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The Effectiveness of E-Modules Based on Local Wisdom in the City of Palembang to Improve Thinking Skills High School Students' Criticism of Static Fluid Material

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Abstract: This study seeks to evaluate the impact of a locally-informed e-module on static fluid concepts on the critical thinking abilities of high school pupils. This research employs a quasi-experimental design utilizing the pretest-posttest methodology. Techniques for data analysis make use of quantitative data to examine information gathered from student achievemen. The average score on the critical thinking abilities pretest was 53, while the average score on the posttest was 82. This demonstrates how implementing the static fluid e-module based on local knowledge in Palembang has enhanced students' critical thinking abilities. The N-gain test analysis results, which indicate that pupils with critical thinking abilities scored 0.60 in the medium category, provide evidence for this.

Keywords: Critical thinking skills; E-module; Local wisdom; Palembang city

Introduction

Science and technology are developing very rapidly, every country must be ready to face technological developments, and Indonesia is no different. Improving the quality of human resources is one solution that needs to be considered to be prepared to face these developments (Anikarnisia & Wilujeng, 2020). The initial step towards enhancing individual quality is to improve the education system, which can unlock potential and empower individuals with the knowledge, skills, and values necessary to navigate the fast-paced advancements in science and technology. (Agustine et al., 2014). However, facts on the ground show that many students face difficulties in learning activities at school (Sumarni & Kadarwati, 2020; Zhao, 2019). Especially in subjects that are fundamental to the development of science and technology, one of which is physics (Liana et al., 2020).

Physics as a science focuses on abstract concepts and is difficult to explain with concrete examples (Syuhendri, 2014). In the process, students are only trained to solve mathematical computing problems, not to understand physics concepts correctly (Syuhendri, 2017). Even though physics is a science that is very relevant to surrounding phenomena (Nazhifah et al., 2022; Wiyono et al., 2024). According to field data, teachers frequently struggle to help students understand the concepts taught in physics classes. Students frequently complain about physics classes and find the subject matter intimidating. Students become unmotivated to study physics as a result of this. Moreover, physics education is still primarily focused on the teacher and infrequently links to technological advancements and real-world situations. (Saprudin et al., 2019). Although physics education should enable students to cultivate the skills necessary for success in the era of globalization, (Adhelacahya et al., 2023;

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Aswirna et al., 2022). These abilities are referred to as the 4C skills, which include critical thinking, creativity, collaboration, and communication. (Susilo, 2015). One of the important competencies to develop in the 21st century is the ability to think critically (Alghafri & Ismail, 2014; Asrizal et al., 2023; Leen et al., 2014).

Advanced reasoning, also known as critical thinking, is a skill that evaluates information or beliefs based on the supporting evidence (Alfiyanti et al., 2020). This skill is essential for students to possess (Nikmah et al., 2021). Critical thinking skills empower students to think critically, logically, and constructively, focusing on how to determine what to believe or what actions to take. This skill is then employed in evaluating situations to make wise judgments and decisions. In addition, it can serve as a useful tool for learning and actively participating in daily life. (Negoro et al., 2020; Sukma & Marianti, 2023). Critical thinkers are better equipped to process information and find appropriate solutions (Barnett & Francis, 2012; Marlina et al., 2022). However, critical thinking skills do not come by themselves but need to be trained and accustomed to (Alfiyanti et al., 2020).

Critical thinking skills can be trained with systematic learning, through projects and integrated with everyday life so that learning becomes more contextual, interesting and fun (Permatasari et al., 2023). Such learning can be created by utilizing technology by applying teaching materials to support the learning process. Students can expand their understanding of the subjects they study in systematic learning activities by using e-modules, which are alternate instructional tools. An electronic module, or e-module, is a digital version of an electronic module that can be accessed and used through electronic devices including laptops, desktops, tablets, and smartphones. (Putri & Syafriani, 2022). Therefore, innovation is needed in the physics learning process at school.

