Ethnophysics and Technology: Physics e-module integrated with local wisdom based on an Android application

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Abstract *– 21st century learning is a collaboration of technology and science that can change students' abilities from LOTS (lower order thinking skills) to HOTS (higher order thinking skills). In its application, 21st century learning is supported by teaching resources and media based on environmental phenomena and technological developments. This research aims to determine the feasibility of the physics e-module based android application that has been developed after validation testing by media experts, material experts, and learning experts. This e-module was developed to serve as an innovation in physics learning in schools to improve high school students from LOTS to HOTS abilities. This type of research is development research by applying 4D model consisting of define, design, develop and disseminate stages. At the define stage, researchers examine and analyze phenomena in schools such as curriculum, student learning styles, teacher teaching styles, learning resources and learning media used. In the design stage, researchers design the needs of students and teachers in learning such as learning modules. In the develop stage, researchers develop products for student learning needs through expert validation from lecturers and teachers. In the disminate stage, researchers apply products that have been developed in schools. The population of this study was all class X students at SMAN 5 Mataram. Sampling in this research was carried out using a purposive sampling method. The classes chosen as research samples were classes X IPA 1 and The average score from the media validation results was 4.8 with a very valid category. The average score from the learning validation results was 4.7 in the very valid category. Based on the validation results, it was concluded that the development product in the form of an integrated physics e-module with local wisdom based on an Android application was suitable for use in schools.*

Keywords*: Physics E-Module; Local Wisdom; Android Application*

INTRODUCTION

Provincial Education in Indonesia found that the Indonesian education index, especially the West Nusa Tenggara (NTB) region, is in 27th place out of 34 provinces in Indonesia. Every individual involved in education must collaborate to continue to improve the quality of education in Indonesia, especially in the Province of West Nusa Tenggara (NTB).

The Sasak tribe has traditional customs that are still preserved today, one of which is that weddings are usually accompanied by traditional Lombok music called Gendang Beleq traditional music.

In the 4.0 era like today, all information is easily obtained by the public because the digital era opens up information freely globally. The use of Android applications as learning media provides broad access to users without having to search again for material that is appropriate to the teacher's discussion of physics (Darmaji et al., 2019) Learning using the internet network system via an Android application will open up new knowledge for all students, both at school and at home.

Curriculum changes that occur in Indonesian education show how the government is trying to integrate developments in science and technology with learning in schools. (Erika et al., 2020) revealed that a learning process that is in line with developments over time will always

have innovations that make it easier for users.

The Educational Assessment Center (PUSMENDIK) states that the quality of learning for senior secondary (SMA) students is still disorienting, teacher reflection index is still passive, and instructional leadership is still limited. (Devi et al., 2021) stated that several obstacles that are often experienced when wanting to implement learning are inadequate facilities such as learning media, data networks to access the internet, and some teachers who are still not experts in applying technology in learning and learning orientation that is not yet appropriate.

In fact (Gulek & Demirtas, 2004) stated that the use of various media for students in the learning process can improve student achievement. Textbooks are like modules that do not yet have videos that can describe or model abstract physical events. Data on learning outcomes recorded by PUSMENDIK states that secondary students' literacy abilities reach less than 50% of the minimum competency limit, as well as students' numeracy abilities which are still below 50% of the minimum competency limit.

The demands of 21st century learning are to change the abilities of students who are in the low category into higher abilities. (Artika, 2019) said higher order thinking skills (HOTS) or high level thinking is an ability in students that is required to be developed and trained with the aim of improving human resources in general.

Achieving this goal is not something that is easy to do but requires synergy in the concepts of implementing learning (Suhatmi et al., 2021). The government and everyone involved in the process of improving education must work together in providing solutions to every problem in the world of education (Sitorus et al., 2021). The use of contextual teaching media integrated with culture and technology is really needed to improve 21st century learning which focuses on increasing students' higher order thinking skills (HOTS).

