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# e-Modul Ethnophysics for Critical Thinking Skills in the Covid-19 Pandemic

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**Abstract**

This study describes the development of an integrated ethno-physics module for critical thinking skills as supporting teaching materials during the Covid-19 pandemic. The development stages used were the 4D models. These stages included defining, designing, developing, and disseminating. The subjects of this study were material experts, media experts, and 50 students in Melawi Regency. The instruments were expert validation questionnaires, student perception questionnaires, and critical thinking tests. The resulting data are in the form of qualitative and quantitative data. The expert feasibility test uses the average score to the maximum score, while the user practicality test uses the average eligibility percentage. The trial design used was a pre-test and post-test group design. The statistical test used is parametric statistics with the help of SPSS 26. The study results show that the e-module ethnophysics have validly improved students' critical thinking skills. This is shown by the results of validity, practicality, and effectiveness of e-module ethnophysics towards critical thinking during the Covid-19 pandemic.

**Keywords**: ethno-physics, module, physics learning, critical thinking, covid-19

## INTRODUCTION

Critical thinking is the process of deep thinking, analyzing, assessing, and evaluating to identify thoughts, ideas, or assumptions that have rational reasons for problem-solving to reach a logical conclusion (Saputra and Kuswanto 2019). Therefore, critical thinking is the fundament of a series of thinking processes for problem-solving. Critical thinking is a multidimensional construction consisting of cognitive, disposition, motivational, attitude, and metacognitive functions (Miele and Wigfield 2014) to achieve goals in an efficient time (Wechsler et al. 2018). As a result, students will have a broader view, creative solutions, and initiative (Simpson and Courtney 2002; Fahim and Bolghari 2014). This evaluation can be measured by the critical thinking aspect developed by Ennis (Ennis 2011).

The critical thinking ability of students in Indonesia is still relatively low (Arini and Juliadi 2018; Priyadi et al. 2018; Farcis 2019; Safitri et al. 2021; Sundari and Sarkity 2021). Students still have difficulty completing their physics calculations but cannot relate the physics concepts to the actual situation (Priyadi et al. 2018) and have not been able to draw conclusions and provide follow-up explanations (Sundari and Sarkity 2021). Therefore, it is still necessary to improve the critical thinking skills of students in Indonesia, especially in learning physics.

One of the efforts that can be made to improve students' critical thinking skills is through an ethnoscience-based learning process. It is confirmed by the results of a study conducted (Aji 2017a) that ethnoscience-based learning can improve students' critical thinking. Ethnoscience-based learning aims to help students recognize the relationship between humans and nature with the cultural background of the surrounding environment (Zidny, Sjöström and Eilks 2020). As a result, students must be aware of the science that exists in the results of culture and the surrounding environment. This awareness is closely related to the mindset of students in problem-solving. Therefore, ethnoscience-based learning is closely related to students' critical thinking skills. It is confirmed by the results of a study conducted (Aji 2017a) that ethnoscience-based learning can improve students' critical thinking.

The scope of ethnoscience consists of many disciplines, namely ethnobiology, ethnochemistry, ethnophysics, ethnomathematics, ethnopharmacy, and various indigenous agricultural practices and food processing technologies. Therefore, ethnoscience is related to local perceptions, practices, thinking skills, ideas, and the underlying cosmology in the context of the socioeconomic development process (Abonyi, Njoku and Adibe 2014). This effort can build the community's cultural diversity because of the entry of knowledge to the community through analysis or logical thinking that impacts community adaptation to development (Bacud 2018). This is based on an ethnophysics-based learning process capable of documenting and classifying cultural results, identifying the basic epistemology, and developing and assessing learning strategies (Hewson and Ogunniyi 2011). The application of ethnophysics in learning modules is needed because of proper and effective hybridization, incubation, and continuing education (Bacud 2018; Zidny, Sjöström and Eilks 2021).

In physics, the term ethnoscience is simplified to ethnophysics. The integration of ethnophysics in learning in Indonesia that has been carried out includes discussion materials and studies in the learning process (Derlina et al. 2019), content materials from modules/sources/learning materials (Astuti, Bhakti and Sumarni 2021; Fadilah et al. 2021; Sari et al. 2021; Walid et al. 2022), physics teaching aids (Falah, Ashari and Fatmaryanti 2018), and ethnophysics-based evaluation tests ethnophysics (Derlina et al. 2019). the results of the integration have a major impact on the success of the learning process. This is an excellent opportunity to improve the quality of the learning process in

Ethnophysics learning can improve students' critical thinking during the pandemic, but it isn't easy. This is because the learning process shifts from face-to-face to blended or online. Face-to-face learning is limited to being the most widely implemented learning process in Melawi Regency. This process makes learning less than optimal because students are not used to following it. At this time, students are required to be able to learn independently. The application of ethnophysics in learning can increase self-efficacy (Srijayanti and Derlina 2020) which has an impact on students' independence. Based on needs, teaching materials are needed that to facilitate students in independent learning.

