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Development of Biotechnology E-Module Loaded with Ethnoscience to Equip Students with Science Process Skills & Science Literacy

Ulfa Cinta Rahmalia✉, Sudarmin Sudarmin, Ellianawati Ellianawati

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Universitas Negeri Semarang, Indonesia

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Abstract

Science learning in Curriculum 2013 emphasises the integration of attitudes, knowledge and skills, especially science process skills which include observation, hypothesis formulation, experimental design, data analysis and communication of results. However, students' science process skills in some parts of Indonesia are still low due to conventional learning methods and lack of local context. This research aims to develop ethnoscience-based biotechnology learning e-modules that integrate local wisdom to improve students' science process skills and science literacy. The research method used Research and Development (R&D) with the 4D model (define, design, develop, disseminate). The e-module was developed using Canva and Heyzine applications with contextualised practicum and ethnovlog content. Expert validation was conducted to ensure the feasibility of materials and media, as well as instrument reliability and question differentiation tests. The results showed that this e-module is feasible to use, practical, effective, and can improve students' science process skills and science literacy. The use of ethnoscience-based digital media provides a more meaningful and contextualised learning experience, supporting increased motivation and learning outcomes.

How to Cite

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✉ Correspondence Author:
E-mail: cinta29rahmalia@students.unnes.ac.id

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INTRODUCTION

Science learning in Curriculum 2013 is developed as an integrative science that integrates attitudes, knowledge, and skills, and emphasizes science process skills (Wafi et al., 2020). These skills include two types, namely basic and integrated (Adirahayu & Wulandari, 2021), which include activities such as observing, formulating hypotheses, designing experiments, analyzing data, and communicating results (Ash, 2020). The benefits include increasing students' independence, effective thinking, and contextual scientific abilities (Saleh et al., 2020; Wafi et al., 2020; Lufia et al., 2019). However, the science process skills of students in several regions of Indonesia, such as SMPN 26 Semarang and SMP Satu Atap Pulau Tunda, are still low (Saleh et al., 2020). This is due to theoretical and conventional learning, which does not involve scientific thinking processes (Adirahayu & Wulandari, 2021). Observations at SMPN 26 and Sudirman Junior High School in Semarang also show that learning is still one-way, despite using technology-based media. Students have difficulty understanding the material because it is not contextualized and interactive (Jiwanjaya et al., 2020; Puspasari et al., 2019).

To overcome this, it is necessary to integrate an ethnoscience approach, namely local culture-based learning that makes science more meaningful and contextual (Puspasari et al., 2019; Erma et al., 2021). Ethnoscience helps students explore the surrounding environment, increase motivation, literacy, learning outcomes, and appreciation of culture (Dwi et al., 2020; Aisyah et al., 2021). This research aims to develop an ethnoscience-filled teaching e-module to equip students' science process skills. This module is equipped with ethnovlog, materials, and practice questions based on the science process. Science literacy, the ability to use scientific knowledge to explain phenomena and make evidence-based decisions (Sutrisna, 2021), is still low in Indonesia. PISA 2018 ranked Indonesia 71st out of 79 countries with an average score of 396 out of 600 (OECD, 2018). This shows the need for learning that involves the process of science and relates it to real phenomena (Wulandari et al., 2023). By linking practicum-based biotechnology and ethnoscience materials, this e-module is expected to improve students' process skills and science literacy (Pratiwi et al., 2018).

This study aims to fill the existing research gap, particularly in integrating science process skills with ethnoscience approach in science learning. Although various previous studies show the importance of science process skills, the application of methods that incorporate aspects of local culture and technology in the Indonesian context is still limited. Most studies focus more on the application of theoretical learning with conventional methods, which results in low science process skills of students. Therefore, the development of ethnoscience-based e-modules that link science materials with local wisdom is an innovation that distinguishes this research from previous studies, and offers a new approach in uniting science and local culture in a learning context that is more contextual and relevant to students. This e-module not only serves as a teaching material that integrates culture and science, but also provides opportunities for learners to apply science process skills in a real context, especially through practicum that is relevant to their daily lives, as expected in the development of science process skills and science literacy in Indonesia (Pratiwi et al., 2018; Wulandari et al., 2023).

