

## Validity of the Content of Science E-Module Based on Problem Based Learning Containing Ethnoscience to Improve Students' Critical Thinking Ability

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**Abstract.** Biodiversity ecology and ethnoscience are materials that are considered difficult to understand because they have to relate abstract material to the problems of everyday life and also the culture/beliefs of a region. Interactive teaching materials play a role in increasing student's understanding and improving their critical thinking abilities. This research aims to produce interactive teaching materials based on electronic modules that are valid to use as learning media. This research employs a descriptive qualitative approach for data analysis. The content validity in this research includes media validity, material validity, learning expert validity and language validation which have been validated by expert validators and practitioners according to their fields. Aspects measured for media validation include learning unit presentation techniques, presentation completeness, e-module size, cover design, and learning unit content design, while material validity includes aspects of material completeness, material breadth, material depth, material accuracy, and up-to-date and contextual. Learning expert validation includes content, strategies, learning evaluation and assessment. Linguist validation includes straightforward, communicative, dialogical, and interactive, suitability for student development, language and slides or icons. Based on the research results, the average validity test for material was 0.89, media was 0.90, learning expert was 0.94 and language was 1.00, these four validations can be stated to be included in the valid category. It was concluded that the science e-module is suitable for use as a learning medium based on Problem Based Learning and containing ethnoscience to improve students' critical thinking skills on ecology and biodiversity material.

**Keywords:** Science e-module, problem based learning, ethnoscience, critical thinking

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## Introduction

Student teaching materials are designed to build a new paradigm in the education system that focuses on helping students orientate towards developing soft skills and student character (Pratiwi et al. 2021). One of the 21<sup>st</sup> century abilities that is still prioritized and integrated into science education is the ability to think critically (Prafitasari et al. 2021). Students are expected to be able to respond to changes by using their abilities and utilizing information aimed at solving a problem with the solution obtained.

Critical thinking skills (CTS) are important for students to master as skills that are useful in everyday life, with CTS students can survive in facing the future and care more about the surrounding environment (Zhong and Cheng 2021; Marangio et al. 2024). Apart from that, CTS also help students in academic achievement and open up future career opportunities (Bellaera et al. 2021; Hart et al. 2021).

The 21st century includes (CTS, collaboration, communication, creativity, citizenship/culture, and character education/connectivity) also known as 6C 6C (Esquivel et al. 2022) which has a major role in developing the independent learning curriculum in Indonesia. This ability involves critical thinking, collaboration, communication, creativity, understanding of citizenship and culture, as well as character formation and connectivity. Research conducted by Nadiroh et al (2021) examined prospective teachers at Jakarta State University, especially during the implementation of the 21st century curriculum in Indonesia. The results of this research show that among the six 6C skills, critical thinking is the most challenging for teachers to master. Several factors cause critical thinking to be the most challenging part for teachers to achieve. These CTS involve the ability to access, analyze, and integrate information. The combination of these critical thinking abilities will later produce a person who has strong critical thinking abilities (Nadiroh et al. 2021; Murnaka & Sulistiawati 2023).

As for the problems that make the learning process less than optimal, based on the results of a preliminary study conducted in October 2023, at one of the State Madrasah Tsanawiyah schools in Madiun Regency, it shows that the use of technology to improve learning media has not been implemented optimally. This is because teachers do not really master various technologies, especially in the use of e-modules in learning and are supported by students' critical thinking abilities obtained with an average of 36% declared in the low category. Another case study focuses on students' CTS, which are still minimal due to several factors including : lack of student involvement in learning caused by monotonous learning models, minimal student involvement in learning activities, teachers' teaching methods are less varied, learning only relies on students' textbooks. Apart from that, the lesson material also does not cover local culture and traditions, so it needs to be reviewed more deeply to increase student participation and interest in learning, as well as increase student understanding in the local cultural context.

The problem is supported by the 2018 results showing that Indonesia obtained 309 points in the PISA survey, a figure far below the OECD average score of 489. As a result, Indonesia was ranked 70th out of 78 participating countries (Avvisati, et al., 2019). Judging from the data analysis, it can be concluded that Indonesian students' critical thinking abilities are relatively low. This assumption arises because students in Indonesia experience difficulties in answering PISA questions which are designed to test the skills of critical analysis, evaluation and interpretation of information (OECD 2019).