Modules are distinguished from conventional modules and electronic modules. Electronic modules have the advantage of being able to present audio, visual, and audio-visual content that can be combined in one product. Several ethnophysics e-modules that have been developed in physics learning have met the rules of learning modules, are interactive and contain audio-visual content (Haspen, Syafriani and Ramli 2021; Kurniawan and Syafriani 2021), but the results of these studies have not been able to present content that provides experience real following the environment directly. This developed e-module overcomes problems in the form of a lack of direct experience of students in understanding their environmental conditions. So this e-module complements the modules that have been developed by taking data directly from the field, which is associated with the experience of using technology to analyze the motion of objects from the videos obtained. This module not only presents ethnophysics content but also guides students in conducting direct motion analysis, from taking videos to analyzing motion variables from the video. Therefore, this study purposes to development of e-module-based ethnophysics for critical thinking skills as supporting teaching materials during the Covid-19 pandemic.

## METHODS

### Experiment Design

The development stages used were the 4D models. These stages included defining, designing, developing, and disseminating.

#### *Define*

Online learning and blended learning were two initiatives made to improve the learning process during the COVID-19 pandemic. Online learning is generally assisted by the use of video conferencing such as Zoom and Google Meet and Learning Management Systems (LMS) such as Google Classroom or LMS from the institution. Blended learning is done by combining LMS with restricted face-to-face learning. Unfortunately, this cannot be applied in all areas in Melawi Regency. Based on interviews with four teachers located in the sub-districts of Ella Hilir, Manggala, Kota baru, and Sayan in Melawi Regency, it is known that internet coverage is still limited and that some locations have yet to be covered. Therefore, offline learning media is still very much needed to improve the quality of learning in isolated areas in the Melawi Regency.

Therefore, an analysis of the availability of supporting media owned by students was carried out. Technological tools owned by students were in the form of television, radio, computer, and smartphones. The device that students privately own is smartphones. Based on the analysis of smartphone ownership, it is known that 97% of students already own a smartphone. Seluruh siswa (100%) menggunakan smartphone dengan operation system android.

Isolated locations have the advantage of having their own cultural features. Unfortunately, this characteristic is rarely associated with the learning process. Therefore, this module is characterized by the inclusion of cultural elements in the presentation. The ability to link elements of culture and knowledge requires critical thinking skills. This ability trains students in making questions, making observations, organizing interference, making conclusions, and re-examining the conclusions they draw. This analysis was conducted on 20 students at MAN (Islamic Senior High School) Nanga Pinoh in Melawi Regency, West Kalimantan, Indonesia. Based on the results of the disposition analysis of critical thinking skills, it is known that 80% of students have low critical thinking skills.

### *Design*

The product design developed is in the form of an integrated ethnophysics e-module for critical thinking skills. The module being developed is an electronic module with parabolic motion with rohak critical thinking stages. The main content used is text, animated videos, and videos that contain ethnophysics studies and how to conduct direct analysis through tracker analysis.

The media design stage carried out was an android application-based module design because, based on pre-research data, it was known that most students in Melawi Regency used Android smartphone devices. Therefore, the resulting output is in the form of .apk. The layout used is a portrait mode by presenting a simple experience.

### *Develop*

This stage aims to produce suitable products as teaching materials that aid in the learning process. The feasibility of teaching materials is determined by the validity and practicality of the module from the user’s point of view, teachers, and students. The module is said to be valid based on the results of interpreting the percentages of two material experts and two media experts. At the same time, the module is said to be practical, as evidenced by the interpretation of the percentage given by users.

### *Disseminate*

This stage aims to disseminate the developed ethnophysics module. Dissemination of this module is carried out in schools by providing a link on google drive to class X students at MAN Melawi and MA Baitul Quran Melawi. This link is limited to 20 MAN Melawi students and 30 Baitul Quran students. Therefore, the users of this e-module are 50 students.

