rice Pupuik is a musical instrument originating from West Sumatra. Pupuik Padi has a source of sound and waves generated from the sound of Pupuik Batang Padi. So that it can be included in high school physics learning in Buyi Waves and Mechanical Waves. The sound produced by Pupuik Batang Padi can be used as physics learning so that students stay familiar with and not forget the local wisdom around them and can get references about the application of physics concepts in their lives close to them.

The problems that exist make educators have to learn how to use technology and make good use of it and can make interesting

teaching materials so that students can return to their enthusiasm for learning. Learning that uses interesting teaching materials can also make it easier for students to learn. (Fahmi, R, 2019) 21st-century skills help to learn very well, because according to educators it is very helpful to be able to improve student learning outcomes for the better and can prepare students to be able to if they have entered the world of work, and students will not be awkward in using existing technology. STEM education is also very useful in increasing student interest, STEM education teaches students to always be able to see everyday life as a place for real and close learning in the lives of students. (Alistiana, L, 2020)

Learning needs to be endeavored to balance scientific knowledge with the inculcation of scientific values and local wisdom of the community. In addition, through the process of making Rice Pupuik Musical Instruments, students can learn about science, technology, manufacturing, and mathematics. students are not only proficient in mathematics, reading, and writing, but students also need to have critical and creative thinking skills in learning and technology literacy. Learning that combines the STEM approach with Pupuik Padi's local wisdom helps students to master the concepts of physics learning. The application of STEM learning like this can help students to compete in facing increasingly fierce global competition in the future, and also improve the soft skills of students starting from problem-solving in an effective, efficient, and teamwork manner.

The STEM approach, combining learning with local wisdom is useful for students so that they can learn about science, can know the typical musical instruments of Minang Kabau (West Sumatra), engineering, and Mathematics, and can reflect Minangkabau cultural values and preserve the nation's culture so that cultures that exist in Indonesia, especially in West Sumatra do not fade and disappear. Researchers hope this research is useful for educators and students to make the learning process more meaningful and enjoyable. Based on the problems above, the researchers researched the Development of

STEM-Based Physics Modules Integrated Local Wisdom of Batang Padi Pupuik towards Critical and Creative Thinking of Class XI Students. By having the researcher aims to get an overview of the development of STEM-based E - Physics Modules that are integrated with local wisdom of rice stem fertilizers on students' critical and creative thinking.

METHOD

The type of research used is the type of research and development, which is a research method used to produce certain products, and test the effectiveness of these products. (Sugiyono, 2010). This research procedure adapts the ADDIE development model, which is a development model consisting of five stages consisting of Analysis, Design, Development, Implementation and Evaluating.

The validity test of the STEM-based Physics learning E-Module is carried out by competent validators, namely media expert validators and material expert validators. Next, the validator is asked to provide a general assessment and suggestions for the developed STEM-based Physics learning E-module, whether the STEM-based Physics learning E-module that has been made can be said to be valid or invalid. The data analysis technique used in this research is descriptive analysis, namely by calculating the percentage value of the validation results.

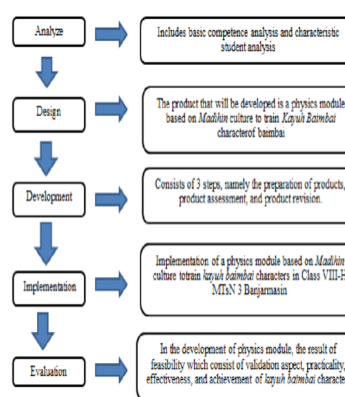


Figure 1. Development Phase of Physics Learning Using the ADDIE Model.

The level of feasibility of the product resulting from development research is identified with the score presentation. The greater the score presentation of the results of data analysis, the better the level of feasibility

of the product as a result of development research. Criteria for making decisions in the validation of STEM-based physics E-modules can be seen in in this study examines the critical and creative thinking of students, in this case the researcher uses a questionnaire and test questions for critical thinking while for creative thinking more uses a questionnaire. (Ridwan 2011)

RESULT AND DISCUSSION

The product resulting from this development research is an Android-based learning E-Module. This learning E-Module product was created and designed by the researcher himself, to be able to be used as a tool for educators in delivering material and also as an independent learning resource that students can use at any time outside of school.

The development of this learning media uses the ADDIE learning E-Modul design model. The ADDIE model has 5 stages, including Analysis, Design, Development, Implementation, and evaluation. Research on the development of the ADDIE model was carried out only until the Development stage

because the purpose of this research was only to develop and produce a valid E-learning module to be implemented based on the validator's assessment.

The stages of development research are described as follows: first, Analysis, the analysis phase of the product development carried out consists of material analysis and analysis of learning E-modules. From this analysis, the material that requires the help of E-Modules as a tool for educators in delivering material and students for independent study is selected material for mechanical waves and sound waves, because the subject requires concrete things to make it easier for students to understand the material. By using the Android learning E-Module, educators can provide a concrete explanation of the abstract material.