Limitations in students' critical thinking abilities and less than optimal use of media indicate the need for the development of appropriate and effective learning media. Learning media is anything that can be used to convey lesson material from teaching materials to students by teachers (Puspitarini & Hanif 2019). Media can stimulate students' thinking, emotions, attention and interest in learning, thereby increasing the effectiveness of the learning process (Zeng et al. 2020; Putri et al. 2024). The better the learning media used by students, the more effective the learning process will be. Therefore, teachers must have the ability to select and assess media that are considered effective and suitable for use by students. Based on the problems, innovation is needed in science learning. One of the effort to improve the quality of learning is by developing learning media that can train students' CTS by connecting concepts, optimizing the potential of the environment as a learning resource and enabling meaningful learning experiences (Yunus 2019; Alika & Radia 2021; Lin et al. 2024).

Problem based learning (PBL) is a learning model that uses contextual problems in

everyday life so that students can learn to improve students' CTS (Ismail et al. 2018; Monalisa et al. 2019; Saputra et al. 2019). Therefore, the PBL model is also used to encourage students to develop their own understanding through a learning process that involves the integration and connection of several areas of knowledge in real situations of everyday life (Ulger 2018; Maulidiya & Nurlaelah 2019; Aufa et al. 2021)

One approach that can support the PBL model to improve students' CTS is using the culturally responsive teaching (CRT) approach (Reynolds 2018). The CRT approach is a teaching method that respects and accommodates cultural diversity in the classroom environment (Chuang et al. 2020). CRT recognizes the existence and importance of culture in students' lives, incorporates elements of this culture into the school curriculum, and establishes significant connections with community culture (Ebersole et al. 2016). The aim of the CRT approach is to empower children and adolescents by utilizing relationships that have cultural values to teach academic aspects, social knowledge and attitudes (McKoy & Lind 2022).

Students' low critical thinking abilities can be overcome by learning that links their cognitive knowledge and ideas with newly acquired information (Sholahuddin et al. 2021). The background to these problems is that efforts have been made to integrate ethnoscience as a material approach to learning (Dewi et al. 2019). Ethnoscience and education are a unity that is seen as able to bridge the understanding of students from various cultural backgrounds which refers to the understanding of modern science (Suciwati et al. 2021; Wahyuni et al. 2023). The integration of science knowledge and local wisdom contexts has not been widely implemented by teachers in East Java province, especially in Madiun. In fact, Madiun has a variety of cultural diversity that can be implemented into learning content such as appropriate technology, traditional food/drink products, traditional ceremonies, arts, and traditional beliefs in the local area (Kasi et al. 2021).

Research conducted by (Dwi, 2022), shows that the frequency of ethnoscience studies in East Java is still low compared to other regions in Indonesia. Research by (Zidny et al. 2020) shows that using an ethnoscience approach in science lessons can improve students' CTS in solving problems and broaden students' understanding of natural science from various perspectives in addressing sustainability issues. Elements of local wisdom in education can increase student motivation and learning motivation (Zubaidah and Arsih 2021). The research aims to produce problem-based learning (PBL) media that is based on ethnoscientific values, with a focus on content validity and empirical validity. This development is expected to guide students in building knowledge independently and in groups through PBL that integrates local wisdom, so as to get feedback to improve students' CTS.

It is hoped that with the development of PBL-based e-modules (digital modules) containing ethnoscience (Prosser & Kromer 2023), it can make learning more interactive so that it can enable students to focus more on the material presented, in accordance with the PBL model (Zubaidah & Arsih, 2021; Wulandari, 2022; Fahrudin et al., 2023; Bogar et al., 2024). It is hoped that it will be able to improve students' CTS so that they can also increase effectiveness in learning, especially science (Nelson-Barber et al., 2023). Systematic development of e-modules equipped with characteristics that guide students to learn independently, so that it is hoped that it will be able to support students to be more interested in learning with material that is still considered difficult and boring. It is hoped that the application of local wisdom in learning natural sciences will later help to improve the quality of student character and introduce students more widely to the local culture of their region.

## Methods

The type of data analysis technique in this research used qualitative research. Qualitative descriptive research is a method that involves collecting data to study and support discussions of other research findings (Kriyantono 2022). This research aimed to produce content validation in Science E-Modules based on PBL containing ethnoscience including: media validation, material validation, learning expert validation and language validation. This research was located at MTsN 1 Madiun and MTsN 2 Madiun involved with 2 classes at each school. The research consisted of an experimental class and a control class with a total of 124 class VII students for the 2024 academic year.