## Participants

The participants in this study were high school students of class XI MAN Melawi and MA Baitul Quran Melawi. The number of participating students was 50, with a distribution of 20 students from MAN Melawi and 30 from MA Baitul Quran Melawi.

### Instruments

The instrument used in this study consisted of an expert validation questionnaire, a practicality questionnaire, and a critical thinking ability test. The expert validation questionnaire consisted of 29 statements from material expert validation and 11 statements from media validation, while the practicality questionnaire consisted of 18 statements from users. The instrument used to measure effectiveness is a critical thinking ability test. This test consists of 3 questions.

### Data Analysis

The data analysis carried out consisted of expert feasibility, user practicality, and the effectiveness of the resulting e-module. The expert feasibility test uses the average score to the maximum score, while the user practicality test uses the average eligibility percentage.

The module's effectiveness aims to determine the differences in students' critical thinking skills before and after using e-module ethnophysics. The test design used is a pre-test and post-test design. The statistical test used is parametric statistics with the help of SPSS 26.

## RESULTS AND DISCUSSION

The critical thinking integrated ethnophysics module is an electronic module developed from the ethnophysics content of the Dayak tribe in the form of the Rohak principle for parabolic motion material. This e-module has advantages in the form of material content that contains ethnophysics from the Dayak community in the form of spirit-hunting tools with critical thinking steps (Ennis 2011). The integrated ethnophysics module for critical thinking skills is an electronic module developed from the ethnophysics content of the Dayak tribe in the form of the *rohak* principle for parabolic motion. This module has advantages in the form of material content that contains the ethnophysics of the Dayak community in the form of *rohak* as hunting tools with critical thinking steps developed by Ennis.

The e-module component includes cover, instructions, competence, concept maps, learning activities, glossary, formative tests, and feedback. The following are the specifications of the integrated ethnophysics module for critical thinking skills. The cover page features images of the local wisdom of the Dayak tribe, which is equipped with the material to be studied. The splashes screen principle is used on this page, which causes it to dismiss immediately and redirected to the user manual page. The instructions include instructions for using the ethnophysics module and the estimated study time required. In addition, this page is equipped with a "start" button to start learning activities. The menu page consists of competencies, concept maps, learning activities 1, learning activities 2, a glossary, formative tests, and feedback.

This page provides the high school competencies required by the 2017 revised K13 curriculum, which include analyzing parabolic motion using vectors with their physical meaning and application in everyday life and presenting data from parabolic motion experiments and their physical meanings. This page offers the physics concepts involved in parabolic motion. The depiction of the concept is as shown in FIGURE 5.


