Development of a Physics E-Module Integrated Local Wisdon and Problem Based Learning (PBL) to Increase Student Preparedness

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Abstract - *The goal of this research is to create e-module teaching materials based on PBL integrated with local wisdom in Physics subjects that are reliable, useful, and efficient. Research and development is the study's technique. The 4-D model, which consists of definition, design, development, and distribution, is the development model that is employed. An e-module with valid criteria (0.86) and practical criteria (94%) was achieved during the design stage, along with an early draft of the module that included the development stage and was effective for cognitive aspects (76%), effective in increasing preparedness (79%) was in the very ready category, the character category became a habit (86%), and moderate skills (87%). At the dissemination stage, it was found to be effective for the cognitive aspect (76.9%), effective in increasing preparedness (78.4%) in the very prepared category, character becomes a habit category (84%), and moderate skills (81.9%). It can be concluded that the developed e-module can improve students' preparedness by applying the PBL model integrated with local wisdom in accordance with the provisions of the Kurikulum Merdeka.*

Keywords*: E-Module; Kurikulum Merdeka; Local Wisdom; Physics; Ready Attitude*

INTRODUCTION

A crucial part of the Pancasila program is the Pancasila Student Profile Strengthening Project (M. N. Sari & Ningsih, 2023). Independence which aims to build a basic character and life competence of pupils in conformity with Pancasila ideals (Hamzah, MR, Mujiwati, Y., Khamdi, IM, Usman, MI, & Abidin, M. Z, 2022). Where the form projects carried out is development culture local in learning (Rahmadani, NKA, Tasuah, N., Nugroho, RAAE, Alianda, D., & Cahyaningrum, D. E, 2023). With hope that can raise a generation that is strong in character, bright in the classroom, and capable of making a great impact on the world (Asyhar, R, 2023).

One of characters that can developed is preparedness (Hidayat, L, 2020). Increasing preparedness, both in the context of education and in everyday life, involves a series of strategic steps to ensure that individuals and groups are ready to face various situations (Wahyuni, R., Rahman, A., & Putri, R. N, 2023). Preparedness can be significantly improved, creating an environment that is more prepared and responsive to various challenges that may arise (Ramadhan, IF, Fitriani, NB, Zakia, HG, Hermawati, SP, & Sahwaludin, TH, 2024). This will more easy For improved through the learning process.

Learning give a chance for pupils to reach their full potential are the ultimate goal of education (Mashudi, M, 2021), In accordance to the goals of the Kurikulum Merdeka. However, in reality, many schools have implemented an Kurikulum Merdeka administratively, but the implementation of learning is still conventional through the lecture method (Sitopu et al., 2023). Local wisdom material can be used as one of the topics that can be raised in learning so that

learning becomes more interesting and more meaningful.

In this way, participants educate will be more trained for answer problem in physics with incident in life everyday (Jonassen, D., Strobel, J., & Lee, C. B., 2006). During This concepts This is not studied enough in the world of education, so that students consider the implementation of Kenduri Sko as just an entertainment activity, not There is mark education that can developed. The solution to this problem is to develop integrated teaching materials with local wisdom materials that can meet the demands of an Kurikulum Merdeka (Nur, SA, Atiqoh, A., & Karyono, H, 2024). For the intention of helping students get better learning results and preparedness in facing disasters.

Increased preparedness needs to be done from various aspects such as family, education and government. However, increased preparedness can be done easily in the world of education (Wicaksono, FA, & Sibuea, R. P, 2022). Disaster management and handling can be done massively by strengthening educational institutions, namely schools, to play a role in providing theoretical understanding and real actions in terms of operating and utilizing digital technology in all areas of school activities, namely by trying to ensure that all academic and non-academic school activities can be connected to be digital-based.

Educational activities can include knowledge about local wisdom, local wisdom that is close to Kerinci Regency is Kenduri Sko. Increasing this knowledge is obtained through e-modules, this is very necessary because currently in 2024 the world of education has collaborated a lot with the development of ICT, children are no longer unfamiliar with technology such as mobile phones, computers, laptops, etc (Dissanayake, L. D. A. D., 2024). By developing e-modules from an early age, it is attempted that each student understands the function of the e-module, so that cases or problems experienced or done do not occur (Rusmiyanto et al., 2023).

The development of this e-module allows students to understand the use of e-modules so that children can easily participate in learning even when hit by natural disasters. The e-module to be developed is designed in such a way that it can provide understanding, procedures and tips to positively influence the advancement of ICT. As well as, constructing technology in everyday learning life in order for pupils to comprehend the true advantages of technology and increase their preparedness.