Second, Design, at the design stage, among others: 1) designing STEM-based learning E-modules; 2) Materials, pictures, and videos that are appropriate and appropriate with the material of mechanical waves and sound waves), 3) Validation sheets for media experts and material experts.

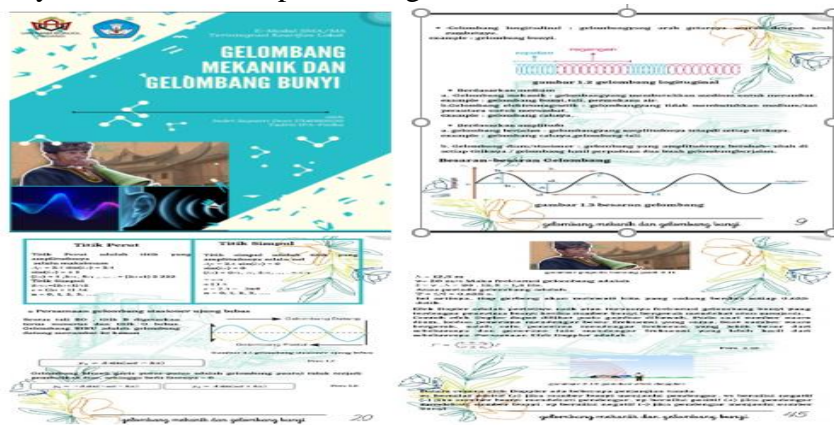


Figure 2. E-Module Display

Third, Development, the results of the development stage are 1) Physics learning E-Modules, E-Modules that can make students more interested in interactive learning, teaching materials, pictures, videos, sample questions, and interactive evaluation questions; 2) E-Module validation score.

Table1. Validation Score

No	Aspects	Persentase (%)
1	Language Validation	95 %
2	Media Validation	93.8 %
3	Material Validation	90 %
4	Rice Stem Fertilizer Validation	94%
5	Rice Stem Fertilizer Material Validation	94%
Average		93.36 %

Four, Implementation, After the validation stage, this product was revised and then tested to determine the level of practicality. After the practical test was carried out on the implementation of the E-Module to identify the critical and creative thinking of students at SMA Kartika 1 – 5 Padang.



Figure 3. View of E-module before and after revision

Fifth, Evaluation. The final stage is an overall evaluation of all the stages that have been carried out. After the results of the analysis are obtained, the design stage is carried out by adjusting the results of the analysis stage of how the character of students and the needs used in the school environment is needed, namely the need for learning devices to support physics learning activities, especially on the material of mechanical waves and sound waves for students' critical and creative thinking. So, researchers are encouraged to develop STEM-Based E-Modules that are integrated with local wisdom of rice stem fertilizers for students' critical and creative thinking.

If the design stage has been carried out, the next step is for the product to be validated by experts, namely material experts, media experts, and linguists. After going through the revision or improvement stage according to the validator's suggestions and being declared valid for use. The next stage is product testing through questionnaires conducted at SMA Kartika 1-5 Padang as many as 15 students and 2 physics educators for practicality and 15 students for effectiveness from class XI MIA 4. So the E-module product developed has criteria very practical and effective for use in learning physics individually or in groups.

Making E-module learning media can also improve the skills of educators in making learning more interesting for students. So that students are more interested in learning because they learn more interestingly.

The spread of Coronavirus Disease (Covid-19), based on the Circular Letter of the Ministry of Education and Culture No. 4 of 2020 concerning the implementation of education policies in the emergency period for the spread of Coronavirus Disease (Covid-19) that the learning process is carried out online/remotely. Learning that initially took place face-to-face in schools now has to carry out learning activities from home (BDR). The purpose of this BDR learning is to ensure the fulfillment of the rights of students to obtain educational services during this Covid-19. (Syafri, S, 2021).

At this time it is very difficult for educators to be able to apply Critical and Creative Thinking to students because the country is experiencing problems with the covid-19 virus that has occurred for the past 2 years which makes learning done online and makes it very difficult for educators to use technology there is. The number of educators who find it difficult to do online learning makes students even more confused about online learning because this problem makes learning goals unattainable or difficult to achieve. (Nursuhud, P, 2020).

The problems that exist make educators have to learn how to use technology and make good use of it and can create interesting E-Modules so that students can return to their enthusiasm for learning. Learning that uses an interesting E-Module can also make it easier for students to learn. (Hizhar, D. 2020).

Critical and Creative Thinking helps to learn very well, because according to educators it is very helpful to be able to improve student learning outcomes for the better and can prepare students to be able to if they have entered the world of work, and students will not be awkward in using existing technology. The STEM approach is also very useful in increasing student interest, STEM education teaches students to always see everyday life as a place for real and close learning in the lives

of students. (Aygün, Ş, 2016).