This research consisted of several stages, namely: initial analysis, preparation of content validation sheets, and content validation results. The analysis stage begun with observations during learning, interviews with science teachers and students, analysis of CTS, and preliminary studies. The analysis stage was carried out by analyzing theoretical gaps in the field related to the use of science media in learning, followed by analyzing media development needs and the limitations involved in the product development process. General steps in the analysis stage included validation of performance gaps, setting instructional objectives, analyzing students, identifying available resources, selecting appropriate strategies, and preparing a management project plan (Branch 2009; Putri Weldami and Yogica 2023).

The stage of preparing the validation sheet is carried out in the product being developed which then was validated with lecturers/practitioners according to experts in their fields to assess the validity of the content of the learning tool components. The research instrument was then developed based on previous instruments which were adapted and adapted to the researcher's needs. Validators provided input and suggestions to be used as a basis for improving product revisions until they are declared suitable for implementation in learning (Branch 2009; Shakeel et al. 2023). The data analysis technique used qualitative descriptive analysis techniques including: content validity used in the form of media validation sheets, material validation sheets, learning device validation sheets and language validation sheets.

Before an instrument is used in a preliminary study, it must pass a validation stage to ensure that it can reliably measure critical thinking. The validation process was carried out by 8 experts consisting of 3 science teachers and 5 lecturers. Validation uses 4 ratings with 8 raters. This statement is declared valid for use after revision according to the validator. The following are the criteria for assessing the validity of learning tools as follows in Table 1.

**Table 1.** Validity interpretation

Correlation coefficient	Validity Criteria
0.81 – 1.00	Very Good
0.61 – 0.80	Good
0.41 – 0.60	Good enough
0.21 – 0.40	Not good enough
0.00 – 0.20	Very Low

(source: Arikunto, 2010)

## Results and Discussion

### Initial Analysis Stage

The initial analysis stage carried out was observation during learning, interviews analyzing the needs of science teachers and students, then pre-research was carried out with analysis of critical thinking ability tests with a population sample of 15 students who

were members of a group with different levels of academic, financial and emotional support. different according to high, low and medium academic abilities. According to (Gay et al. , 2009) the use of this sample is limited to a minimum of 10% of the population and a minimum of 20% of a relatively small population.

The research results show that students' ability to think critically is included in the low category because the percentage of students with CTS is only 38%. This is supported by analysis of interviews with teachers to obtain several conclusions regarding learning activities. This includes: (1) teachers teach using conventional methods, (2) the use of school facilities is not yet optimal to improve learning activities, (3) teachers sometimes still have difficulty in determining media and methods during learning, (4) students who are less motivated in learning science due to the monotonous nature of learning (5) the lack of use of technology to improve learning activities and (6) the lack of learning activities that can help students to develop CTS.

Science e-module based with PBL containing ethnoscience is designed to facilitate students in learning science at school and at home, so that students can learn more easily and flexibly. The Science e-module based with PBL containing ethnoscience is expected to meet the needs of teachers and students to be able to carry out learning. Integrating a Science E-Module based on PBL containing ethnoscience helps students learn to analyze and solve problems in everyday life. The design of a science e-module based on PBL containing ethnoscience aims to facilitate students' CTS in science learning.

### **Content Validity Preparation Stage**

Preparation of e-modules that combine material analysis, media analysis, learning tool analysis and language analysis which is supported by media validation sheets, material validation sheets, learning tool validation sheets and language validation sheets which will later be validated by validators according to experts. Ecology and biodiversity material includes chapters related to environmental damage which is a problematic topic in this research, which is the main focus of this chapter. Furthermore, the focus material on this issue is linked to local culture/local beliefs which are related to the field of science (Laksmana 2022; Sudrajat 2023). This course is concerned with discussing one of the 6 dimensions of the Pancasila profile, namely, critical reasoning. As is also related to local cultural wisdom inherent in the local area, it is supported in the strengthening pancasila student profile project (P5) dimension (Gustianingrum et al. , 2023; Rahmawati et al. , 2023). Apart from that, at this stage a design module design will also be produced which will be developed.

The development in this research resulted in an ecology and biodiversity e-module based on PBL and containing ethnoscience intended for SMP/MTs students with material on ecology and biodiversity. This IPA e-module is made with an electronic module design which has advantages. Each stage of the science e-module is adapted to an interesting PBL *model* compared to the student's science textbook. The following is the cover design for the science e-module which has been designed according to the theme and material of ecology and biodiversity as shown in Figure 1.