Using technology and fusing it with things that happen in everyday life—namely, the community's local knowledge—is how innovation is carried out. Everything that is unique to a place, whether it be its cuisine, traditions, songs, dances, or ceremonies, is known as local wisdom. (Maknun, 2017). South Sumatra is a province in Indonesia known for its significant level of diversity. (Pitoyo & Triwahyudi, 2017). South Sumatra's diverse geographic and sociocultural circumstances offer a solid foundation for fusing the region's traditional knowledge with physics education. Similar to the Musi River, which has come to symbolize the city of Palembang among students, the aquatic environment in the Musi River can be used as a source of physics education, particularly in the area of fluids, provided that local knowledge in Palembang creates contextually based teaching materials.So, using e-modules based on local wisdom in the city of Palembang is a new solution to learning physics.

Due to the lack of such learning methods in Indonesia, students with insufficient critical thinking skills are frequently observed in both domestic and international educational environments. (Lestari et al., 2018; Prasadi et al., 2020; Suci et al., 2022; Suharno et al., 2022). This is in line with the results of observations made at SMAN 2 Palembang, showing that when given assignments, students tend to be lazy about working on questions that they think are difficult and slightly different from the example questions given by the teacher, because students are not used to being trained and directed to think critically. in solving problems. Lack of mastery of critical thinking skills is certainly a challenge for teachers to create the current golden generation (Redhana, 2019).

Research was done to find out how integrating local wisdom-based e-modules affected high school students' critical thinking in fluid material, based on the backdrop of the problem explained and prior research. The findings of this study can be consulted when developing engaging educational opportunities that enhance students' abilities.

Method

The research was conducted at SMA Negeri 2 Palembang during the even semester of the 2023–2024 academic year, involving 42 students from Class XI as participantsThis research utilized a one-group pretest-posttest design, which is a form of quasi-experimental methodology. This approach evaluates the same group of students both prior to and following the intervention—specifically, the use of e-modules grounded in local wisdom—to identify any changes in their critical thinking skills. This approach allows researchers to measure the effectiveness of the educational intervention by comparing pre-intervention (pretest) and post-intervention (posttest) scores, providing valuable insights into the impact of the e-modules on student learning outcomes. .(Fraenkel & Wallen, 2012). The study will explore how employing e-modules based on local knowledge in Palembang can enhance students' critical thinking abilities using a One-Group Pretest-Posttest design. The framework for this design is illustrated in Table 1 below.

Table 1. One Group Pretest-Posttest Design Research Design

Group	Pretest	Treatment	Posttest
Experiment	O1	X	O2

The instruments used for data collection included tests for concept comprehension and students' critical thinking skills. The assessments for concept comprehension were conducted through both a pretest and posttest. Before the learning process using e-modules based on local wisdom for static fluid material, students are given a pretest to develop their critical thinking skills. During the learning process, they work through the e-module, followed by a posttest.

The data collected from students' achievement scores in critical thinking skills were analyzed using quantitative data analysis techniques, which involve statistical methods to summarize and interpret numerical data. This type of analysis allows researchers to draw meaningful conclusions about the effectiveness of the educational interventions. Following the initial analysis, the data was further examined using the Wilcoxon analysis method and the N-Gain Score Test. The Wilcoxon analysis, a non-parametric test, compares two related datasets, such as the pre-test and post-test scores, to determine if there is a statistically significant difference between them. This method is particularly useful in evaluating whether the use of e-modules grounded in local wisdom has had a measurable effect on enhancing students' critical thinking skills.

Conversely, the N-Gain Score Test assesses the enhancement in students' scores between the pre-test and post-test. This assessment offers a more comprehensive insight into the extent of improvement in students' critical thinking skills resulting from the utilization of the e-modules. By employing both the Wilcoxon analysis and the N-Gain Score Test, the study aims to comprehensively assess the effectiveness of the educational intervention in enhancing students' critical thinking abilities. Before applying the Wilcoxon test, normality and homogeneity tests were conducted on the data using SPSS version 23 software. (Arviani et al., 2023).