The STEM approach expects students to be prepared to face the era of globalization which is growing rapidly from time to time. STEM-based learning requires students to become innovators, problem solvers, and inventors who are confident, technologically aware, and think logically, without a strong foundation of science, technology, engineering, and mathematics, students are not able to qualify for a job in an era full of competition and competition. technology advances. (Krasnova, L, 2020).

The use of the STEM approach is intended so that students can have the ability and understanding in all four aspects of STEM that are interrelated on one subject and can help students solve problems and draw conclusions from previous learning by applying them through science, technology, engineering, and Mathematics. (Benda, M. G. P., 2019). The general goal of learning with a STEM approach is to be able to apply and practice basic content. (Stute, M, 2020).

The application of STEM to situations that students face/find in their lives to become STEM literate/literate. STEM is an effective learning approach because it combines knowledge, mathematics, technology, and techniques. Engineering is experiencing rapid development, especially in the field of architecture/development. The field of architecture/development that is currently developing cannot be separated from local wisdom that has existed since the past (Zainalipour, H, 2010).

Critical and Creative Thinking can educate participants to be Fluency (the ability to generate a large number of ideas or problem solutions); flexibility (the ability to generate varied ideas or answers or think flexibly); originality (the ability to generate new and original ideas; and elaboration (the ability to think in detail/detail and systematically) is included as Creativity. (Ongardwanich, N, 2020) Creativity is needed by students to solve problems in real life and adapt to new demands flexibly.(Ongardwanich, N, 2015).

Various problems will be able to be

solved with creativity, including new demands that arise in everyday life. (Anggraeni, A. A, 2021) Based on this, creativity needs to be trained to students so that they become more prepared to live life and careers after graduation. One of the efforts is to train creativity through learning. (Syukri, M, 2021) Critical and Creative Thinking equips future individuals to face real life position problems to sustain the progress of the world and turn it into a better situation to live in. (Wardani, Y. R, 2021).

Efforts that can be made to improve the quality of education and improve Critical and Creative Thinking problems are by providing E-Modules that can hone students' thinking. Through the E-Module, students' activities and creativity in learning can be increased. Submission of subject matter can also be facilitated by using the E-Module. The main role of teaching materials is to make learning more interesting and practical.(Waluyo, R., & Wahyuni, S., 2021).

At the critical thinking stage, based on the results of research conducted by Rahmadani (2020) showed that the results obtained for critical thinking skills were in the medium category, meaning that students were able to think critically. In the research that the researchers did, for the trial phase about the effectiveness of students' critical thinking skills at SMA Kartika 1-5 Padang, the average score was 82.29%. For indicators providing a simple explanation (elementary clarification) an average of 81.25% is obtained, building basic skills (basic support) is obtained an average of 75% and for indicators making further explanations (advanced clarification) an average of 90.62% is obtained. . This shows that the results of research conducted by researchers are more effective than research conducted by Ramadhani.

In this study, the indicators for critical thinking (fluency) were obtained on average 71.87%, flexible thinking (flexibility) with an average of 75%, and original thinking (originality) with an average of 81.25%. The highest criticalhinking indicator is in the original thinking indicator. From the results of the activity test to improve critical and creative thinking at SMA Kartika 1-5 Padang, the

results were very effective. Meanwhile, for the effectiveness questionnaire, the average result is 78.5% with the effective category.

In addition to critical thinking, it is also expected that students can become creative thinkers. Creative thinking is a thinking process that requires imagination to find or create unrelated ideas into a new whole. Creative thinking will be easily realized in a learning environment that directly provides opportunities for students to think openly and flexibly so that students can produce various solutions in solving existing problems. In West Sumatra, in the city of Padang, creative thinking is a soft skill that is important and has an impact on the development of their innovation.

The stage of creative thinking, according to Langella (2013) reveals that ideas arise from situations or information provided and from the knowledge they have. Based on the results of research conducted by Almuharomah and Mayangsari (2018), the results for the creative thinking ability of students are in the sufficient category. The flexible thinking indicator is the highest creative thinking indicator, which is 71.70%. Can be seen in the research journal pages 5-6.

The results obtained indicate that STEM-based physics teaching materials that are integrated with the local wisdom of Pupuik Batang padi in mechanical waves and sound waves can improve Critical and Creative Thinking for students of class XI science. This E-Module can be used as a guide for learning for students.

CONCLUSION AND RECOMMENDATION

In this study, the indicators for critical thinking were obtained on average 71.87%, flexible thinking with an average of 75%, and original thinking with an average of 81.25%. The highest critical thinking indicator is in the original thinking indicator. From the results of the activity test to improve critical and creative thinking at SMA Kartika 1-5 Padang, the results were very effective. Meanwhile, for the effectiveness questionnaire, the average result is 78.5% with the effective category.

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