**Figure 1.** The cover of e-module

Student learning activities refer to the syntax of the PBL stages including: orienting students to problems, organizing students to research problems, guiding students' investigations independently or in groups, developing and presenting work results, analyzing and evaluating the problem-solving process. At the analysis stage, students are faced with a group LKPD assignment where students are faced with problems that exist around them and are related to local culture. By being faced with a problem, students learn and improve students' CTS. The following is a design explanation of the ethnoscience approach to the science e-module which has been explained and designed to make it easier for students to understand the material as shown in Figure 2.

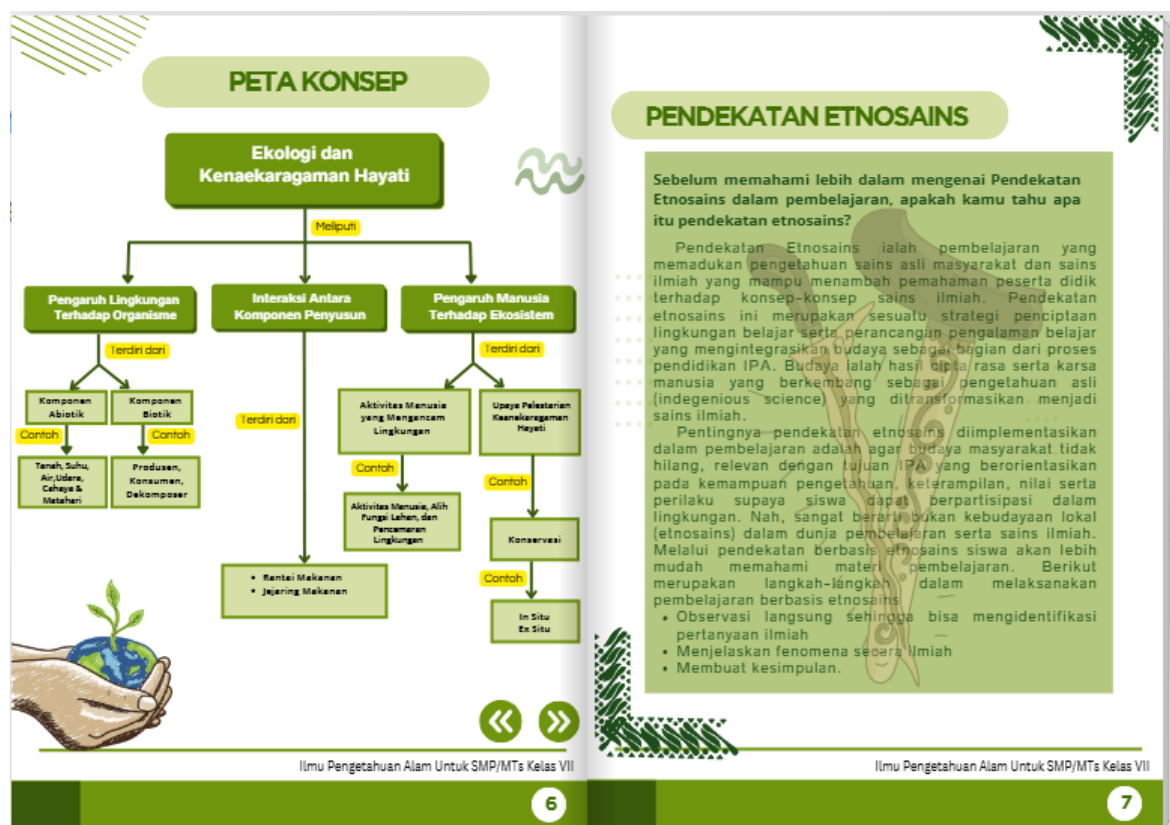


Figure 2. Ethnoscience approach

**Content Validation Results**

Science e-module based with PBL containing ethnoscience were developed integrated with ecology and biodiversity material. After the science E-module has been developed, the next stage is the development stage. The science e-module based with PBL containing ethnoscience that is developed must be validated first by a validator who is an expert in the field. Below are 4 results of e-module validation based on PBL and containing ethnoscience on ecology and biodiversity material which included with validation of media and material experts, learning and language experts. The following can describe the results of the media validation test which are presented in Table 2.

