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Validating The Problem-Based Learning Module Based on Local Wisdom Material to Improve Elementary School Students' Critical Thinking Skills in Natural and Social Science Education (IPAS)

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Abstract: The current research aims to validate a problem-based module based on local wisdom material to influence elementary school students' critical thinking skills. A mixed-method research design with quantitative descriptive analysis was used to explore the experts' validation, and observation was conducted to prove the influence of the module for students' critical thinking skills. The participants were two experts who were purposely selected to measure the module's appropriateness and ten students who were conveniently selected to prove the influence of the module on students critical thinking skill. The experts' validation considered several aspects, such as the accordance of the module to the syllabus, the overall appropriateness of the module, and the media acceptance of the module. Based on the module's accordance with the syllabus, the overall expert rating was 4.71, the pedagogical aspect of the module acceptance was 4.66, and the media characteristic of the module was 4.50, indicating the agreement of the experts on the appropriateness of the module. In terms of the impact of the module on students' critical thinking skills, observation was conducted measuring the students' ability in critical thinking throughout the learning process with the module. It was found most of the students were able to conceptualize a question, analyze arguments, clarify and answer questions, do observation and do evaluation based on the observation, make deductions and draw conclusions and evaluate the outcomes, and formulate inductions and evaluate them.

Keywords: Critical thinking skill; Local wisdom; Module; Problem Based Learning.

Introduction

One of the traits that is important for elementary school students is the critical thinking skill. It was stated that the critical thinking skill benefits students in academic achievement and helps students in real-life situations. In terms of academic achievement, Liu et al. (2023), explain the reason why critical thinking can help students to elevate their academic achievement. They stated that with the critical thinking skill, students were able to analyze and solve problems rationally. It became the equipment for students to be able to solve academic problems, be able to answer the summative assessment question, and elevate their grade (Liu et al., 2023). It was emphasized by Kanbay et al. (2017), who stated that the overall students' academic achievement is the reflection of how the students maintain and use their critical thinking throughout the education journey. In this case, when they use their critical thinking in their academic process, they will have a better comprehension of the subject matter. Therefore, critical thinking has a positive correlation with the students' academic achievement

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(Ali & Awan, 2021). Other than helping students in academic achievement, critical thinking also helps students to solve their daily life problems. Halpern & Dunn (2021) stated that a real-life problem often requires an innovative solution, and critical thinking can provide students with the necessary trait that is necessary for solving real-life problems. Furthermore, the critical thinking activities provided in the classroom mostly push students to analyze various aspects of a problem before forming a conclusion, thus mirroring the decision-making processes they encounter outside the classroom (Masruro et al., 2021).

In regard to the importance of critical thinking for students, finding the appropriate pedagogical aspect in the classroom that can elevate elementary school students critical thinking is necessary. In this case, one of aspect that can be considered is the Problem-Based learning module based on local wisdom material. Problem based module means that the module emphasizes student engagement through the exploration of complex, real-world problems, fostering active learning as opposed to traditional, lecture-based instruction (Asih et al., 2022). Local based material module means the utilization of indigenous material as the learning material taught in the module. In this case, there is possibility that the problem learning module based on local wisdom material can elevate the elementary school students critical thinking skill. it is because the problem based learning has similar characteristic with the critical thinking skill activity. For instance, Problem based learning module based on local wisdom material lead students to engage with the real word problems, thereby students practice to solve issue by finding the possible solution (Dewi et al., 2017). In this case, the local wisdom material can give the contextual learning which can be used to improve the students cognitive and analytical skill which might improve students critical thinking skill (Sudjarwo et al., 2018; Uslan et al., 2024). Furthermore, real life problems related to the local issue might be the complex problem which necessitates critical analysis and creative problem-solving skills. In solving these problem, it drive students to unique approach of solving problem, enabling students to navigate complex issues in new ways (Yanto et al., 2021). It might improve the students' critical thinking as it requires a thorough, structured, and authentic way of solving problems (Major & Mulvihill, 2017).