The urgency of this research is increasing considering the results of international studies, such as PISA 2018, which show low science literacy in Indonesia, with Indonesia ranked 71st out of 79 countries, and an average score of 396 out of 600 (OECD, 2018). This shows that Indonesian students have not been able to connect the science concepts learned with real-world phenomena, which is an important part of developing science literacy. This research is very relevant because it can help overcome these challenges by creating learning that is more contextual, culture-based, and interactive. By developing ethnoscience-based e-modules, it is expected that learners will not only gain more in-depth science knowledge, but can also improve their science process skills and science literacy. Moreover, this module is expected to facilitate the mastery of skills that are more relevant to current conditions, as well as support national goals to improve the quality of education in Indonesia, which is in line with efforts to improve the quality of science literacy that is still low among students (Wafi et al., 2020; Lufia et al., 2019).

METHOD

This research uses a Research and Development (R&D) approach. This research aims to produce certain products, and test the effectiveness of the products produced (Sugiyono, 2015). This research model uses 4D, while the steps of the 4D model are define, design, develop, and disseminate. The process in this research uses the

4D development model, as for the stages of the research step description as follows.

1. Phase define

This stage begins with a literature study, field observations, documentation, and interviews with teachers and students to identify learning needs and problems. The main objective is to collect initial data relevant to the development of learning media. The analysis includes materials, media, teaching materials, learning resources, student characteristics, interests, facilities, and learning environment. Observation was conducted for three months, during which the researcher also acted as a teacher between times. Documentation was in the form of data on students' science scores, while interviews explored learning experiences and students' needs. The results showed the need for ethnoscience-based electronic media containing practicum material. In addition, the Basic Competencies (KD) and the potential for ethnoscience integration in science materials were analyzed. Based on these findings, the research continued to the design stage to develop ethnoscience-based teaching e-modules.

2. Design stage

At the design stage, researchers designed learning media in the form of ethnoscience e-books that are relevant to the local context. Initial activities include determining the time of implementation, preparing instruments, and selecting typical processed food products in the form of kastengel cookies made from jali flour, which is a local plant substitute for wheat and is usually served in big day celebrations. The e-module design includes analyzing the objectives and characteristics of science materials, learning resources, characteristics of students, as well as determining learning indicators and content. All activities in this stage are systematically organized to support the integration of ethnoscience elements into the learning process.

The development stage is the process of actualization of the design into the form of real products. At this stage, researchers determine the specifications of e-book media that will be developed in the context of ethnoscience-based science learning. Furthermore, the e-book content is designed which includes material descriptions, exercise questions, and vlog videos of fermented food making. The production process includes making and editing videos, as well as preparing evaluation instruments in the form of expert validation sheets (material, media, and language), practicality and effectiveness sheets, and student response questionnaires. Initial validation was conducted by experts to assess the feasibility of the product, and the results were used as the basis for improvement through the review stage. The review activity aims to improve the quality of learning products from the aspects of material, media, and language, based on the input obtained from the validators.

3. Expert validation

The instrument is said to be valid if it is able to measure precisely the variable under study. The validity of the instrument shows the extent to which the instrument is able to reveal data in accordance with the measurement objectives (Sugiyono, 2013). One form of validity used in this study is construct validity, namely validity obtained through expert judgment (judgment experts). This study used Aiken's V validity coefficient to measure content validity, as formulated by Aiken (1985), which assesses the extent to which an item represents a construct based on an expert panel evaluation (Azwar, 2012).

$$V = \sum \frac{S}{[n(C-1)]}$$

$$S = R - Lo$$

Description:

Lo : lowest validity assessment number
C : highest validity assessment number
R : the number given by the assessor

Table 1. Validity Categories based on Aiken's Index V

Agreement Index	Validity Category
0.71-1.00	High
0.31-0.70	Medium
0.00-0.30	Low

(Hsu et al., 2015)

4. Question Item Validity

The tool to test the validation of the question instrument can use the product moment correlation formula, as follows.

$$r_{xy} = \frac{N\sum xy - (\sum x)(\sum y)}{\sqrt{\{N\sum x^2 - (\sum x)^2\}\{N\sum y^2 - (\sum y)^2\}}}$$

r_{xy} = correlation coefficient between x and y
N = the number of subjects/students studied
$\sum x$ = the sum of the scores of each question item
$\sum y$ = sum of total scores
$\sum x^2$ = sum of squares of item scores
$\sum y^2$ = sum of squares of item scores

The results of the calculation of the r_{xy} value obtained are compared with r_{table} using a 5% significance level. If $r_{xy} > r_{table}$, then the item is valid (Arikunto, 2012).