**Table 2.** Media validation test results

No	Aspects	Average Score	Conclusion
1.	Presentation techniques of learning units	0.88	Valid
2.	Presentation equipment	0.89	Valid
3.	E-module size	0.91	Valid
4.	Cover design	0.89	Valid
5.	Design of learning unit content	0.90	Valid
Average Score			0.90



Based on Table 2, shows that there are 5 aspects of media validation including learning unit presentation techniques, completeness of presentation, e-module size, cover design and learning content design equipped with 30 statement items related to media variables which were tested for the validity of media expert assessments on 6 validators. The results of the validity test were then analyzed using 30 items statement items were

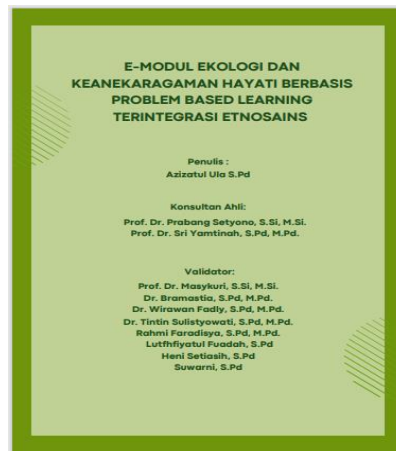
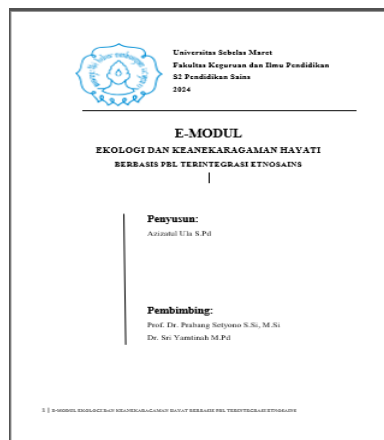
declared valid with an average of 0.90, including in the very high validity category which shows that The e-module is developed in accordance with the model and curriculum used.

The learning unit presentation component obtained an average value of 0.88. This reveals that the E-module was created with systematic consistency in learning activities, logic, sequence and coherence in the presentation including questions, images, videos related to the material which can guide students in answering the questions available in the e-module (Ernica and Hardeli 2019). The completeness of the e-module presentation received an average value of 0.89. This shows that the presentation of the e-module is in accordance with the e-module design criteria and is equipped with an introductory stage at the beginning of the e-module, table of contents, general description, instructions for use to make it easier for students to use the e-module, glossary and bibliography. (Khaira and Andromeda 2020).

The e-module size aspect obtained an average value of 0.91 which was complemented by the suitability of the learning units and the size of the learning content material. The cover design aspect received an average value of 0.89 which was complemented by suitability of the elements of location on the cover, color consistency according to proportions, layout (title, logo, author's name and illustration), suitability of fonts and illustrations. The content design aspect of the learning unit obtained an average score of 0.90 which was complemented by appropriate layout placement, font format and clear and appropriate letter variants. The before and after display of improvements to the subject matter experts on the e-module can be seen in Table 3.

**Table 3.** The results of the improvements made in the science e-module based on input and suggestions from experts in the media are as follows

Before Revision	After Revision
	
<p>The cover of the e-module does not have the word "e-module" added and there is no author title yet</p>	<p>The cover of the e-module has been added with the word "e-module" and there is no author's title yet</p>



The francis page containing the full validator has not been added, and the supervisor's name in the e-module has been replaced with "Expert Consultant"

Therefore, based on the results of media validation, all aspects of valid statement items are in the very high category and can be used as a research instrument to measure the Draft 1 Science e-module for field trials. Input from experts is used as a guide to improve the Science Draft 1 (Revision 1) e-module. Meanwhile, the results of material validation are described in Table 4.

**Table 4.** Material validation test results

No	Aspects	Average Score	Conclusion
1.	Completeness of materials	0.90	Valid
2.	Breadth of material	0.87	Valid
3.	Depth of matter	0.93	Valid
4.	Material accuracy	0.88	Valid
5.	Up-to-date and Contextual	0.89	Valid
Average Score			0.89

Based on Table 4, shows that there are 5 aspects of media validation including completeness of material, breadth of material, depth of material, accuracy of material and compliance with statutory laws, equipped with 19 statement items related to material variables which were tested for the validity of material expert assessments on 6 validators. The validity test results were then analyzed using 19 statement items were declared valid with an average of 0.89, including in the very high validity category.