Previous research that was used as a source of study to obtain updates was research conducted by (Sae et al., 2021) with the title "Development of Physics Teaching Materials Based on Local Wisdom Nyiru Woven to Improve Students' Understanding of Concepts". The research carried out is development research with the development stages including problem exploration, information gathering, product design, product validation, product improvement, and testing. The conclusion obtained is that the teaching materials developed are suitable for use as learning resources in schools and can improve students' understanding of concepts. Conducted research with the theme "The Development of Physics Teaching Material Based on Local Wisdom to Train SARABA KAWA Characters" (Hartini et al., 2018). The research is development research with the research model applied being the ADDIE model. The ADDIE model consists of analysis, design, development, implementation, and evaluation. (1) the validity of the teaching materials based on the content and appearance is in the good category, (2) the practicality of the teaching materials is in the very practical category, (3) the effectiveness of the media is in the very practical category, (4) and the achievement of the Saraba Kawa character is in the very good category. It can be concluded that physics teaching materials based on local wisdom to train the saraba kawa character are suitable for physics learning.

The research with the theme "The Use of Android-Based Teaching Materials in Physics Learning process at Vocational High School" (Hakim et al., 2019). The

effectiveness of Android-based teaching materials is assessed based on students' understanding of concepts and responses. The research subjects were 40 vocational school students in Surabaya. Concept understanding is measured by giving test questions and student responses are measured based on a Likert scale. The data analysis used is descriptive statistics. Android-based teaching materials are effective if the average score of students' conceptual understanding is ≥ 60 and the percentage of student responses is ≥ 61% (good or very good). The results obtained were the average score of students' conceptual understanding x = (85 ± 6) and students' responses were categorized as very good (the percentage of effectiveness was 85%). The research results show that Android-based digital teaching is in the effective category for use in the Physics learning process in vocational schools.

One of the things that is highlighted in interactive learning is how the processes that occur in the classroom can make students become more active and communicative in conveying learning concepts. (Emilio et al., 2024). Apart from that, learning in the 21st century requires several skills that students must have, one of which is literacy skills. A form of literacy ability can be cultural literacy (Siswoyo et al., 2023), where Indonesia has a diverse culture. This nation's wealth can be used as a learning resource for students to form a relationship between lessons at school and the environment they live in everyday life.

The integration of technology and culture in the world of education are two things that have a positive influence on physics learning in schools because they can prevent students from boredom, monotonous learning and suboptimal learning outcomes. (Emilio et al., 2024; Riyan, 2021). So teachers who teach in the 21st century must be able to have creative technological and cultural literacy skills (Adnyaswari et al., 2022; Fauzi et al., 2022). Communication technology such as Android smartphones is a communication tool that almost all levels of society have to access information. If this is developed for student learning it will become a tool that makes it easier for students to learn physics and their own culture.

e-modules developed through Android applications and the integration of local wisdom can be innovative teaching materials for students in studying physics. The content and form of the module, which is different from the printed module, will bring a new atmosphere for students studying physics, providing a positive impact on interest and motivation in studying physics with more flexible use of the module anytime and anywhere. Positive changes in students' enthusiasm for learning physics will be proportional to changes in students' thinking abilities from low to higher abilities. Therefore, in its application, an Android application-based e-module that is integrated with local wisdom will provide real benefits for students' development in their learning styles, patterns and outcomes at school.

Therefore, this research focuses on developing physics e-modules based on ethnoscience (Lombok traditional music arts) and technology (Android applications). The framework of thin research iis shown in Figure 1.