The urgency of this research is first to be a solution to solving problems in Physics learning, second local wisdom material is conveyed well to students, and third there is material that can support the independent learning process, fourth E-modules can be utilized as instructional resources to raise student preparedness. In order to increase students' preparedness for the Kurikulum Merdeka, this project aims to demonstrate the degree of practical validity and efficacy of e-modules combined with PBL-based local knowledge content.

Researchers have used the PBL model in learning (**Sahida D, 2021**), developed teaching materials in the form of interactive multimedia for physics learning (**Sahida D, 2022**), and implemented the PBL model in various school units (**Sahida D, 2023**), but until now the research team has never developed an e-module for SMA/MA Physics integrated with local wisdom material. While wisdom local is urgent need must applied in learning as demands in curriculum independent.

RESEARCH METHODS

Research Design

The study was carried out from March to May of 2024 at MA Negeri 1 Kerinci. An Integrated Physics E-Module with reliable, useful, and efficient local knowledge content was the end result of this study (A Safitri, Fauzi A, R Ratna Wulan, 2018) with a gradual, causal process (Santi IKL, Santosa RH, 2016). According to how the problem has been formulated, the research that has been done is research and development (Rosana D, 2006). One research technique used to create specific items is the research and development process. (Hanafi, 2017). According to a different viewpoint, educational research and development (R&D) is a procedure used to create and verify instructional materials (Sugiyono, 2022). This means that development research is a process that produces a valid, practical and effective product (Gustiani, 2019).

According to the researcher's concerns, the Four-D (4-D) model was used in the construction of this PBL-based E-Module (Liyana Nurmalasari, M. Taheri Akhbar, Sylvia Lara Syaflin, 2022). The author used the 4-D development model's four stages in this development (Ana RFR, 2018).

1. Define

Recent research emphasizes the importance of identifying and defining elements of local wisdom that are relevant to physics material. This includes local traditions, cultures, and practices that can be integrated into learning. Conduct surveys and interviews to understand students' needs and contexts, and how local wisdom can increase the relevance of physics material.

2. Design

The e-modules are designed with local context in mind, connecting physics concepts to phenomena that students are familiar with. For example, using examples from everyday life that relate to local culture. Using various multimedia elements (video, audio, animation) that display local wisdom and physics concepts to increase student engagement. It also includes interactive simulations that are relevant to local culture.

3. Development

Adopting a prototyping approach, where e-modules are tested and revised based on feedback from students and teachers. This ensures that the modules are effective and meet user needs. Involving local experts or practitioners in the development of e-module content, ensuring that the information presented is accurate and in accordance with existing wisdom.

4. Disseminate

Using multiple channels to distribute e-modules, including apply it in class that number his students more many . This is important to ensure that teachers understand how to integrate e-modules into everyday learning. After distribution, The effect of the e-module on students' comprehension of physics and its connection to local knowledge was assessed. This includes collecting quantitative and qualitative data.

The research stage carried out by researchers becomes a skill that develops over time in the shape of knowledge and attitudes, and skills needed for community, national and state life and contributes to human welfare (Widyaningsih L, 2020). Therefore, learning activities are directed to empower all potential students to become the expected competencies (Adeyeye, BA & Maso, J, 2020).

Data Analysis

Problem solving strategies are found in the stages of research conducted by researchers, where at each stage of research an instrument is first prepared. The instruments in question are as follows:

1. Definition Stage

At this stage, the instruments developed are observation sheets, assessments of teacher needs and student needs.

2. Design Stage

At the design stage, an assessment instrument was developed for validity, practicality and effectiveness sheets.

3. Development Stage

At the development stage, the focus shifts toward refining and testing the instructional materials to ensure they meet rigorous standards of quality, utility, and impact. This phase involves using validity, practicality, and effectiveness sheets—tools that have been rigorously assessed and validated in earlier stages. The validity sheet, for example, confirms that the content aligns well with the intended learning objectives, thereby ensuring that it is accurate and relevant to the target audience's needs. The practicality sheet assesses the ease with which instructors and students can engage with the materials, highlighting the usability and accessibility of the design. Lastly, the effectiveness sheet measures the extent to which the materials achieve their intended learning outcomes, providing critical feedback on how well students are absorbing and applying the knowledge. By using these validated instruments, the development stage ensures a systematic approach to identifying and resolving potential issues, ultimately leading to a robust and well-rounded instructional product that effectively supports learning. This structured process is essential in educational material development, as it not only enhances the quality of the resources but also fosters confidence in their application within real-world learning environments.