**FIGURE 1**. Cover


**FIGURE 2**. Instruction

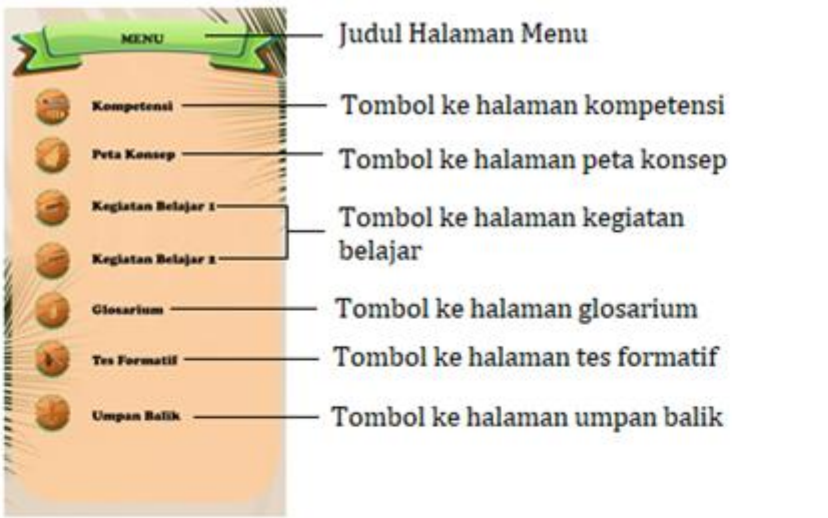


**FIGURE 3**. Menu

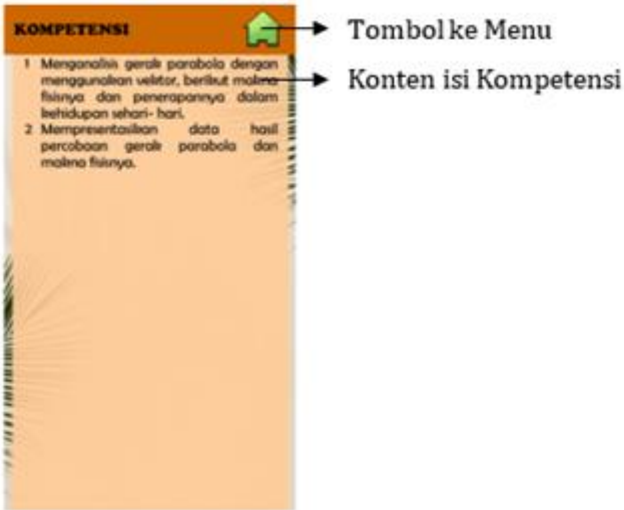


**FIGURE 4**. Competence

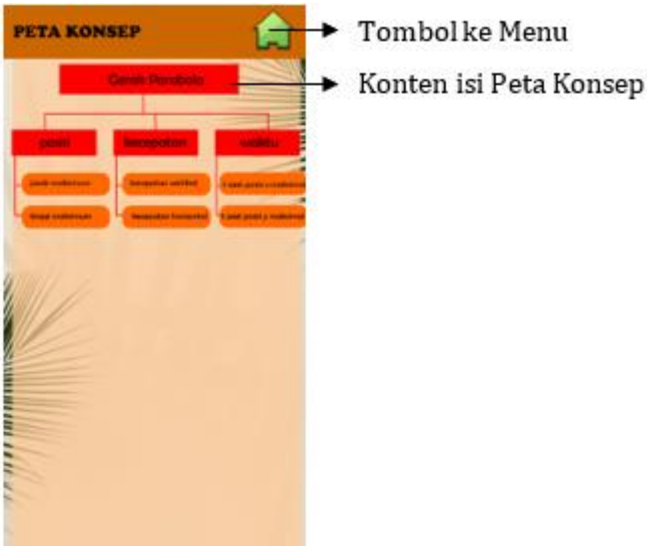


**FIGURE 5**. Concept Maps

Learning activities consist of learning objectives and study materials. Learning objectives describe goals to be achieved after learning. The study material presents four steps of learning activities following Ennis's critical thinking stage: elementary clarification, essential support, interference, and advanced clarification. Rhetorical strategies and techniques are not presented in this module since the module's content is not derived from everyday problems but from cultural peculiarities. This peculiarity is brought up to evoke admiration for the local culture among students in the Melawi Regency. TABLE 1 describes the blueprint in terms of aspects of critical thinking based on the characteristics of *rohak* hunting tools

**TABLE 1**. The Blueprint of Ethnophysics E-Modul for Critical Thinking Skills

| Ennis' Critical Thinking Aspects | The Implementation in the Ethnophysics Module | |
|---|---|---|
| | Learning Activity 1 | Learning Activity 2 |
| Elementary Clarification | Presenting procedures of the use of *rohak* hunting tools and questioning the physical principles (parabolic motion). | Presenting questions about the estimation of *rohak* hunting tools in shooting the prey in terms of physical quantities. |
| Basic Support | Present videos on using PhET simulation and information related to three types of parabolic motion. | Presenting videos of parabolic motions that are analyzed using tracker analysis |
| Interference | Presenting the types and concept of parabolic motion and application | An explanation of vector quantities in the parabolic motion |

| Ennis' Critical Thinking Aspects | The Implementation in the Ethnophysics Module | |
|---|---|---|
| | Learning Activity 1 | Learning Activity 2 |
| Advanced Clarification | Presenting questions that can summarize the learning process or define learning outcomes. | Presenting questions that can summarize the learning process or define learning outcomes. |

The elementary clarification in this module comprises questions that are used as the basis and subject matter to guide in comprehending situations related to *rohak* hunting tools with its physical principles and magnitudes. These questions also contain some information about *rohak* hunting tools and how it works.

Interference is drawing conclusions from learning activities' results and linking them to relevant theories. As a result, the module component of interference includes relevant theories widely recognized by scientists. This activity aims to clarify the results of the practicum carried out with the basic theory.

Advanced clarification is an activity to check students' ability to understand learning related to problems or daily life


**FIGURE 6**. Lesson Page

## Glossary

The glossary presents a list of physical terms for parabolic motion and their definitions in alphabetical order.