The completeness aspect of the material received an average score of 0.90 in line with the suitability of the material to the learning objectives. The material presented is in accordance with the learning outcomes, material presented reflects suitability contained in the learning outcomes (CP) and learning objectives (TP), and it is not too broad while remaining focused on the theme used. The depth aspect of the material received an average value of 0.93, in line with the scope of the material used which began with concepts adapted to learning outcomes (CP) and learning objectives (TP). Then, the accuracy aspect obtained an average value of 0.88, which is in line with the problem and what the students are faced with is actually a fact. It is a fact that it is able to help improve students' understanding, the concepts presented do not give rise to double meanings, the principles and theories are in accordance with applicable science (Ula and Fadly 2022) and

are equipped with a sequence of principles and methods used.

In the up-to-date and contextual aspects, an average score of 0.89 was obtained, in line with the suitability of the material which is adapted to the latest science including its application, descriptions of examples and questions are presented attractively, reflecting current events, descriptions of examples and questions are presented interestingly, reflecting culture based on daily experience, as well as the description of the examples and questions presented can open students' insight into maintaining and preserving resources, so that attractive material design in the E-module can foster students' motivation to learn and understand the material (Triana et al. , 2021). The appearance before and after the improvement on the e-module material can be seen in Table 5.

**Table 5.** The results of the improvements made in the science e-module based on input and suggestions from experts in the material are as follows

Before Revision	After Revision

In the concept map, there are no links between each table and variable

In the concept map, a link has been added to each table and variable

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In the integration of IPA, it is more appropriate to use the Webbed model than Connected

Added webbed integration model in IPA integration



The image animation on the ethnoscience approach is not in accordance with the traditional ethnoscience theme in Sendang Lawe

The image animation has been adapted to the theme of traditional ethnoscience in Sendang Lawe

Therefore, based on the results of material validation, all aspects of valid statement items are in the very high category and can be used as a research instrument to measure the Draft 1 Science e-module for field trials. Input from experts is used as a guide to improve the Science Draft 1 (Revision 1) e-module. Meanwhile, the results of material validation are described in Table 6.

**Table 6.** Results of the learning expert validation test

No	Aspects	Average Score	Conclusion
1.	Learning Content	0.93	Valid
2.	Learning Strategies	0.93	Valid
3.	Learning Evaluation	0.95	Valid
4.	Evaluation	0.93	Valid
Average Score		0.94	

Based on Table 6. It is known that the 21 statement items related to the learning expert variable include 3 aspects, learning content, learning strategies, learning evaluation and assessment. The e-module design was tested for the validity of learning expert assessments on 5 validators. The results of the validity test were then analyzed that 21 statement items were declared valid with an average of 0.94, including in the very high validity category.

The completeness aspect of the material received an average score of 0.90 in line with the suitability of learning methods, learning objectives, equipped with systematic PBL learning steps, as well as the suitability of learning media which includes instructions in learning so that it can make it easier for students to understand. and using the IPA e-module. The learning strategy aspect received an average score of 0.93 in line with the ease of learning with the suitability of the material, as well as the accuracy of learning referring to tests that have been adjusted to indicators of critical thinking abilities, easy-to-understand sentence structure. The learning evaluation aspect obtained an average score of 0.95 in line with effectiveness during learning, and can improve students' CTS and mastery in solving problems (Aini et al., 2018).

Then, the assessment aspect obtained an average score of 0.93 in line with the activities in the e-module, teachers can obtain students' knowledge and ability scores, the

question presentation is also equipped with supporting instruments such as question grids and assessment rubrics, and the question presentation is based on on indicators of student critical thinking and Bloom's taxonomy C4 and C5. Of course, the higher Bloom's taxonomy is integrated into the questions, the higher the high-level thinking abilities and the resulting results of students' critical thinking abilities will also be higher and better (Aini et al. 2018; Ramdani et al. 2020). The before and after display of improvements in e-module learning experts can be seen in Table 7.