a. Analysis Validity

Validity analysis using *Likert scale* . *Likert scale* is a scale that can be used to measure a person's attitude and opinion about a variable (Riduwan, 2008). According to Arikunto (2020) " *Likert scale* is composed of five statements and followed by five responses that indicate the level". Validity analysis steps using *Likert scale* :

1) Give a score for each answer item, strongly agree (4), agree (3), disagree (2), and strongly disagree (1).
2) Add up the total score of each validator for all indicators.
3) The value of validity analysis uses descriptive analysis that describes the validity of *PBL* based e-module integrated Local Wisdom. Validity analysis uses the Aiken's V formula (Azwar, 2015). Namely:

$$V = \frac{\sum s}{[n(c-1)]} \qquad (1)$$

Description:
s = r – lo
lo = Lowest validity assessment number
c = Highest validity assessment number
r = Number given by an appraiser
n = Number of assessors

The validity categories of performance *assessment* based on the final scores obtained can be seen in Table 1.

Table 1. Product Validity Categories

Achievement Level	Category
≥ 0.6	Valid
< 0.6	Invalid

(Azwar, 2015)

b. Analysis Practicality

The practicality of the product is analyzed based on the questionnaire that has been filled out by respondents, teachers , and students. The analysis of the product practicality questionnaire data uses a *Likert scale* with the same steps as the validity analysis.

Steps for analyzing practicality using a *Likert scale* :

1) Give a score for each answer item, strongly agree (4), agree (3), disagree (2), and strongly disagree (1).
2) Add up the total scores for all indicators.
3) Giving practicality value by using the formula:

$$P = \frac{Q}{R} \times 100\% \qquad (2)$$

Description:
P = practicality value
Q = score obtained
R = maximum score

The practicality category can be seen in Table 2.

Table 2. Practicality Category

No	Mark	Criteria
1	76% < x ≤ 100%	Very practical
2	51% < x ≤ 75 %	Practical
3	26% < x ≤ 50 %	Less practical
4	0% < x ≤ 25 %	Not practical

c. Analysis Effectiveness

Analysis of preparedness is seen from the realm of knowledge, which is tested through a validated essay test, where in its preparation the preparedness indicators that will be presented have been considered. In measuring the increase in each meeting, *a pretest* and *posttest are carried out* to obtain values that will be processed using *a gain score* with the following equation:

$$< g >= \frac{<S_f> - <S_i>}{(100 - <S_i>)} \qquad (3)$$

Description:
S_f: *Post-test score* (*final score*)
S_i: *Pre-test score* (*initial score*)

The determination of the conclusions reached is based on the *gain score categories* in Table 3.

Table 3. *Gain Score Categories*

No	Category	Average *Gain Score*
1	Low	$< g > < 0{,}3$
2	Currently	$0{,}7 > (< g >) < 0{,}3$
3	Tall	$(< g >) > 0{,}7$

(Adapted from Hake, 1999)

To see preparedness of students individually, the following formula is used:

$$N = \frac{X}{Jumlah\ skor\ maksimum} x\ 100 \qquad (4)$$
(25)

Dexcription:
N : Preparedness of students individually
X : Total scores obtained by students

With the criteria as in Table 3.

Table 3. Classification of Preparedness

Interval	Criteria
$0 \leq N \leq 39$	Not Prepared
$40 \leq N \leq 55$	Lack of Prepared
$56 \leq N \leq 65$	Quite Prepared
$66 \leq N \leq 79$	Prepared
$80 \leq N \leq 100$	Very Prepared

(Adapted from Arikunto, 2020)

As for seeing the increase in students' *preparedness during the study, it is by comparing the results of the analysis of students' preparedness* at the end of the study, with the results of the analysis at the beginning of the study. This analysis uses the same instrument, namely the student analysis questionnaire.

4. Disseminate

At the deployment stage, the same instruments are used as at the development stage, but with a wider scope.

Based on this strategy, it can be seen what instruments are needed in this study. Through these instruments, students can increase their knowledge of local wisdom which is very necessary for them to live and be part of society and the country and have a positive impact on human existence. Additionally, this study aims to increase students' preparedness. As a result, educational activities are designed to maximize each student's potential and help them develop the necessary skills.

RESULTS AND DISCUSSION

Results

The 4-D model development research obtained the following results:

1. Define

Based on the previously completed study, the e-module's design is implemented.

The needs that were established during the defining stage serve as the foundation for the development of the e-module. A PBL-based e-module that incorporates local knowledge to enhance student preparedness is the product that is being discussed in this research.