Based on the possible role of a problem-based learning module based on local wisdom material on students' critical thinking skills, there is still a limited number of research on this theme. For example, problem-based learning modules are based on local wisdom material associated with science literacy improvement (Arrafi et al., 2023), problem-solving ability (Annam et al., 2023), and science literacy (Zainuri et al., 2024). Other research correlated the problem-based learning module based on local wisdom material on students' critical thinking but in the context of junior high school (Annam et al., 2024; Ridho et al., 2021) and high school (Iwan et al., 2025). There is also research in the context of elementary school students (Mahsup et al., 2024). But this module did not directly test the module on students; it just limited the appropriateness of the model to empower elementary school students' critical thinking based on the experts' agreement. It indicated that there is a limited number of research studies exploring the significance of the problem-based learning module based on local wisdom material in the context of elementary school students. Therefore, to fill the gap and add on the references, the current research aims to validate and test the problem-based learning module based on the local wisdom material on elementary school students' critical thinking skills.

Method

Procedure

The current research aims to validate and examine the influence of a problem-based learning module based on local wisdom material on elementary school students' critical thinking skills. In the validation aspect, the current research used the experts' validation, validating several aspects of the module, such as the accordance of the module to the Indonesian curriculum, the pedagogical aspect of the module, and the media aspect of the module. In examining the influence of the module on students' critical thinking skills, researchers observe the students' critical thinking throughout the learning process using the module.

Sample

There are two kinds of participants in the current research. First, experts who validate the module and the students who experience the module and are being observed. The experts consisted of two lectures in different expertise. One has expertise in students' critical thinking skills, and one has expertise in pedagogical learning in elementary school education. In terms of the students, a total of 10 students grade at the elementary school of Gmit Oebufu Kupang, Indonesia, participated. They were selected based on the convenience sampling method.

Instrument

In terms of the research instrument, there are two instruments used in the current research, namely questionnaires given to the experts and an observation

list used to observe students during the learning process based on the module. The questionnaires given to experts measured three aspects of the module, namely the accordance of the module with the current Indonesian curriculum, consisting of seven items; the pedagogical aspect contained in the module, consisting of six items; and the media aspect of the module, consisting of twelve items. In terms of the observation list, the observation consists of six indicators of students' critical thinking skills, namely, the ability of students to formulate questions, the ability of students to analyze arguments, the ability of students to clarify concepts, the ability of students to do observations and evaluate the results, the ability of students to draw conclusions, and the ability of students to formulate inductions and evaluate them. Each of the indicators was measured with a rating scale of 1 to 5. 1 for very poor, 2 for poor, 3 for fairly good, 4 for good, and 5 for very good.

Data analysis

In terms of the research instrument, there are two instruments used in the current research, namely questionnaires given to the experts and an observation list used to observe students during the learning process based on the module. The questionnaires given to experts measured three aspects of the module, namely the accordance of the module with the current Indonesian curriculum, consisting of seven items; the pedagogical aspect contained in the module, consisting of six items; and the media aspect of the module, consisting of twelve items. In terms of the observation list, the observation consists of six indicators of students' critical thinking skills, namely, the ability of students to formulate questions, the ability of students to analyze arguments, the ability of students to clarify concepts, the ability of students to do observations and evaluate the results, the ability of students to draw conclusions, and the ability of students to formulate inductions and evaluate them. Each of the indicators was measured with a rating scale of 1 to 5. 1 for very poor, 2 for poor, 3 for fairly good, 4 for good, and 5 for very good.

Data analysis

After the data collected through the instrument, the data were analyzed to be reported in the current article. In terms of the experts' validation data, it's analyzed through quantitative descriptive analysis, reporting the means of the experts' ratings for each item. The total means of all items were also examined to report the total agreement of the experts. In terms of the observation data, each of the students was observed in each critical thinking category through a Likert scale of 1-5. The data were analyzed by computing the total student rating in each critical thinking category. It will show how the students can perceive the critical thinking skill within the implementation of the module.