The effectiveness of Palembang-based e-modules based on local knowledge in raising students' critical thinking abilities is evaluated using Normalized Gain (N-Gain) methodology. Numerous scholars employed normalized gain analysis in earlier work. (Muthi'ik et al., 2018; Doyan et al., 2020; Pratama, 2020; Khaira et al., 2021; Wiyono et al., 2022). The N.Gain value formula is:

$$\mathrm{N-gain\ (g)} = \frac{S_{post} - S_{pre}}{S_{max} - S_{pretest}} \quad (1)$$

Once the results of these calculations are obtained, the next step is to interpret these values regarding the effectiveness of utilizing e-modules based on local wisdom in the city of Palembang. The criteria for the N-Gain can be found in Table 2.

Table 2. Effectiveness Categories Based on N-gain (Hake, 1998)

N-gain Value Criteria	Category
N-gain ≥ 0.7	Tall
0.7 > N-gain ≥ 0.3	Currently
N-gain < 0.3	Low

Result and Discussion

Implementation of an E-Module Based on Local Wisdom in the City of Palembang to Improve Thinking Skills Student critical work on static fluid material has been carried out. The purpose of the static fluid material e-module is to assist students in comprehending physics material and developing the necessary abilities. It is anticipated that after utilizing local wisdom-based e-modules for learning, students' critical thinking abilities will increase. The N-gain score, which is derived from exam results obtained before and after learning, shows how much the students' skills have improved. Table 3 displays the average student test results. Then the percentage results of students' skills based on indicators of critical thinking skills can be seen in Table 4.

Table 3. Average data on student pretest and posttest results

Parameter	Critical Thinking Skills	
	Pretest	Posttest
Number of students	42	42
The highest score	60	92
Lowest value	42	67
Average	53	82

Table 4. Pre- and Post-Results of Students' Critical Thinking Skills

Category	%
Tall	34
Currently	66
Low	0

Table 3 displays the outcomes of the pretest regarding students' critical thinking skills, indicating an average score of 42, with a maximum score of 60 and a minimum score also of 42. It further outlines the posttest results, highlighting a lowest score of 67, a highest score of 92, and an average score of 82 among the students. These findings suggest a notable improvement in the students' critical thinking abilities. Supporting data shows that 43% of students now demonstrate high levels of critical thinking, while none fall into the low category, and 66% are in the medium category. This growth aligns with previous research, which also observed similar

increases. Suparmin et al. (2024) and Aswirna et al. (2022) which indicates that e-modules rooted in local wisdom can enhance students' critical thinking abilities.. Putri & Syarifuddin (2023) in his article shows similar results, especially in the local wisdom of South Sumatra.

Normality Test

Using the SPSS program, a normality test is the initial step in data analysis. This test is crucial as it helps determine whether the distribution of data for a particular set of variables adheres to the assumptions of normality. Normality is important because many statistical analyses, including parametric tests, rely on the data being normally distributed to produce valid results. The criteria for conducting the normality test involve establishing a null hypothesis (H0), which asserts that there is no deviation from a normal distribution in the data. This means that if H0 holds true, the data should follow a bell-shaped curve typical of a normal distribution.

The significance value obtained from the normality test is pivotal for decision-making. If this value falls below 0.05, it indicates a significant deviation from normality, leading to the rejection of H0. This suggests that the data does not conform to a normal distribution, which may necessitate the use of non-parametric statistical methods for further analysis. Conversely, if the significance value exceeds α (0.05), the data is considered to follow a normal distribution, allowing researchers to proceed with parametric tests that assume normality, thereby enabling more powerful statistical analyses and interpretations of the data. (Wiyono et al., 2022). The normality of the students' critical thinking skills data is assessed in Table 5.

As shown in the table above, the significance values for the pretest and posttest of students' critical thinking skills are 0.002 and 0.026, respectively, both of which are below α = 0.05. Based on the preceding description of H0, H0 is disproved. Put otherwise, the study's pretest and posttest data were not normally distributed. Next, a homogeneity test will be carried out to see whether the data obtained is homogeneous or not.