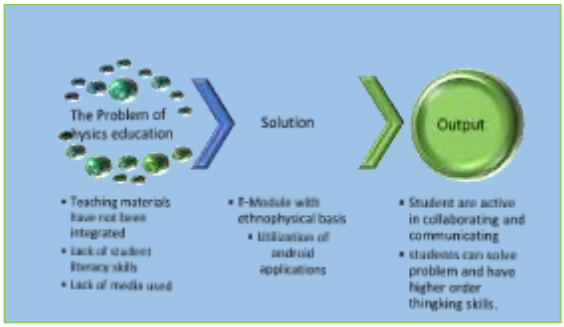

Figure 1: The Framework of research

RESEARCH METHODS

The research is research & development (R&D) research by applying the 4-D model from Thiangrajan and Semmel (1974). The development procedure for the 4-D model is; (1) Define, (2) Design, (3) Develop, and (4) Disseminate. The flow of this research development can be seen in Figure 2 below.

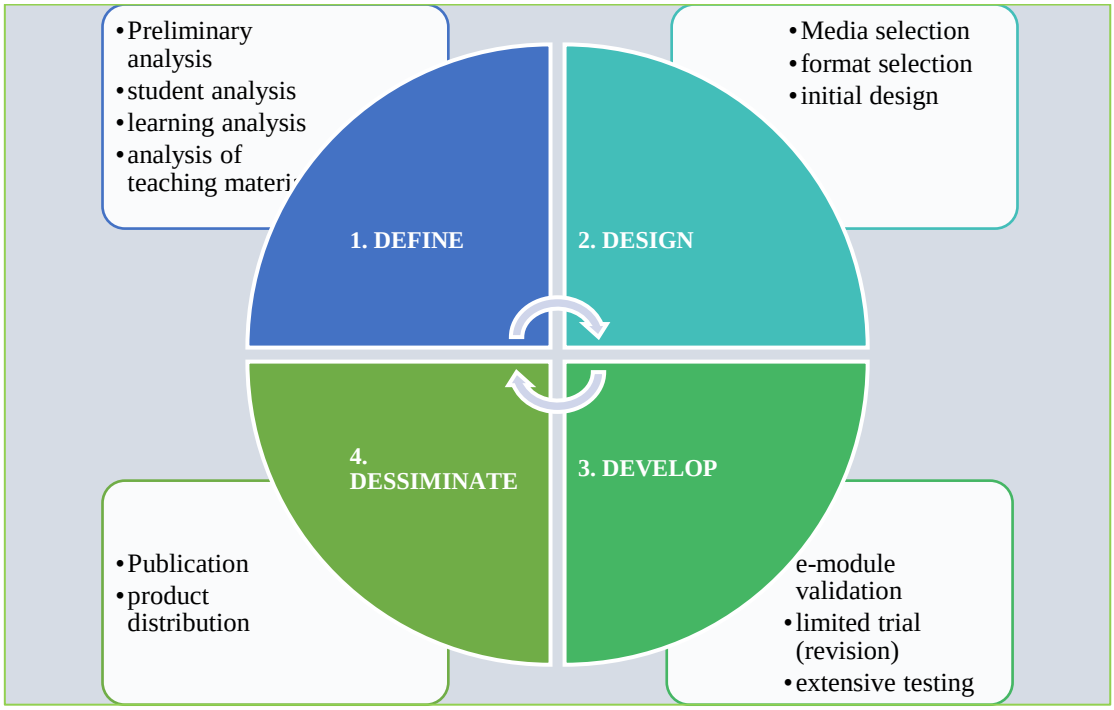

Figure 2. 4D Models

The population of this study used class XI IPA at SMAN 5 Mataram, while the sample used classes XI IPA 1 and XI IPA 2. This sample selection used a purposive sampling method with certain considerations. The research instrument used material suitability instruments and Android application media. The data collection technique uses a questionnaire technique and is analyzed using the Aiken validation formula.

$$V = \frac{\sum n_i |i-r|}{N(t-1)} \qquad (1)$$

Feasibility assessment is measured by calculating the average score for each indicator which is then analyzed and converted using a Likert scale. The following is a Likert scale table 1 and its categories.