2. Design

The developed e-module follows the mandatory components of the teaching module published by the Ministry of Education and Culture. Because the e-module is applied in learning using an Kurikulum Merdeka, the e-module contains the profile of Pancasila students. In order for the developed e-module to be easily recognized, an identity is created consisting of the title, author, and user which can be seen in Figure 1.

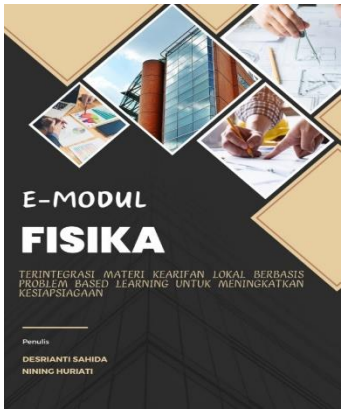

Figure 1. *E-Module Cover*

3. Development

At this stage, validation of the e-module was carried out with the validation results entering the valid category and the practicality of the e-module entering the practical category. Then it was tested in class XI IPA 2 MA Negeri 1 Kerinci with the results entering the very effective category.

This matter obtained Because learning meaningful physics integrated with material local wisdom , and the application of PBL can increase readiness alert participant educate . In simple can seen in table 4.

Table 4. Analysis PBL Syntax and Indicator Student Preparedness

No	PBL Syntax	Indicator Student Preparedness
1.	Orientation The problem	A body of knowledge
2.	Organization Student For Study	Way of investigating
3.	Implementation Investigation	Way of thinking
4.	Develop and present results work	Interaction of science, technology, and society
5.	Analyze and evaluate the problem solving process problem	Interaction of science, technology, and society

4. Disseminate

At the dissemination stage, the product was distributed to a wider scope, namely class XI IPA 1 MA Negeri 1 Kerinci, obtaining results in the very effective category.

Discussion

The reasons for the findings of the investigation include the result of complex interactions between various factors, including the quality of e-modules, technological readiness, teacher training, student motivation, project structure, and evaluation. Understanding these causes will help in designing better strategies to improve the effectiveness of e-modules and PBL in the future. Further research can be done to explore these factors in more depth and to identify ways to improve learning outcomes.

Berkes, F., & Berkes, M. K. (2009) research on local knowledge in the form of customs, continued by Van Dijk, F. J., Bubas, M., & Smits, P. B. (2015) who researched disaster preparedness, Liliarti, N., & Kuswanto, H. (2018) can develop physics learning into mobile, Sibarani, R., Simanjuntak, P., & Sibarani, E. J. (2021) also researched local wisdom. By explaining some of this research, the author conducted

research on the development of this e-module.

Based on the research method that has been carried out, the e-module of Physics integrated with local wisdom based on PBL to improve students' learning readiness in the Kurikulum Merdeka was developed through the Four-D procedure. This conversation will clarify the study's findings, the limitations encountered, and several alternative solutions. The results of this study include definitions, design, development (validity, practicality, and effectiveness), and the dissemination process.

1. Define

The definition of e-modules is done through analysis including initial-final analysis (curriculum analysis), student analysis, and material analysis. Through this analysis, the needs of e-modules are formulated. There are analysis results that will be the basis for developing e-modules. The outcomes of this planning stage have been consistent with the anticipation that the planning stage's goals may be effectively accomplished. The outcomes of this initial phase served as the foundation for the device's development (Fodor, G., Dahlman, E., Mildh, G., Parkvall, S., Reider, N., Miklós, G., & Turányi, Z., 2012).

In the curriculum analysis, an assessment was carried out on the curriculum used by MAN 1 Kerinci. The curriculum used by MAN 1 Kerinci is an Kurikulum Merdeka. Based on the needs of this research, the researcher will use class XI as the subject of this research by implementing an Kurikulum Merdeka. This analysis is adjusted to the basic needs in developing e-module content. And adjusted to the circumstances and characteristics of the school. In the curriculum analysis, the CP and ATP were obtained which were used in developing e-modules.

To ascertain the attainment of student competences and the challenges that students encounter along their educational journey, student analysis is carried out. The process of problem analysis involves gathering data to identify issues and potential solutions (Brown, A, 2017). The results of the student analysis indicate that the low achievement of student competencies is caused by the low attitude of student readiness. Based on the results of the analysis, information was obtained that students of class XI IPA 2 MAN 1 Kerinci The attitude of student readiness towards physics material is still low. Therefore, teaching materials are needed that can improve students' attitude of readiness in understanding physics material.