Result and Discussion

Experts Validation

The current research aims to validate a problem-based learning module based on local wisdom material and test its effectiveness or significance on elementary school students' critical thinking skills. Firstly, researchers validate the module. The module was validated through the experts' validation, where experts rated the module based on their expertise. The result is then calculated to determine the appropriateness of the module. In this case, there are several aspects measured within the experts' validation, such as the accordance of the module with the syllabus proposed by the Indonesian Ministry of Education, the overall module acceptance, and the characteristic of the media aspect of the module.

Firstly, the accordance of the module with the Indonesian Ministry of Education syllabus was examined. Experts were asked to rate their agreement on certain aspects of the accordance of the module with the syllabus, such as the basic competence within the module, the learning activities carried out, the time allocation, and the learning resources used. The result of the experts' validation of the accordance of the module with the syllabus can be seen in Table 1.

Table 1. Experts` validation on accordance of the module with the curriculum

Indicators	Items	Mean
Basic competence	The basic competencies in the module is in accordance with the applicable curriculum.	5.00
	The alignment of indicators used in the module with the basic competencies.	4.50
	The alignment of competency standards aimed in the curriculum with the basic competencies.	4.50
Learning activities	The written syntax in the demonstrated in the module is accordance with learning activities applied.	4.50
	The learning activities are accordance with the assessment carry out in the module	5.00
Time allocation	The time allocated is appropriate	4.50
Learning resources	The selection of learning resources is in accordance with the learning objectives.	5.00
	Total mean	4.71

Table 1 displays the expert validation on the accordance of the module with the syllabus. It can be seen that the total expert validation was 4.71, indicating the strong agreement of the expert on the accordance of the module with the syllabus. In terms of the basic competences, the experts agree that the module's basic competences are in accordance with the applicable curriculum's basic competences (mean = 5.00); the experts agree that there is alignment of the learning indicator in the module with the learning indicator in the syllabususus (mean = 4.50), and there is alignment regarding the standard competency aim to be fulfilled in the module with the standard competency in the curriculumum (mean = 4.50).

In terms of the learning activities carried out in the module, the experts agree that the syntax of the learning activities written in the module is what is carried out or implemented in the learning activities (mean=4.50), and the learning activities carried out are in accordance with what is measured (mean=4.50). Other than that, the experts agreed that the time allocated in the module is appropriate with what is suggested in the curriculum (mean=4.50), and the learning material selected is in accordance with the learning objective in the syllabus (mean=5.00). Therefore, based on the experts, the module was in accordance with the characteristic of learning suggested by the curriculum.

Secondly, experts were asked to rate the pedagogical aspect of the module. In this case, there are various parts of the module that were examined, such as the material or task contained, the issue raised, the clarity of the learning objective, activities carried out to empower students' critical thinking skills, and the module was supplemented with pictures or illustrations to support the module materials. The result of the experts' validation of the overall module can be seen in Table 2.

Table 2. Experts` validation on the pedagogical aspect of the module

Items	Mean
The module is presented systematically.	5.00
Contains essential material/tasks to empower students critical thinking skill	5.00
The issues raised are appropriate to the students' cognitive level.	4.50
Each activity has a clear objective.	4.50

Table 2 shows the experts' validation or agreement on the pedagogical aspect of the module. The total expert agreement was 4.66, indicating the strong agreement of the experts on the overall aspect of the module. In this case, the experts agreed that the module is presented systematically (mean=5.00), the module contains essentials to support the development of students' critical thinking skills (mean=5.00), the issues raised in the module were appropriate for the students' cognitive level (mean=4.50), the module activities have clear objectives (mean=4.50), the learning activities of the module can foster the students' curiosity, which can empower the students' critical thinking (mean=5.00), and the module includes pictures and illustrations as supplementary material (mean=4.00). Therefore, it can be concluded that the experts agreed on the pedagogical aspect of the module.