Table 1. Likert Scale

No	Score Interval	Criteria
1	$Mi + 1{,}5SDi \leq \bar{M} \leq Mi + 3{,}0\ SDi$	Very good
2	$Mi + 0\ SDi \leq \bar{M} < Mi + 1{,}5\ SDi$	Good
3	$Mi - 1{,}5\ SD \leq \bar{M} < Mi + 0\ SDi$	Pretty good
4	$Mi - 3{,}0\ SDi \leq \bar{M} < Mi - 1{,}5\ SDi$	Not good

Source: Sudjana, 2013

Description:

Mean Ideal (M_i) = $\frac{1}{2}$ (Maximum score + Minimum Score)

Ideal Standard deviation (SDi) = $\frac{1}{6}$ (maximum score-minimum score)

Mean ($\bar{M}$) = The average score obtained

Meanwhile, the reliability test in this study used SPSS 24 software by looking at the Cronbach's alpha column

RESULTS AND DISCUSSION

Results

Product Development Results

The development of this research follows the 4D development model which consists of define, design, development and disseminate steps.

1. Define

a. Job gap analysis

Teachers interviewed informed that the use of media in learning is still rarely used. The learning process only focuses on completing the material in the LKS book which consists of concise material and questions. The physics teacher also informed that the use of mobile phone-based media was not carried out considering that every student was prohibited from using mobile phones while studying. The use of social media such as the WhatsApp Group is limited to sending information to students regarding administrative matters.

b. Identify student characteristics

Based on the results of the researcher's observations, there are 32 students in class XI MIPA 2 SMA Negeri 5 Mataram and have almost the same characteristics as other classes and are receptive to the physics learning given by the teacher. However, when students start the learning process, most of them no longer focus on the teacher's explanations, which are more dominant teacher-centered and even bother each other. Apart from that, students appear to have difficulty understanding the concepts and use of equations given by the teacher, in other words the explanations received by students are still abstract so that students do not have a concrete picture of physics in everyday life. Students' difficulties were also seen when the teacher started giving practice assignments using LKS books.

c. Availability of resources and student needs

In this case, the researcher identified the LKS book which was the main guide for teachers and students and then developed the required material. Apart from that, researchers also examine core abilities (KI), basic competencies (KD), and learning objectives that will be achieved at the end of each lesson. Furthermore, the physics teacher provided information that students need visualization media and its use is flexible whenever and wherever the students are. The availability of resources in the aspect of applying technology in physics learning consists of a limited number of LCDs so that they are used interchangeably, computer laboratories, WiFi and libraries.

d. Formulation of Instructional Objectives

Based on several problems that have been identified by researchers, it is necessary to use teaching materials based on Android applications with the aim of making it easier and helping students in carrying out the physics learning process at school or learning activities outside of school. The next hope through the use of technology in physics learning is to increase students' understanding in mastering physics concepts.

e. Preparation of Work Plans

What is done at this stage is to determine what steps the researcher will take in compiling teaching materials based on the local wisdom of traditional Lombok music and used as Android application media. In this case,

researchers also appointed several experts as media and material validators.

2. Design

a. Material Selection

Determine core competencies, basic competencies, learning indicators, and learning objectives to be achieved.

b. Designing the product model

Some of the results of Android-based learning e-module designs are as follows:

1) Android application-based modules are developed with the help of MS Word, Power Point and Photoshop programs to support the creation of teaching materials that will be included in the Android application.
2) Photoshop to edit several images to match the colors and topics discussed in the Android application.
3) The contents of the Android application-based e-module are as follows:
   1. Introductory menu features
   2. Material menu features
   3. Video menu feature
   4. Simulation menu feature
   5. Evaluation menu featur
   6. Exit menu feature

c. Development of a validation instrument for student reactions to the attractiveness of the e-module application

The questionnaire contains ten questions and each has a five-point rating scale. Researchers also developed pretest and posttest questions to assess the usefulness of the media produced and students' ability to achieve learning outcomes both before and after using Android learning resources in Physics subjects.