In curriculum design, the material analysis stage is critical, as it involves a comprehensive evaluation of both curriculum needs and content to ensure alignment with educational goals. This stage allows educators to make necessary adjustments to meet the diverse needs of students and the specific learning outcomes of the course. A key aspect of effective learning is encouraging students to actively engage with the content by identifying their own ideas, principles, and interpretations of the phenomena they observe and study (Slavich, G. M., & Zimbardo, P. G., 2012).

This reflective process helps students internalize knowledge and build a deeper understanding of the subject matter. The organization of learning activities is grounded in findings from the material analysis, insights into student needs, and the core content of the subject. This approach aims to cultivate the targeted competencies in a structured manner, preparing pupils to use what they've learned in practical

situations (Nousiainen, T., Kangas, M., Rikala, J., & Vesisenaho, M., 2018).

Active learning models are important, according to the Republic of Indonesia's ACT 16 of 2007 about National Education on Academic Qualification Standards and Teacher Competencies. One such model is Problem-Based Learning (PBL), which shifts the instructional paradigm from direct instruction to a student-centered approach (Ali, S. S., 2019). In PBL, students are not simply presented with information but are instead expected to investigate and organize their learning independently, fostering critical thinking and problem-solving skills.

The Project-Based Learning (PBL) model fundamentally reorients the learning process by centering students as active participants in their education. Rather than passively receiving information, students engage deeply with topics through structured, guiding questions designed to prompt curiosity and inquiry (Chin, C., & Brown, D. E., 2002). This approach empowers learners to navigate their understanding independently, encouraging them to develop a sense of ownership over their knowledge.

In this model, instructors assume the role of facilitators rather than direct transmitters of information, guiding students as they grapple with complex issues and encouraging them to seek out solutions on their own (M. Sari et al., 2022; M. N. Sari & Ningsih, 2023). By refraining from simply providing answers, instructors create an environment that fosters critical thinking, problem-solving, and adaptability—key skills for the modern world. This shift reflects contemporary educational objectives that emphasize self-directed learning, where students become adept at analyzing, synthesizing, and applying knowledge rather than memorizing it. Consequently, PBL not only enhances content comprehension but also builds lifelong learning skills, preparing students to face future challenges with a proactive, investigative mindset.

In a problem-based learning (PBL) environment, students engage in a process that goes beyond rote memorization and encourages critical engagement with complex, real-world issues. PBL requires students to gather extensive information, analyze it thoroughly, and generate solutions to pre-existing problems. This approach emphasizes that, unlike traditional models of education that often focus on finding a single correct answer, PBL acknowledges the existence of multiple valid solutions. Consequently, students are encouraged to use creativity and divergent thinking, allowing them to explore a variety of perspectives and innovate in their problem-solving processes. This requirement for creative thinking enables students to move beyond passive learning and instead become active participants in constructing knowledge, which ultimately enhances their ability to make meaningful connections between the content they study and the environment around them. Furthermore, PBL fosters a holistic development in students by encouraging them to see the relationships between academic content and real-life contexts. By navigating complex, open-ended problems, students gain insights into how theoretical knowledge applies in diverse scenarios, thereby deepening their understanding and relevance of what they are learning. This process of exploration and synthesis nurtures well-rounded individuals who not only acquire knowledge but also develop essential life skills, such as critical thinking, adaptability, and resilience. Thus, problem-based learning effectively prepares students to engage with and contribute to an ever-evolving world, positioning them as proactive and insightful learners capable of

understanding and responding to the complexities of their surroundings.

Students' knowledge, attitudes, and abilities may all be developed using the scientific method. When using a scientific method to learning, the norms of the scientific approach must be followed. An emphasis on the aspects of observation, reasoning, truth-finding, validation, and explanation characterizes this method. using standards or concepts from science. By enhancing information, attitudes, and abilities, this method should be able to help students think critically, rationally, scientifically, and objectively in light of the facts at hand. It should also result in students who are productive, creative, inventive, and effective.

The ideas and principles of physics that are presented in an approachable manner and connected to real-world situations are what inspire students to learn the subject. To increase their preparedness, students also want relevant instructional resources and learning models. When employing the PBL approach, students' attitudes of preparedness are superior than those of traditional learning models. (Ningsih, 2023). In order to attain the intended skills, teaching materials are created in line with student requirements, resources, and learning objectives based on the analysis's findings. A physics e-module that incorporates local knowledge based on PBL is one of the teaching resources in question that aims to increase students' preparedness for the Kurikulum Merdeka.