Table 5. Data Normality Test Results Critical thinking skills

Research variable		Asymp. Sig
Critical thinking skills	Pretest	.002
	Posttest	.026

Homogeneity Test

Table 6. Homogeneity Test Results for Critical Thinking Skills Data

Levine Statistics	df1	df2	Sig.
.050	1	82	.823

Table 6 displays the results of the data analysis concerning the homogeneity of students' critical thinking skills. The significance value derived from the pretest and posttest data is 0.823, exceeding α = 0.05, which indicates that the data is homogeneous. While the results suggest that the data does not follow a normal distribution, the homogeneity test affirms its consistency. As a result, non-parametric hypothesis testing is utilized, employing the Wilcoxon test for this analysis. The findings are presented in Table 7. The Wilcoxon test is utilized when the normality assessment indicates that the data does not follow a normal distribution. This non-parametric test is carried out using SPSS software to facilitate the analysis. The outcomes of the Wilcoxon test are presented in Table 7.

Table 7. Wilcoxon test result

Statistics	Pretest-Posttest Results
Z	-5.673
Asymp. Sig (2-tailed)	.000

Table 7 presents the results of the hypothesis test based on the post-test scores of both the experimental and control groups. These findings reveal a significant improvement in student performance, demonstrated by the post-test score surpassing the pre-test score, quantitatively reflected in a negative Z value of -5.462. This negative Z value, derived from the Wilcoxon test, indicates a substantial change in scores, highlighting the effectiveness of the intervention.

Moreover, the Wilcoxon test results indicate a significance level (2-tailed) of 0.000, which falls well below the alpha level of 0.05. This low significance value provides strong evidence to reject the null hypothesis, thereby confirming that the implementation of the static fluid e-module, which is rooted in the local wisdom of Palembang, significantly enhances students' critical thinking skills. The fact that the significance value is less than α = 0.05 reinforces the conclusion that the e-module had a meaningful impact on student learning outcomes.

These findings imply that integrating local wisdom into educational tools, such as e-modules, can yield substantial benefits for students, particularly in developing their critical thinking abilities. Additionally, the n-gain test analysis results presented in Table 6 further substantiate these conclusions.

The n-gain test was developed to measure the level of enhancement in students' critical thinking skills by comparing their test scores before and after the implementation of the e-module. This analysis offers a numerical evaluation of how effective the intervention has been. Table 8 displays the average n-gain for critical thinking abilities, providing important insights into the overall improvement achieved through the educational program. In essence, the n-gain test serves as a tool to quantify the impact of the e-module on students' cognitive development, allowing educators to gauge the success of their teaching strategies in fostering critical thinking.

Table 8. Data on Average N-gain of Students' critical thinking skills

Skills	Lowest gain	Highest gain	Average N-Gain	Category
Critical thinking	0.4	0.8	0.60	Currently

Table 9. N-Gain Per-aspect of Critical Thinking Skills

Aspect	Pre Value	Post Value	N-Gain
Provide a simple explanation	64	83	0.53
Build basic skills	52	85	0.69
Conclude	47	73	0.49
Provide further explanation	50	83	0.66
Set strategy and tactics	45	80	0.64
Average	52	81	0.60

According to the data presented in Table 9, critical thinking abilities are as follows: 0.53 in providing clear explanations, 0.69 in developing basic skills, 0.49 in drawing conclusions, 0.66 in supplying supplementary explanations, and 0.64 in managing strategies and tactics.. On the whole, students' critical thinking skills have an average n-gain score of 0.60, which falls into the medium category (Hake, 1998). In other words, the e-module based on the local wisdom of Palembang has been developed effectively to enhance students' critical thinking skills concerning static fluid material.

These findings illustrate the successful implementation of the e-module-based learning approach that incorporates students' local wisdom. At the start of the learning process, students are encouraged to view the instructional video to gain an understanding of the material to be covered. After that, they are asked a number of questions and told to participate in the discussion forum on the e-module.

By offering questions and challenges in the discussion forum, it is expected that students' problem-solving skills will be enhanced. During this process, students are encouraged to explore various sources for reading materials. The locally-based wisdom e-module developed includes simple experiments that students can conduct, along with student worksheets to facilitate their experimentation. Then at the end of each lesson, there are practice questions to hone students' abilities after studying (Nazhifah et al., 2022; Wiyono et al., 2022).