3. Development

a. Making a Physics E-Module Based on an Android Application

1) Using MS Word, Powerpoint and Photoshop applications to create physics teaching materials based on local wisdom, Lombok's traditional music arts.

Figure 3. the module in ms word

2) Entering modules that have been compiled using MS. Word, Power Point, and Photoshop into Android applications using the Kodular application.

Figure 4. Display of the e- module

3) Determine the menus that will be displayed in the application.

Figure 5. Menu display (Available in Bahasa)

4) Entering the contents of the introductory menu into the Android application being developed Validation of the Android Application-Based Physics E-Module

Figure 6. Display the contents of the introductory menu (Available in Bahasa)

5) Entering the contents of the material menu into the application.

Figure 7. Display the contents of the material menu (Available in Bahasa)

6) Entering the contents of the video menu into the application.

Figure 8. Display the contents of the video menu (Available in Bahasa)

7) Entering the contents of the simulation menu into the application (Figure 9).

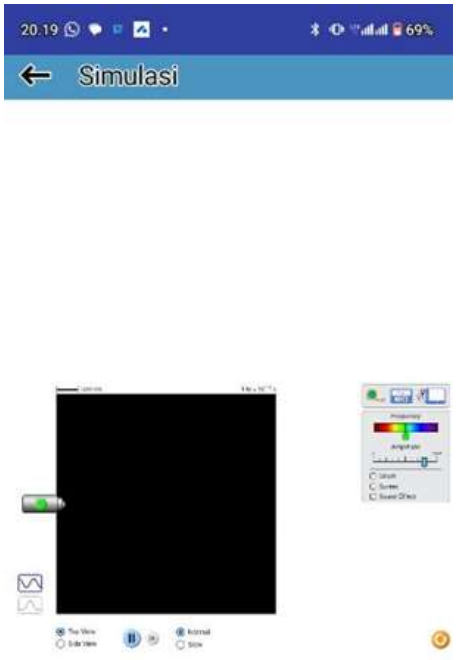

Figure 9. Display the contents of the simulation menu (Available in Bahasa)

8) Enter the contents of the evaluation menu into the application

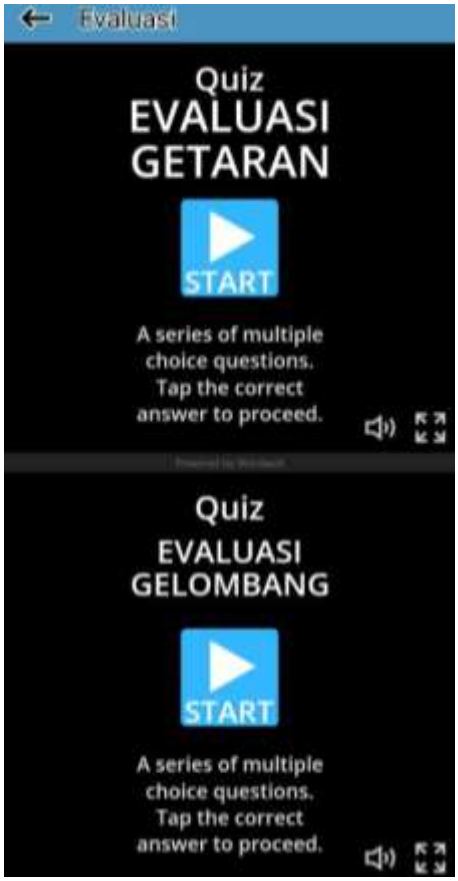

Figure 10. Display the contents of the evaluation menu (Available in Bahasa)

9) Entering the contents of the sub menu into the application

Figure 11. Sub menu displays regarding vibration and wave material (Available in Bahasa)

4. Disseminate

This disseminate stage is the stage of distributing the product to schools (students and teachers) who study physics. The distribution of this development product was carried out to class X Science2 students at SMA Negeri 5 Mataram, consisting of 32 students. In this session the researcher gave a questionnaire to students regarding their responses to the use of Android applications in the learning process

Development Data Results

a. Validity Data

Below is a graph of the validation results of the product developed, namely an integrated e-module of local wisdom, Lombok traditional music art 'gendang beleq' based on an Android application.