2. E-module design

The design of e-modules is based on the analysis that has been done previously. Previous analysis serves as the foundation for the creation of e-modules. E-modules are created in accordance with the requirements that were established during the defining phase. Every analysis's outcome contributes to the creation of e-modules. Compiling tests according to criteria to create e-module evaluation indicators is the first stage in the e-module design process. The criteria to be measured serve as the basis for the formulation of indicators. Validity, usefulness, and efficacy are three criteria that may be used to assess the quality of instructional materials (Roza, 201). such that every element of the created e-modules is evaluated for efficacy, usefulness, and validity.

The second stage in developing this e-module is the selection of appropriate media, a process driven by both a thorough analysis of the material and a careful consideration of the students' specific learning needs. This step aims to facilitate a more intuitive and accessible learning experience by leveraging resources that resonate with the students' immediate environment and prior knowledge. By integrating elements from their surroundings, students are more likely to grasp the concepts being presented, as they can relate new information to familiar, tangible contexts. In this study, e-modules have been selected as the primary instructional media due to their versatility and accessibility. E-modules provide a structured yet flexible framework that not only supports diverse learning styles but also enables students to engage with the content in an interactive and self-paced manner, enhancing their understanding and retention of the subject matter. This alignment of media with both content and learner needs is crucial for fostering an effective and meaningful educational experience.

Selecting a format is the next step. The e-module's design is modified to conform to the reference format. In this instance, the current structure focuses on enhancing the preparedness attitude that students build during learning activities. The e-module

must be used in conjunction with other instructional resources in order to be used as one of the teaching resources. Through learning objective analysis, this seeks to assist students in meeting learning objectives. An assessment instrument that can gauge students' mastery of learning abilities is required in order to gauge their attainment of learning objectives.

Permendiknas No. 20 of 2007 about educational assessment criteria is cited in the assessment design. In line with the learning objectives derived from CP, the assessment tools created focus on characteristics of students' knowledge, attitudes, and abilities. Descriptive tests are used in cognitive evaluation. Questionnaires for responders to employ as observers during the learning process are used in attitude and skill assessments.

3. Development

a. Validity Test

The developed e-module is already in the legitimate category, according to the study findings that have been given. The indications listed in the e-module validation tool have been satisfied by the produced e-module. Furthermore, the e-module based on the established PBL paradigm has satisfied the validity assessment requirements (language, construction, and content validity). Because the theory that served as a guide for the e-module's preparation and compilation served as the basis for its creation, the e-module has satisfied the content validity requirements. The e-module's creation is tailored to the curriculum's references.

The e-module received a value of 0.87 with a valid category, according to the validation findings. The data from the average validation computation is still below 1. This demonstrates that the e-module's development still has flaws. Nonetheless, there are benefits to the product under study or development. Benefits include the product's consideration of component relationships and the e-module's compatibility with the chosen learning model throughout development. To increase student preparedness, the PBL model of learning is employed. One of the PBL phases in the e-module offers an additional benefit. In terms of language, the product was created using proper EYD and good, accurate Indonesian.

b. Practical Test

To ascertain the e-module's degree of practicality, a practicality test was performed. Information on the usefulness of the created e-module was gathered via the instructor response test. With a score of 93%, the e-module practicality test fell into the extremely practical category. The created e-module is highly useful for usage as a teaching tool during the educational process..

The purpose of the student response test was to gauge how useful the created e-module was. After students had accessed all of the created instructional resources, the student response exam was administered. With a first meeting score of 87.4%, a second meeting score of 91.2%, a third meeting score of 92.4%, and a fourth meeting score of 93.6%, the e-module practicality test results fell into the extremely practical category. This indicates that the e-module being utilized as a learning resource in practice. The created e-module is generally user-friendly and extremely beneficial to instructors in terms of planning, carrying out, and evaluating the learning process. This is consistent with Arikunto's view (Arikunto, 2020), according to which an instrument satisfies practical requirements if it is simple to use and uncomplicated.

a) Knowledge Assessment Results

Data on student knowledge competency was gathered from each meeting's written exam outcomes. The exercise score responses on the assessment sheet represented the outcomes from the first to the fourth meeting. The average value of student learning outcomes for knowledge competency fell into the good category, according to the analysis's findings. Thirteen students did not finish the test since their scores fell below the KKM (<70), but eight of the twenty-one students were known to have finished it at the first meeting. By the time of the second meeting, sixteen pupils had finished the test. The number of pupils who finished rose to 21 over the third and fourth meetings. As a result, every student in class XI IPA 2 falls into the completed group. Over the course of four sessions, students' average score was 76, and their completion rate was 79%. This demonstrates how using physics e-modules with local wisdom integrated and based on the PBL paradigm may enhance students' learning results in knowledge skills.

b) Results of Student Attitude Analysis

The outcomes of observations of student attitudes throughout the learning process were used to determine the findings of the student attitude evaluation. In order to track student attitudes throughout the learning process, observers filled out the responder sheet. With a class average of 86%, student attitudes were generally in the very good range. This indicates that the physics e-module with local wisdom incorporated, which was created using the PBL approach, is successful in the educational process. This demonstrates how well the PBL-based physics e-module with local knowledge integration works as a teaching tool.