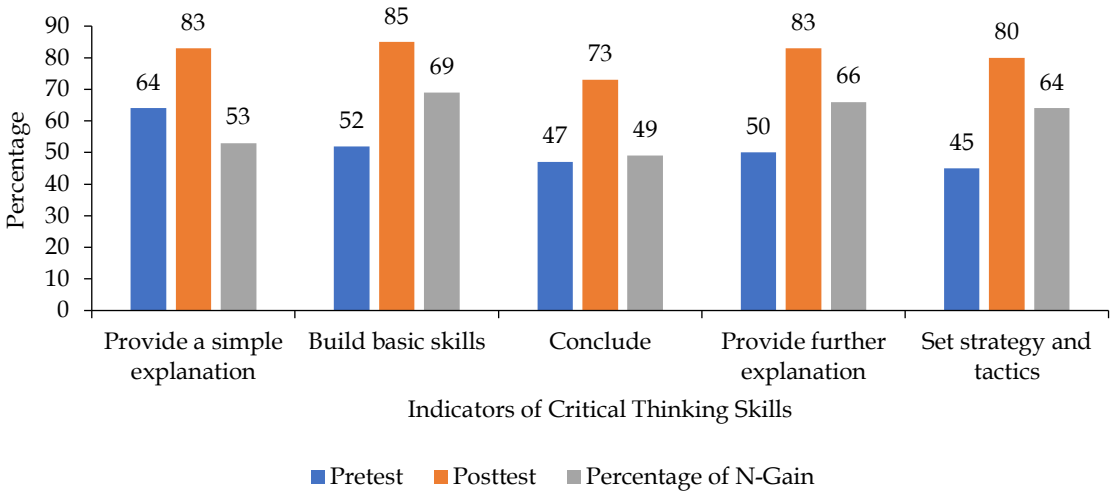

Figure 1. N-gain Graph for Each Aspect of Critical Thinking Skills

The indicator for managing strategy and tactics had the largest growth, as seen in Figure 1, at 35%, while the indicator for offering a brief explanation had the lowest increase, at 19%. These findings are corroborated by Mulatsih et al. (2023), which present similar results. Overall, the data suggests that integrating local wisdom can enhance students' critical thinking skills, as evidenced by an increase in the N-gain score across various areas. The application of local knowledge in Palembang contributes to creating an engaging learning environment that positively impacts student learning outcomes and motivation. (Nazhifah et al., 2022). To enhance critical thinking skills and motivate students to engage in the learning process, the instruction is

delivered through an e-module that incorporates interesting local wisdom from the city of Palembang. This approach leads to increased enthusiasm among students for sharing their ideas.This is in line with the research conducted by Maulida et al. (2021) believe using educational materials can spark students' curiosity and will to study (Cholis & Yulianti, 2020), and integrating physics learning with local wisdom can make learning more contextual to students' lives (Kurniahtunnisa et al., 2023). For the application of learning through e-modules to increase crucial skills, students must actively participate in the learning process as directed by the teachers' stimulus. (Asrizal et al., 2023; Permatasari et al., 2023).

Research by Martini et al. (2021) indicates that students have a positive experience with e-modules due to the high quality of the content, materials, and media presentation. Additionally, the integration of local knowledge is believed to enhance the achievement of learning objectives. Consequently, the implementation of e-modules in education positively influences students' learning outcomes. (Haruna et al., 2021). It has proven to be quite successful to integrate ethnophysics into the classroom in order to foster good critical thinking skills.

Conclusion

Employing e-modules grounded in local knowledge in Palembang can enhance students' critical thinking skills. This is reflected in the increase of the average pretest score for critical thinking skills from 53 to 82 following the post-test. The average N-Gain of 0.60, indicating a medium level of improvement, implies that the local wisdom-based e-module is effective in boosting students' thinking abilities.

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The author declares that there is no conflict of interest regarding the writing and publication of this paper.

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