Thirdly, experts were asked to rate the media aspect of the module. The media of the module contain the aspects of numbering, font, layout, text, language, sentences, and time allocated. The result of the experts' agreement on the module's media aspect can be seen in Table 3.

Table 3. Experts` validation on the media aspect of the module

Items	Mean
The numbering system is clear.	4.50
The type and size of the font are appropriate.	4.50
The appropriateness of the space or layout.	4.50
The content text of the lesson plan is balanced.	4.50
Using language that conforms to the Enhanced Spelling System (EYD).	4.00
Using simple and easy-to-understand language.	4.50
Using terms that are easy to understand.	4.00
The instructional sentences do not cause multiple interpretations.	5.00
The accuracy of the theory or concept.	4.50
The steps of the activity are in accordance with the syntax of the learning method.	4.50
The time allocation for each activity is stated clearly.	5.00
The appropriateness of the time allocation used in each stage of the demonstration learning process.	4.50
Total mean	4.50

Table 3 displays the result of the experts' agreement on the media aspect of the module. It can be seen that the total mean was 4.50, indicating the strong agreement of the experts on the media aspect of the module. Specifically, the experts were agree on the aspect the clear of the numbering system of the module (mean=4.50), the appropriateness of the size of the font (mean=4.50), the appropriateness of the layout of the module (mean=4.50), the balance of the content text of the module (mean=4.50), the language is conform with the enhanced spelling system (mean=4.50), the language used is simple and easy to understand (mean=4.50), the term used is easy to understand (mean=4.00), the instructional instruction is not redundant (mean=5.00), the accuracy of the theory contained in the module (mean=4.50), the syntax activities is accordance with the learning method (mean=4.50), the time allocated for each learning activity is clear (mean=5.00), and the time

allocation in each stages is appropriate (mean=4.50). Therefore, it can be stated that the experts were in agreement on the module media aspect.

As explained above, experts validated the module in three aspects, namely the accordance of the module with the curriculum, the pedagogical aspect of the module, and the media aspect of the module. Based on the result, experts agreed on the three aspects of the module measured, namely, accordance with the curriculum with the total mean of 4.7, the pedagogical aspect of the module with the total mean of 4.66, and the media aspect of the module with the total mean of 4.50. The conclusion of the experts' validation can be seen in Table 4.

Table 4. Conclusion of Experts` Validation

Aspect measured	Items	Mean
Accordance with curriculum	4.71	Very valid
Pedagogical aspect	4.66	Very valid
Media of the module	4.50	Very valid

The influence of the module on students` critical thinking

After validating the module, researchers check or examine the influence of the module on students' critical thinking skills. In this case, researchers want to understand how the module can drive or guide students to empower their critical thinking skills. To do that, researchers conduct observations throughout the learning activities implemented based on the module. A total of 10 students were observed. They were observed and rated with the five Likert scale in several aspects (1 = very poor, 2 = poor, 3 = fairly good, 4 = good, 5 = very good). The result of the observation can be seen in table 5.

Table 5. The Observation result

Student	Ability to formulate question					Ability to analyze arguments					Ability to clarify concept by asking and answering questions.					Ability to do observations and evaluating observation reports.					Ability to draw conclusions and evaluating the outcomes.					Ability to formulate inductions and evaluating them				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
S1		√							√					√					√				√								√
S2					√					√					√				√						√				√		
S3				√				√						√						√					√				√		
S4										√					√				√					√						√	
S5					√				√						√			√					√								√
S6					√					√					√					√					√						√
S7				√					√					√				√						√							√
S8					√				√						√					√					√					√	
S9			√							√					√				√					√					√		
S10					√					√					√					√			√								√
Total	-	1	1	2	5	-	-	1	4	5	-	-	-	3	7	-	-	2	4	4	-	-	3	4	3	-	-	2	3	5