According to the PBL paradigm, students' behaviors may be altered to improve their attitudes during the learning process. Stated differently, the use of integrated local knowledge physics e-modules based on the PBL approach enhances attitude competency learning outcomes for students.

At the first meeting, the students' attitude competence was still low compared to the next meeting. This was because the students' curiosity was still lacking, the students had not been able to show their curiosity clearly, so it was not seen by the respondents. Likewise with how to work together and communicate with students. Students who were used to working alone found it difficult on the first day of learning. For the aspects of being careful and responsible at the first meeting, some students showed a sense of responsibility and were careful in conducting experiments, at the next meeting there was an increase in curiosity and responsibility and this was observed by the respondents.

c) Skills Assessment Results

Students' learning results in the skills competency, as determined by their learning activities, indicate that, on average, 87% of their abilities fall into the very good group. The majority of the students' talents at the first meeting fell into the good range. Students' skills fell into the very excellent category after the third meeting. The average value attainment at each meeting differs, even though both fall into the very good level. This demonstrates how using physics e-modules with local wisdom incorporated and based on the PBL paradigm may enhance students' learning results in terms of skill proficiency.

This shows an increase in student skill competency, where the increase occurs at each meeting. At the first meeting, students who were rarely involved in the discussion looked awkward so that student skills were difficult to observe by respondents, but at the

next meeting students were more confident in conducting experiments. There was cooperation between fellow group members in assembling experimental tools/materials and participating well in each step of the experiment. So that they can use experimental tools/materials well. Likewise, in analyzing experimental results, recording experimental conclusions, and presenting group reports, students can do it well.

d) Results of Analysis of Increased Preparedness Results of Increased Preparedness

Obtained from the evaluation of the knowledge domain. Improvement in readiness can be seen through a written test using essay questions on physics material. To see the improvement in readiness, a pre-test was conducted at the beginning of the meeting and a post-test at the end of the meeting. Then the results of the first meeting test were used to see the improvement in readiness at the second meeting, followed by the results of the second meeting test used to see the improvement in readiness at the third meeting. To see the improvement in readiness at the fourth meeting, the results of the third meeting test were used. The average student score increased at each meeting. Although at the first meeting the students' classical completeness was only 38.1%, at the next meeting the percentage continued to increase. The students' completeness in physics material increased at each meeting. At the third and fourth meetings the completeness was at 100%. This means that all students of class XI IPA 2 have achieved KKM (≥70). This is in line with the improvement in student readiness. Although at the second and third meetings there was no increase in readiness calculated using the gain score, there was an increase in the average value of learning achievement and the percentage of classical completeness from the initial condition to the final condition of the meeting. In addition, there was an increase in the readiness of each student at the fourth meeting, all students were in the very ready category.

4. Dissemination

The dissemination stage was carried out to determine the level of practicality and effectiveness of the e-module if it was tested in other classes. The author carried out the dissemination stage in class XI IPA 1 MAN 1 Kerinci. The author took this class because it was in the same school and had the same level of ability as the trial class. However, the number of students in the dissemination class was greater than in the trial class, so the distribution of the e-module was also wider.

This distribution stage's objective is to evaluate the usefulness and efficacy of testing in various classes. Both teacher and student responses to the practicality test at the dissemination stage show that the results fall into the extremely practical category. With a very practical area, teacher answers to the usage of e-modules received a 94% score. With an e-module practicality score of 96.6%, student answers fell into the extremely practical category as well. These findings suggest that the created e-module is highly useful for usage in a variety of classroom settings.

Based on the findings of the evaluation of the e-module's efficacy during the dissemination phase. The average score on the student knowledge evaluation was 76.9. with an overall completion rate of 78.4%. This demonstrates how well the students in the Physics class were able to identify and work through the physics challenges in the e-module. Furthermore, via complete student participation in the learning process, the PBL stage has also been successful in helping students in the disseminating class to grasp the subject.