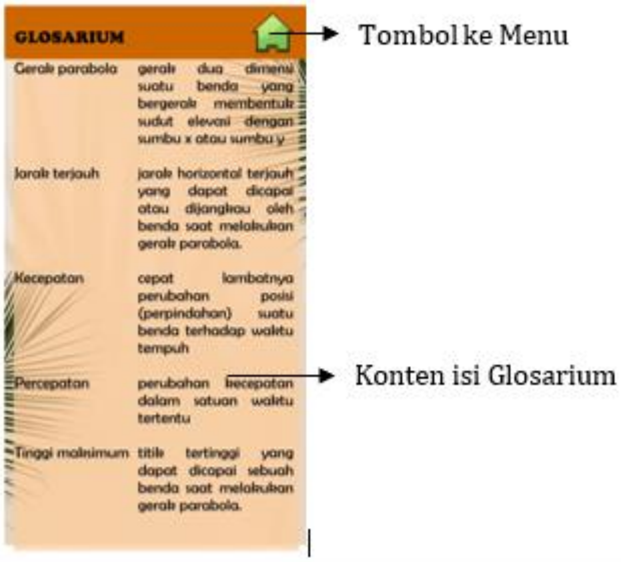


**FIGURE 7**. Glossary Page

## Formative Test Page

This page contains exercises to measure success in learning.

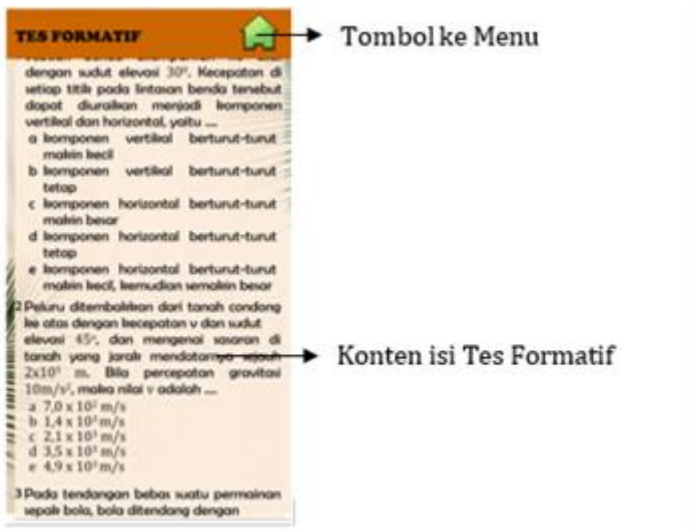


**FIGURE 8**. Formative Test Page

## Feedback Page

The feedback contains the answer keys of the formative tests and their scoring guidelines.


**FIGURE 9**. Feedback

## Expert Validity

The integrated ethnophysics module for critical thinking skills was validated by two material experts and two media experts. Aspects of the material developed were subject matter, learning, and language. Based on the material experts, the average score was 33.67 and was classified as feasible. The aspects of media consist of usability testing and presentation/graphics. The media expert assessment showed an average score of 19 and was categorized as feasible.

**TABLE 2**. Product Validity from Experts

| Aspects | Sub-aspect | Score Maks | Score | Conclusion |
|---|---|---|---|---|
| Material | Subject matter | 48 | 43 | Feasible |
| | Learning | 28 | 24 | Feasible |
| | Language | 40 | 34 | Feasible |
| Media | Usability testing | 28 | 24 | Feasible |
| | Presentation/graphics | 16 | 13 | Feasible |

## Practicality

Product evaluation was carried out to test the quality based on student assessments on a limited scale. Based on the results of the limited trial to 20 students, the average score obtained was 80%. The score belongs to the good category. In addition to quality, product evaluation results also receive suggestions and input as the final product revision.

Based on the product analysis, the product is said to be feasible to support the learning process during Covid-19 as this module trains students to work independently. Learning during the pandemic requires students to be more independent in learning. This is strengthened in the Circular Letter of the Minister of National Education and Culture that independent learning aims to provide a meaningful learning experience without being burdened with completing curriculum achievements for grade promotion and graduation (Gusti, Sri 2020). Module integration with technology is an effective new solution in improving learning in the industrial era 4.0. The use of technology can improve physics learning outcomes (Siahaan 2012; Ismail and Gumilar 2019; Affandi, Widyawati and Bhakti 2020). The government has imposed distance and blended learning to overcome the COVID-19 pandemic. In Melawi Regency, the implementation of distance learning tends to be ineffective because most areas suffer from poor internet connection. Therefore, limited face-to-face learning is an effective solution to dealing with these problems.