5. Reliability Test

Reliability in an understanding that an instrument is trustworthy enough to be used as

a data collection tool because the instrument is good (Arikunto, 2010: 104). Reliability test of questionnaire items and questions is done with the Cronbach Alpha test. The Alpha Cronbach formula is as follows.

$$r_{11}=\left(\frac{n}{n-1}\right)\left(1-\frac{\sum\sigma_t^2}{\sigma_t^2}\right)$$

Description:
r_{11} : Reliability of the questionnaire
n : Number of questionnaire statement items
$\sum\sigma_t^2$: The total variance of the scores for each questionnaire item
σ_t^2 : Total variance

Meanwhile, to find the variance of the questionnaire item scores using the formula.

$$S_i=\frac{\sum X_1^2-\frac{(\sum X_1^2)}{n}}{n}$$

Description:
S_i : Variance of score of each questionnaire item
$\sum X_i^2$: Sum of squares of X_i items
$(\sum X_1^2)$: The sum of items X_i squared
n : Number of items X_i squared

And the total variance is calculated using formula.

$$S_t=\frac{\sum X_t^2-\frac{(\sum X_t^2)}{n}}{n}$$

Description:
S_t : Variance of score of each questionnaire item
$\sum X_t^2$: Sum of squares of items X_t
$(\sum X_t^2)$: Number of items X_t squared
n : Number of respondents

After r_{11} can be known then compared with r_{table}. If $r_{11} > r_{table}$, then the questionnaire is said to be reliable.

6. Differentiating Power of Question Items

The differentiating power of a question is the ability of a question to distinguish between high-ability learners and low-ability learners. This difference can be seen when more high-ability learners can answer difficult questions compared to low-ability learners (Arikunto, 2012). The number indicating the amount of discriminating power is called the discriminating index, abbreviated as D and ranges from 0.00 to 1.00. To find out the differential power of the description question, the formula (Arifin, 2002) is used as follows.

$$t=\frac{(MH-ML)}{\sqrt{\frac{\sum X_1^2+\sum X_2^2}{ni(ni-1)}}}$$

Description:
MH : average of the upper group
ML : mean of the lower group
$\sum X_i^2$: sum of squares of individual deviations of the upper group (HG)
$\sum X_2^2$: sum of squares of individual deviations of the lower group (LG)
ni : 27% x N
t : critical ratio (discriminating power)

RESULT AND DISCUSSION

The ethnoscience-based approach plays an important role in connecting learning materials with local cultural knowledge owned by students, so that the material taught becomes more relevant and contextual (Puspasari et al., 2019). Ethnoscience refers to the knowledge that develops in a society that includes language, customs, culture, morals, and technology, which often contains scientific knowledge that can support the understanding of nature. By integrating ethnoscience, science learning becomes more holistic and relevant as it creates a connection between learners' cultural knowledge and the scientific knowledge taught at school.

Characteristics of E-Modules and Research Instruments

This research produces development products in the form of electronic teaching devices, namely e-modules. This e-module was developed using the 4D model Research and Development (R&D) method. The development of e-modules refers to the learning guidelines in the independent curriculum. The material studied in the e-module is biotechnology in phase D or equivalent junior high school in class IX odd semester. The coverage of biotechnology material in this e-module includes: 1) Definition of Biotechnology, 2) Difference between conventional & modern biotechnology, 3) Impact of conventional & modern biotechnology.

This research produced e-modules of biotechnology teaching materials designed using Canva and Heyzine applications. This e-module is informative and innovative, with learning content about the latest biotechnology. The e-module includes components such as cover, preface, table of contents, instructions for use, understanding ethnoscience, learning outcomes, learning objectives, and biotechnology materials integrated with ethnoscience.

Supporting content presented in this e-module includes current information, practicum instructions with videos of making innovative

and conventional biotechnology products, and making traditional food. The tasks presented, including analysis of microorganisms in traditional Indonesian food and group work, aim to improve students' understanding of the material, cooperation, and communication. The e-module also engages learners in practicum activities for making biotechnology products, using technology for video recording, and product design, as well as exercises in calculating ingredients and product packaging. In addition, the e-module is equipped with PISA-standard formative and summative exercises to train students' science literacy. The following is cover design e-module in this study.