Students had an average score of 84% in attitude competency, indicating that their attitudes were generally in the very good range. On the other hand, the indicators of collaboration, correctness, and responsibility were greater than the indicators of curiosity and communication when analyzed from the observations of the respondents. This is because the students' interest, demonstrated by direct communication with group members and knowledge gathering from other educational resources, demonstrates that both attitudes are invisible to the responders. As a result, the author advises educators to remind pupils of certain attitude markers that need to be present and emphasized.

The average score for the skills competency was 81.9%, falling into the "very good" category. However, there were anomalies in the tool assembly skill indicator findings from the first meeting. This was because certain students were assigned the task of assembling the tool, and other group members were not kept track of their tool assembly abilities. Based on this, the author recommends that educators remind students to divide up the inquiry materials equally and complete the tasks in accordance with their allotted time. As a result, the student's demonstration tool assembly skill indication increased for the following meeting. Similarly, the conclusion recording skill and the participation skill indicator rose in the following meeting after receiving the same therapy.

The results of the increase in preparedness at the disseminate stage were also obtained from the results of the knowledge domain evaluation. Similar to the trial class, the disseminate class also did the same thing to see the increase in preparedness. The increase in preparedness was seen through a written test using essay questions about physics material. To see the increase in preparedness, a pre-test was conducted at the beginning of the meeting and a post-test at the end of the meeting. Then the results of the first meeting test were used to see the increase in preparedness at the second meeting, followed by the results of the second meeting test used to see the increase in preparedness at the third meeting. The outcomes of the third meeting test were used to gauge the level of readiness in the fourth meeting. At the first meeting, the average student score rose. Even though the students' classical completeness was only 36.4% in the first meeting, the proportion kept rising at the subsequent one. This corresponds with the rise in readiness. Students already fall into the group of being extremely prepared overall.

Students' mastery of physics material increased at each meeting. At the third and fourth meetings, students' mastery was at 100%. This means that all students of class XI IPA 2 have achieved KKM (≥70). This is in line with the increase in student readiness. Although at the first, second, and third meetings there was no increase in readiness calculated using the gain score, at these meetings there was an increase in the average value of learning outcomes and the percentage of classical mastery from the initial condition to the final condition of the meeting. Furthermore, at the fourth meeting all students were in the very ready category. Thus, it can be concluded that the use of local wisdom-integrated physics e-modules based on the PBL model in learning can increase student readiness in other classes.

The author's hope so that further research can adapt e-module content according to local cultural and social contexts, so that it is more relevant and effective for students in various regions and continues to encourage innovation in e-module development, by utilizing the latest technologies such as artificial intelligence,

augmented reality, and gamification to enhance the learning experience. It is hoped that future research will involve interdisciplinary collaboration, such as educational psychology, information technology, and learning design, to create a more comprehensive and effective approach. Future research is expected to place more emphasis on the development of 21st century skills, such as collaboration, creativity, and problem solving, through the use of e-modules and PBL.

CONCLUSION

Based on the results of the research conducted, the following conclusions were obtained:

The development of an integrated local wisdom physics e-module, designed according to the Problem-Based Learning (PBL) model, has been successfully carried out through four key phases: definition, design, development, and dissemination. Findings from this development process indicate that the e-module achieves high standards in terms of validity, practicality, and effectiveness. Specifically, the module attained an average validity score of 0.86, categorizing it as valid. The practicality of the e-module was rated at an impressive 93%, placing it in the very practical category, which underscores its ease of use and applicability in educational settings. Furthermore, the e-module has demonstrated significant effectiveness by fostering improvements in students' knowledge competencies, attitudes, and skills across each instructional session. These gains highlight the module's capacity to enhance students' readiness and engagement in learning. Overall, the integration of local wisdom elements within the PBL framework has yielded an educational tool that not only aligns with curriculum goals but also enriches the learning experience by connecting theoretical concepts with culturally relevant knowledge.

The dissemination stage of the integrated local wisdom physics e-module, developed using the Problem-Based Learning (PBL) model, demonstrated its effectiveness in supporting physics learning across different classes. The e-module achieved a high practicality rating, with a score of 94.5%, categorizing it as "very practical" for classroom implementation. Additionally, the results indicated significant improvements in students' readiness, encompassing knowledge competence, attitudes, and skills, across consecutive meetings. These findings suggest that the integration of local wisdom within a PBL-based e-module not only enhances student engagement but also fosters comprehensive learning outcomes. Therefore, this e-module represents a promising tool for effective physics instruction, highlighting the value of incorporating culturally relevant materials into science education.

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