 

### Effectiveness Test

Field tests are carried out to determine the effectiveness of ethnophysics e-modules on students' critical thinking skills. Based on TABLE 3, it is known that there are differences in students' critical thinking skills before and after the use of the ethnophysics e-module during the 2019 covid pandemic. Presentation of parabolic motion material content, as in general, students feel the influence of motion directly. Parabola on its cultural product, namely hunting wild animals using sapek hunting tools, provides added value in learning activities. Students directly carry out the learning process by taking videos of hunting activities with sape Dayak and analyzing parabolic motion variables. Direct involvement of students in the learning process has a significant impact on student's critical thinking skills (Risdianto et al. 2020; Nurcahyani et al. 2021).

**TABLE 3**. Hypothesis Test

| Class | t table | t count | Conclusion |
|---|---|---|---|
| Pre-test<br>Post-test | 2,045 | 5,812 | $H_0$ rejected |

This learning consists of two learning activities: I and II. In learning activities on I, students are led to understand the general parabolic motion, which is explained in the face-to-face learning process. In learning activities on II, the learning activities carried out include building motivation and appreciation, investigating videos, conducting videos, making a conclusion, and providing further explanations. Learning activities start from introducing direct conditions from using sape Dayak for hunting animals or sports. With this activity, students become closer to the socio-cultural conditions that were almost abandoned. This is necessary because motivation has an important role in students' active participation in the learning process (Risdianto et al. 2020).

The second step is for students to document the video directly. The goal is for students to feel that the learning process is directly related to the culture in their environment. The impact is that students have a concern and the preservation of local culture from the video recording.

The third stage is to analyze the motion variable using the help of tracker analysis software. Tracker analysis software helps students measure existing motion variables from video recordings. Based on the results of this presentation, students can find the quantities that make up the special equations in parabolic motion. Students conduct group discussions to analyze the motion variable and find its special conditions. Students who find their knowledge of existing ethnophysics can build their critical thinking skills (Kurniawan and Syafriani 2021).

The fourth step is drawing conclusions from the parabolic motion equations. This activity is carried out by presenting and comparing the results of each group. The teacher guides the students to conclude the results of the presentation.

The last step, students plan how to play until they can achieve the expected target. Learners recount experiences when recording sape Dayak and predict the success and failure of Sape Dayak when used in hunting and as a means of sport.

Efforts to build effective critical thinking skills by integrating ethnophysics in learning are quite effective. Students' critical thinking skills can be improved through learning that provides direct experience to students (Aji 2017b), one of which is ethnophysics. Many researches on the integration of ethnophysics/ethnoscience in physics learning to improve critical thinking skills have been carried out. Dinissjah, Nirwana & Risdianto using dol music ethnoscience from Bengkulu as a discussion material in physics learning related to interference material and sound intensity levels found that students' critical thinking skills increased with the n-gain category, namely moderate (Dinissjah, Nirwana and Risdianto 2019). Local knowledge in the learning process is needed because it can build students' critical thinking skills (Sakti, Defianti and Nirwana 2020).

Students are required to have a broad view, be able to formulate creative solutions, and have the initiative in solving problems (Simpson and Courtney 2002; Fahim and Bolghari 2014) related to their culture. The step begins with a direct investigation of the culture to the stage of loving and appreciating the local culture. The short-term impact obtained is to maintain the sustainability of cultural products in Indonesia. This is due to problems in the form of cultural products that are being abandoned by the younger generation due to the influence of globalization and modernization (Larasati Zaini 2014; Iban, Subroto and Roychansyah 2015; Sulha 2020). Another goal of the integration of ethnophysics in learning is to realize appropriate and effective crossbreeding between western science and local science, development of curriculum development mechanisms and methods, and continuing education (Bacud 2018; Demssie et al. 2020; Zidny, Sjöström and Eilks 2021). Its long-term impact is that it contributes greatly to technological development in the world depending on the level of the role assigned to it and the opportunities created for its exploration (Adeyeye and Mason 2020).

## CONCLUSION

This e-module ethnophysics is valid for improving critical thinking skills. This is shown from the results of validity, practicality and effectiveness e-module ethnophysics towards critical thinking during the COVID-19 pandemic. The limitations of this study are that the content presented does not contain the native language of the Dayak tribe, students who are the sample have undergone modernization which has the effect of not knowing how to use the spirit hunting tool, feedback from the test still seems manual because students determine their own graduation scores and electronic modules. developed is not interactive enough and does not yet have a special discussion forum for users.

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