Table 5 displays the result of the observation report on ten students with six critical thinking skill indicators. Based on the indicator, it can be reported as follows: the first indicator was about the students' ability to formulate questions. In this case, a total of five students were categorized as very good, two students were categorized as good, one student was categorized as good, and one student was categorized as poor. It shows that the majority of students were able to formulate the question throughout the learning with the module. The second indicator was about the students' ability to analyze arguments. In this case, a total of five students were categorized as very good, a total of four students were categorized as good, and one student was categorized as fairly good. Therefore, it can be concluded that the overall students were able to analyze arguments. The third indicator was about the students' ability to clarify concepts. In this indicator, a total of seven students were categorized as very good, and a total of three students were categorized as good. Therefore, it can be concluded that the majority of students have the ability to clarify concepts. The fourth indicator was about the students' ability to do observation and evaluate the observation report. In this indicator, a total of four students were categorized as very good, four students were categorized as good, and two students were categorized as fairly good. The fifth indicator was about the students' ability to draw conclusions and evaluate the outcome. In this indicator, a total of three students were categorized as very good, four students were categorized as good, and three students were categorized as fairly good.

The sixth indicator was about the students' ability to formulate induction. In this indicator, a total of five students were categorized as very good, a total of three students were categorized as good, and two students were categorized as fairly good. Therefore, it can be concluded that most of the students were able to formulate induction on their own. Based on the sixth indicator of critical thinking skill, most of the students were accomplished or attained this indicator. Therefore, it can be concluded that the module was able to drive students in the activities of critical thinking skills.

Discussion

The current research aims to validate the problem-based learning module based on local wisdom material and examine its impact on elementary school students' critical thinking skills. On the validation aspect, the current research found that the module was appropriate in terms of the accordance of the module to the curriculum, the pedagogical aspect of the module, and the media aspect of the module. The accordance of the module with the current Indonesian curriculum is significant as it confirms that the module was the prolongation of the Indonesian curriculum objective. In this case, one of the objectives of the Indonesian curriculum is to promote material that is culturally relevant and inserted in the academic and non-academic activities (Senatama, 2023). Other than that, the current Indonesian curriculum emphasizes the students' critical thinking. As stated by Pasaribu (2023), the Indonesian curriculum intends to strengthen the students' critical thinking, as it is seen as the most important trait in the current rapid development of the globalization era. In this case, teachers are asked to implement learning activities that not only impart knowledge but also cultivate students' capabilities to think critically so they can engage in a real-life problem and foster inquiry (Nawawi, 2017). This is where the current module validated its importance, as the current module can be the medium that can support the learning implementation aimed at by the Indonesian curriculum.

The capabilities of the current module to support the Indonesian curriculum purpose manifest within the pedagogical aspect of the module that empowers the students' critical thinking development. For example, the experts agreed that the current module contained essential material to support the students' critical thinking development by being able to foster curiosity among students. It is because when the students are curious, they are more likely to engage in a deeper learning process, shown by their willingness to question, explore, and practice (Nurdiana et al., 2023). Another strategy on how the module can cultivate the students' critical thinking is by providing the supplementary material in the form of pictures and illustrations. Imami (2021) stated that the supplementary material is a prerequisite to trigger the students' critical thinking; students can analyze the supplementary material, relate it to other contexts, or even compare it to other concepts. Other than that, the module was made to make sure the material provided in the module is in accordance with the elementary school cognitive level. It is important since when instructional materials are tailored to complement children's cognitive styles, it significantly enhances their learning experiences and outcomes. For example, Arnup et al. (2013) demonstrate that presenting information in ways that align with students' cognitive styles can lead to improved performance across subjects, fostering increased enjoyment and engagement as a consequence of tailored learning experiences. It can make the process of cultivating the students' critical thinking easier and run smoothly.