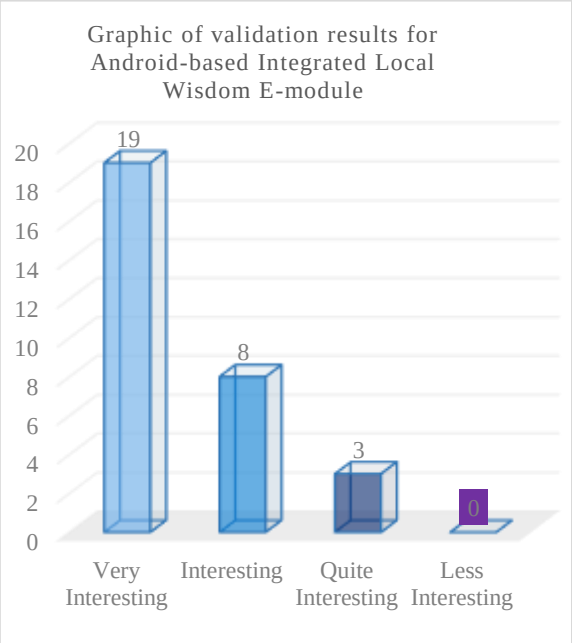

Figure 12. Validation Results Graph

b. Data on Student Responses to the Attractiveness of Android-Based E-Modules

The graph below is a graph of the results of student responses to the use of an integrated e-model of local wisdom, the art of traditional music, Gendang Beleq, based on an Android application.

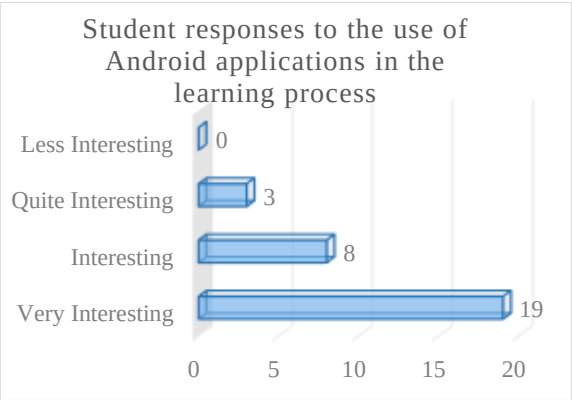

Figure 13. Student responses

Discussion

Study of the product being developed

1. Media Development Design Analysis

The development of this Android application-based e-module has been adapted to the material and design that will appear on the mobile phone. The appearance of the application such as colors, letters, menus and others have been adapted to the characteristics of class XI SMAN 5 Mataram students.

The design of this e-module aims to provide additional facilities for students to learn through media that can be used anytime and anywhere, so that limited learning resources are no longer an excuse to search for learning material information as needed. The use of e-modules based on this Android application can be used to access information whenever and wherever students are (Sari et al., 2021). This more flexible collection of information will broaden students' insight in exploring their understanding for the better and can improve low abilities to high ones.

2. Feasibility Analysis of Android Based E-module

a. Analysis of Material Expert Validation Results

The material used in this research is class X high school material, namely vibrations and waves. The material of vibrations and waves is explored in the local wisdom of the Sasak community, especially the traditional music art 'gendang beleq'. The concept of vibrations and waves can be seen directly in drums and other musical instruments which produce vibrations and sounds and then the sounds can be heard by other people, this is the concept of waves that propagate through the medium of air. From this traditional music, it can also be analyzed what type of waves are produced and how period, frequency, amplitude and others influence the sound produced. The material validation results that have been obtained are 94 with a very valid category. So, based on the validation results, it can be concluded that the e-module which is integrated with local

wisdom, traditional Monday music, gendang beleq, based on an Android application, has been tested well, so it can be tested in limited classes (Ali & Zaini, 2023). During the validation process of this material, several suggestions and input were also obtained from the validator regarding the material displayed in the e-module, such as the use of words and sentences that must be in accordance with standard language, as well as increasing the number of practice questions accompanied by ways of answering them that have been completed and corrected by the researcher.