Figure 1. Cover of Ethnoscience E-module

The ethnoscience-laden biotechnology e-module design integrates biotechnology materials with ethnoscience, such as the manufacture of traditional food processed products and innovative biotechnology products. This integration aims to improve students' science process skills and science literacy. Some of the main components in this e-module include instructions for use, learning outcomes, learning objectives, apperceptions, mind maps, and practicum instructions for making innovative products. Some of the components presented in the e-module can be seen in some of the pictures below.

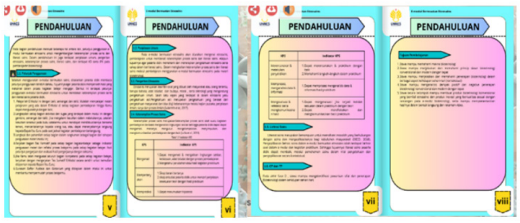

Figure 2. Instructions for Use, Learning Outcomes and Learning Objectives

The instructions for using the ethnoscience-laden biotechnology e-module aim to facilitate students in accessing and using the e-module effectively, either in a guided, group, or independent manner, in order to improve science process skills and science literacy. This e-module was developed based on the independent curriculum phase D science learning outcomes, which include students' ability to identify inheritance of traits and the application of biotechnology in everyday life.

Figure 3. E-module Aperception and Mind Map

The ethnoscience-infused biotechnology e-module comes with an apperception at the beginning to connect the subject matter with the knowledge and experience students already have. After the apperception, there is a mind map that helps students in recording and organizing information by involving both sides of the brain. The use of a combination of colors, symbols, and shapes in the mind map makes it easier for students to remember and understand the material.

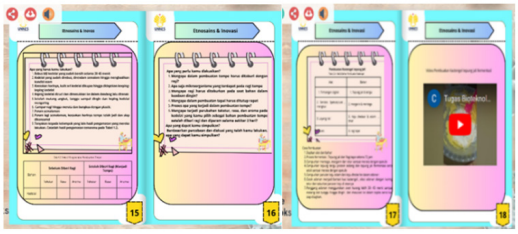

Figure 4. Practical Instructions for Making Innovation Products

The ethnoscience biotechnology e-module is equipped with practicum instructions for making biotechnology products of Indonesian food as well as a table of microorganism utilization in traditional Indonesian food. This allows students to integrate ethnoscience in biotechnology materials. In addition to practicum on typical foods, there are also practicum instructions for making 8 biotechnology innovation products, which provide new information for students. The practicum instructions aim to facilitate students in conducting practicum simulations independently.

The e-module developed is digital-based with a design using the canva application. The canva application is one of the media that can support the learning process visually while developing students' visual literacy skills, an online design application that provides various editing tools to create various kinds of graphic designs (Maulia, 2023). Canva is an online design application that makes it easy for teachers to compile learning media, such as displays, binders, brochures, graphics, banners, invitations, image editing, and many more. Canva makes it easy for

teachers to design learning media and enables the implementation of learning that focuses on skills, creativity, technology, and other benefits (Afianti, 2024). Canva is also a platform that can be accessed free of charge through the Play Store or through its official website. The Canva application offers a variety of attractive design templates, for example for presentations, resumes, creating curriculum vitae, pamphlets, and others (Pratama et al., 2023). After using the Canva application, then the e-module is converted with the Heyzine application.

Heyzine is a platform that offers interactive e-book creation features that can provide a more dynamic and engaging reading experience. Through Heyzine, teachers can convert learning materials into digital form with the ability to add interactive elements, such as hyperlinks, video, and audio, which can increase learner engagement. Heyzine can also be accessed via smartphone or PC (Saraswati et al. 2021). The reason for using the heyzine application is that it can make the e-module display very attractive because it can foster creativity and innovation in making teaching materials (Pratiwi, W. et.al.2023).