In terms of the influence of the module on elementary school critical thinking skills, the current research confirms that the students were directed to the abilities of critical thinking in six different ways. For example, the current research confirms that the students had the ability to formulate questions, analyze arguments, clarify concepts, make observations, evaluate the results, draw conclusions, formulate inductions, and evaluate them. Literature indicates that these aspects were part of the critical thinking. For example, Arif (2024) explains the characteristic of critical thinking as the ability to do exploration of supporting evidence, such as the ability to ask pertinent questions to guide further analysis and understanding. In terms of the ability to analyze arguments and clarify concepts, Waruwu et al. (2023) explained that the ability to interpret and analyze cases in the discussion is a part of students' critical thinking criteria. Doing observation and evaluating the result are also claimed as part of critical thinking. Hidayah et al. (2017) stated that the capacity to observe effectively helps to a deeper comprehension, which is essential for making appropriate judgments and decisions. Other than that, evaluating results entails analyzing the credibility of findings and their relevance to the questions addressed, emphasizing the need for effective critical thinking processes (Abdulah et al., 2023). Furthermore, the formulation of inductive reasoning is integral to critical thinking, allowing individuals to generalize from specific instances to broader principles. Saiz & Rivas (2023) demonstrated that critical thinking promotes cognitive functions such as analysis and inference, which are necessary for forming solid conclusions. Thus, inductive reasoning becomes a method via which learners can apply their ideas across diverse settings,

strengthening both their critical thinking and problem-solving capacities (Syahputra & Nasution, 2018).

The above paragraph explains the indicators of students' critical thinking in this research. The current research found that the problem-based module based on local wisdom material was able to drive students to have these indicators. It might have happened for several reasons, such as the contextual material within the module making the abstract type of material more tangible and relatable for students. According to Hikmawati et al. (2024), incorporating local wisdom into the learning environment helps students comprehend content by connecting academic concepts to their life experiences. This link helps students to engage more fully with the topic, which improves their critical thinking skills. When students face real-life difficulties rooted in their cultural contexts, their critical thinking skills are tested as they evaluate evidence and reach educated decisions based on actual obstacles (Cahayu et al., 2024). Moreover, the current material was related to natural and social science education. Elvianasti et al. (2023) explained that the natural science material formulated within the local wisdom material enriches the students' comprehension by grounding scientific inquiry in local contexts. It makes the material more practical for students. For example, when students learn about ecological systems or biological processes in their immediate environment, they understand how science may be used in their daily lives. This relationship helps students understand the significance of scientific topics, which encourages inquiry and improves critical thinking skills. Furthermore, a central feature of problem-based learning is its focus on authentic problems drawn from students' local environments. According to Adnyani & Suniasih (2023), the problem-based learning paradigm efficiently improves critical thinking skills by encouraging students to cope with real-life challenges. Moreover, integrating local wisdom with PBL supports students in making connections between scientific concepts and their everyday experiences. This alignment is crucial, as Sari et al. (2023) emphasize the need for learning materials that link educational content with local products and issues, which enhances student engagement and motivation—vital components for critical thinking development.

Conclusion

This research aimed to validate a problem-based learning module grounded in local wisdom and to examine its influence on elementary school students' critical thinking skills. Using a mixed-method approach, the study involved expert validation and classroom observation. Two experts evaluated the module's appropriateness in relation to the syllabus, pedagogical aspects, and media characteristics. The module received high validation scores: 4.71 for syllabus alignment, 4.66 for pedagogical quality, and 4.50 for media characteristics, indicating a strong agreement among experts on its suitability for classroom use. Furthermore, observations involving ten students revealed that the module effectively enhanced critical thinking skills. Most students demonstrated the ability to formulate questions, analyse arguments, clarify and respond to issues, conduct observations, evaluate information, draw conclusions, and formulate and assess inductions. These findings confirm that the validated module not only aligns with curriculum requirements but also positively influences students' critical thinking development through active, problem-based learning rooted in local wisdom.

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All authors involved in this research

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Conflicts of Interest
The authors declare no potential conflicts of interest.

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