**Table 7.** The results of the improvements made in the science e-module based on input and suggestions from experts in learning experts are as follows

Before Revision	After Revision

The orientation of the problem has not been adjusted to the real problem used in the ethnoscience theme

The orientation of the problem has been adjusted to the real problem used in the ethnoscience theme



Learning material in the e module does not have science integration



The learning of the material in the e module of science has been integrated with the integration of science in the concept of science

Therefore, based on the media validation results, all valid statement items are in the very high category and can be used as a research instrument to measure the science e-

module draft 1 for field trials. The input from experts is used as a guide to improve the Science e-module Draft 1 (Revision 1). Meanwhile, the results of language validation are described in Table. 8.



**Table 8.** Language validation test results

No	Aspects	Average Score	Conclusion
1.	Businesslike	1.00	Valid
2.	Communicative	1.00	Valid
3.	Dialogical and interactive	1.00	Valid
4.	Adaptability to student development	1.00	Valid
5.	Language compatibility	1.00	Valid
Average Score			1.00

Based on Table 8, shows that there are 5 aspects of language validation including: straightforward, communicative, dialogic and interactive, suitability to student development and suitability to language, equipped with 9 statement items related to language variables which were tested for the validity of linguist assessments on 3 validators. The results of the validity test were then analyzed of the 9 statement items are declared valid with an average of 1.00, included in the very high validity category. This is supported by (Arisandy et al. 2019) who state that language is an important aspect and must be paid attention to because good and correct language will make it easier for students and readers to understand an explanation given.

Language validation includes straightforward aspects which obtain an average score of 1.00 in line with the effectiveness of the sentences used, the suitability of the standard terms used according to function so that it can make it easier for students to understand ecology and biodiversity material (Triana et al. 2021). The communicative aspect received an average score of 1.00 in line with the ease of understanding the message or information. The dialogic and interactive aspects which received an average score of 1.00 are in line with the e- module being able to motivate students and encourage students to think critically. The aspect of suitability of student development which obtained an average score of 1.00 is in line with the suitability of students' intellectual development. The aspect of appropriateness of language rules which received an average score of 1.00 is in line with grammatical accuracy and spelling accuracy used in the science e-module. Then the aspect of using terms, slides or icons which received an average value of 1.00 is in line with the use of correct and unchanging terms and the correct use of slides or icons. The before and after display of improvements in e-module language can be seen in Table 9.

**Table 9.** The results of the improvements made in the science e-module based on input and suggestions from experts in language are as follows

Before Revision	After Revision
 <p>The title of each chapter still uses the question sentence</p>	 <p>The title of each chapter no longer uses a question sentence</p>

 <p>In ethnoscience info, explanations are too long-winded and lack of focus on the problem</p>	 <p>In ethnoscience info, the explanation directly focuses on the problem</p>
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Based on the results of the validation of Table 9, it can be concluded that all valid statement items are in the very high category and can be used as a research instrument to measure the science e-module draft 1 for field trials. The input from experts is used as a guide to improve the Science e-module Draft 1 (Revision 1).

The product presented in the form of a science e-module based on PBL has succeeded in improving students' CTS, namely, through validation carried out by several experts with valid criteria with suggestions and input. Apart from that, the average results of media validity are included in the very high category, namely 0.90, the average results of material validity are included in the very high category, namely 0.89, the average results of the validity of learning experts are included in the very high category, namely of 0.94 and the average language validity is also in the high category of 1.00.

Science e-modules that integrate PBL and ethnoscience offer an effective approach for science teachers. These modules facilitate the development of CTS by engaging students with current cultural issues. Moreover, these modules help students connect scientific concepts to aspects of daily life, making the learning experience more relevant and meaningful. Such methods are recognized as beneficial in educational settings ((Asnidar et al., 2024; Yuliarta et al., 2024)). The science e-module also contains local wisdom that is feasible and effective to be integrated by developing critical, creative and logical thinking skills (Fitri, 2023). Thus, it can be concluded that, the results of validity tests from several validations on PBL based e-modules containing ethnoscience to improve CTS including media and material, learning expert and language validation can be declared feasible with a very high validity category and can be continued at the effectiveness stage.

## Conclusion

The PBL-based science e-module has been validated as an effective tool for improving students' CTS, with high validity scores across media, material, learning, and language aspects. Therefore, the module is ready for further testing on its effectiveness. The research was limited to the Sendang Lawe cultural topic, and future studies could expand this e-module to include other cultural topics in Madiun, such as dongkrek, megengan, ruwatan bumi, and gembrungan. This study contributes to cultural conservation by linking local wisdom with scientific understanding, helping to educate the younger generation about local culture in Madiun.

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