b. Analysis of Media Expert Validation Results

This e-module, which integrates local wisdom and traditional music, Gendang Beleq, based on an Android application, has also been validated from the design and function aspects of the media being developed. The score obtained from the validation of this media is 96 with a very valid score category, so it can be concluded that the media is suitable and interesting to be implemented at SMAN 5 Mataram class X Science.

Through this media validation process, the researcher also received several suggestions from the validator, such as not showing too many videos and showing enough to be easy and simple so that students can easily understand, paying more attention to the use of colors and background so that they can be read clearly. The suggestions from the validator serve as guidelines for researchers to improve the application being developed and make it more suitable for application in schools.

3. Analysis of Media Interest Level

The e-module being developed is an e-module which discusses the material of vibrations and waves by integrating the concept with local culture (local wisdom) of the Sasak people, namely the traditional music arts of Lombok. Lombok traditional music is a type of music that continues to be preserved by the Sasak community and has even become a characteristic of the local community.

Therefore, researchers examine physics concepts through local culture, apart from being a physics lesson, it can also be a means of education so as not to forget the culture of each region, especially Lombok. In this e-module, apart from presenting vibration and wave materials, it also displays videos about the concept of vibration and waves, simulations about vibrations and waves, and questions about evaluating vibrations and waves. The following are the results of the analysis of the level of attractiveness of the e-module integrated with local wisdom, Lombok's traditional music art, gendang beleq, based on an Android application.

The implementation of e-modules based on Android applications increases students' curiosity in learning physics, students find it easier and get a lot of information related to the concept of vibrations and waves. In the aspect of fostering curiosity, students gave very satisfactory marks and students strongly agreed with the use of Android application-based e-modules in learning physics, with this, students' motivation to learn physics increased and gave a new color to learning (Chanifah, 2021). During classroom learning, researchers observed that all

students were happy with learning using Android applications.

The positive response from students brought new energy to studying physics. The increase in students' curiosity to learn physics is directly proportional to student learning outcomes that are better than before. Students admitted that learning to use Android applications was more realistic to feel and see in everyday life

The use of an integrated e-module with local wisdom based on an Android application attracts students' interest in learning physics. Most students provided information that using Android applications in learning made students more motivated. They thought that physics, which is usually considered difficult and has many formulas, actually had applications in the surrounding environment. One thing that is interesting according to students is that there are learning videos which are a supporting source for studying vibration and wave material and there are physical simulations which help students to understand the relationship between each vibration and wave quantity.

4. Pengaruh E-Modul Terhadap Pembelajaran siswa

In the current era, students and teachers are required to be creative subjects in every teaching and learning activity (Sari et al., 2021). Active and creative students certainly need a lot of information to build their own knowledge and skills. Likewise, teachers should be able to be creative and innovative facilitators in directing students to build their own understanding. Student centers, which are the goal of education today, must be equipped with facilities that are easy to use according to students' learning needs.

One of the important things to give to students is teaching materials as a learning resource for students (Chanifah, 2021). Flexible learning resources used anytime and anywhere are an important need for students to continue to search for accurate information according to their needs (Hakiki et al., 2021). Therefore, e-modules with new colors need to be developed for students, such as e-modules that are integrated with the local wisdom of Lombok's traditional music art 'gendang beleq' and can be accessed via an Android application.

Based on the results of the questionnaire distributed, students reported that they were more motivated and stimulated their curiosity in learning physics using e-modules based on Android applications. Students feel something different compared to learning using teaching materials in the form of textbooks as usual. According to students, learning with e-modules via Android is very interesting, because it contains videos, images, simulations, and evaluation questions and the material discussed is the concept of vibrations and waves in traditional Gendang Beleq music so that students can more easily understand the concept of the material provided. The e-module being developed is also equipped with examples of questions which are accompanied by a solution process, so that students are trained to solve questions in that material. Therefore, students who were initially only able to solve LOTS type questions have been able to solve HOTS category questions. This is in accordance with research conducted by (Ali & Zaini, 2023) which revealed that the application of e-modules with the integration of local wisdom was able to increase students' higher order thinking skills because it was able to provide new enthusiasm for students in studying physics. Motivation and interest in physics material really depends on how a teacher packages models, methods,

strategies and learning techniques in the classroom.

Innovative and creative learning styles provide a new learning atmosphere for students at school. Modifying learning styles will provide positive energy for students' learning success and prevent them from getting bored with a monotonous learning style (Devi et al., 2021). The use of integrated local wisdom e-modules based on Android applications for students not only influences students' cognitive abilities, but also influences students' motivation, interest and curiosity (çimen et al., 2020). Aspects of motivation, interest and curiosity are certainly very important for students to grow individual student understanding and knowledge at a higher level.

The development of an Android-based e-module integrated with local wisdom has significant implications for physics learning in schools. (Gola et al., 2022). Based on student responses to the e-module developed, students have increased motivation and interest in learning physics because it is taught using online media and is easily accessible anytime and anywhere so that learning can be done anywhere by opening the application.

Students' motivation and passion in learning changed significantly and had positive implications for their understanding of physics learning. (Puri & Diyana, 2023). Student activity in communicating physics is better than before because easily accessible information provides a broad understanding that physics is close to life and even all daily activities are directly related to physics. (Lesmana & Nurussaniah, 2022). Literacy skills, especially in students' cultural literacy, are also increasingly profound, so that learning physics is no longer seen as just learning formulas and calculations that have a distant correlation with life, but students' views have shifted to the understanding that physics is a subject that is integrated with human life such as the involvement of physics in discussing the concept of gendang beleq with vibration and wave material.

5. Research Limitations and Suggestions

In this study, of course, there are several shortcomings in its implementation so that improvements are needed in the implementation of further research. Time constraints are one of the variables that need to be considered in subsequent research, because there are several things that are outside the plan that can occur and affect the results of the study. Therefore, it is necessary to estimate more time for each step of the research carried out, so that obstacles in the field do not affect the results of the study.

The science class with a physics interest is still relatively small with three classes, so that the selection of samples is also not optimal. Therefore, the implementation of research for the next time needs to consider the research location that has a large number of science classes with a physics interest, so that sample selection can run optimally.

CONCLUSION

Based on the results of the research and discussion that have been described, in the research on the development of an integrated e-module of local wisdom on the traditional music art of Lombok gendang beleq based on an Android application, it was concluded that the feasibility of an e-module integrated with local wisdom of the traditional music art of Lombok Gendang Beleq based on an Android application obtained a score of 94 in Very valid criteria for material validation, score 96 with very valid criteria for media validation. Apart from that, it was also found that the results of the learning process analysis were with a score of 94 with the criteria being very

suitable for application, and the level of attractiveness of the application-based e-module according to students after using it in the learning process obtained a score of 81.33 with the criteria being very attractive to students.

The developed e-module can be used in physics learning in schools at the high school/vocational high school level with a maximum use of android-based smartphones so that it can be installed properly. In addition, teachers also need to explain to students about the physics concepts displayed in the form of videos and simulations in the android application-based e-module, in this way students will get a concrete and in-depth understanding. Another thing that needs to be considered in implementing android smartphone-based learning is the control system carried out by the teacher so that students do not open other windows on the smartphone, so that students learn by focusing on the material being taught.

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