The combination of Canva and Heyzine allows the creation of modules that not only present information in a clear and structured manner, but are also visually appealing and easily accessible (Anggriana, Siti, et.al., 2024). The heyzine application is used as a menu creation in operating e-modules in the form of flipbooks, adding links, adding long videos, adding practice questions via google form. Flipbook is an application that supports the use and creation of e-modules (Ramadhina & Pranata, 2022). Flipbook is a book in the form of a digital file that contains images, animations, videos, and audio, where readers can open pages in a flipbook like reading a book or magazine in general (Humairah, 2022). Heyzine flipbook is an application that is useful for creating flipbook-based e-modules. A web-based program called Heyzine Flipbook can convert PDF files into books, brochures, catalogs, magazines, digital brochures and can be accessed for free or paid without the need to download the application (Khomaria & Puspasari, 2022). In the Heyzine Flipbook application there are features that can be used such as adding links, images, videos, audio, and the web so that e-modules with the Heyzine Flipbook application contain more information with diverse sources than printed modules.

The developed e-module integrates ethnoscience and biotechnology material that contains the making of innovative products. So that in this e-module does not separate cultural science and local wisdom of the community which can be used as a learning approach to improve students' science process skills. Through e-module learning tools with ethnoscience content, students are more active, creative and can train science process skills because they are directly involved in conducting experiments with learning resources that are used real and close to the daily lives of students (Bakti et al., 2023). Science process skills are the ability of students to apply scientific methods in understanding, developing and discovering science (Pertiwi, 2019). In addition to training students' science process skills, this e-module also trains science literacy. It is proven that by applying ethnoscience-laden e-modules based on heyzine flipbooks developed by previous researchers showed an increase in science literacy (Dwiyanti & Rosana, 2020), (Zumaroh, et.al, 2024).

The characteristics of the developed e-module are informative and innovative, with learning content that produces the latest biotechnology products. As for the e-module, there is a practicum guide for making several biotechnology products. Students can practice making biotechnology products in class by making cassava tapai, tempeh and kastengel cookies. This is a practicum activity that students have never done. So this module is innovative and informative that can equip science process skills. Learners can independently make these products and make learning more meaningful. This is what distinguishes ethnoscience-laden teaching e-module products from other products. The ethnoscience paradigm in learning is to provide support for direct manipulation of concrete objects from the environment around students as an important element/tool in learning development, conceptual mastery and science process skills (M. W. Lidi et al., 2020). Learning using ethnoscience-based textbooks can improve science knowledge abilities and can train students' science literacy with a percentage increase of 17% (S. Arfianawati, 2016 in Rokhali, E. F & Khusaini, 2023). Therefore, it is necessary to develop e-modules in ethnoscience-based science learning designed with a specific curriculum. So that it is expected that students in the learning process can recognize their own culture, provide new experiences, and have motivation to study natural science that is integrated with local culture (Rokhali, E. F & Khusaini, 2023).

Feasibility Analysis E-Modules and Research Instruments

Feasibility analysis aims to evaluate the ex-

tent to which the developed product, in this case the e-module, is feasible to use in learning. In this study, the feasibility analysis of e-modules was carried out using validation questionnaires from experts. The results of the validity analysis are then translated into qualitative form to assess the level of feasibility based on predetermined criteria. This feasibility questionnaire includes several indicator components listed in the table.

Table 2. Feasibility of Biotechnology E-modules

Indicator	Total Score	Description
Cover	0.97	High Validity
Format & Systematics	0.92	High Validity
Substance of Material	0.87	High Validity
Writing Style	0.87	High Validity
Readability	0.87	High Validity
User-Friendliness	0.97	High Validity
Ethnoscience	0.97	High Validity
Total Score per Indicator	0.92	High Validity

The feasibility analysis of ethnoscience-laden biotechnology teaching e-modules was carried out through the validity test stage involving two material and media experts and three practitioners. This validity test is an important step to measure the quality, effectiveness, and feasibility of e-modules in supporting the learning process. The evaluation results showed that all aspects of the e-module assessment obtained a high validity score with an average of 0.92, so it can be categorised as very valid and feasible to use. In the cover aspect, the e-module obtained a validity score of 0.97, which shows an attractive and representative visual appearance. The design using an interactive flip book format with multimedia such as learning videos provides a more effective and efficient learning experience, allowing students to learn independently or in groups. The format and systematic aspects also received a high score of 0.92, where the e-module is arranged systematically starting from the title page, learning outcomes, main material, to the bibliography and glossary. The material is focused on the application of biotechnology in everyday life with no suggestions for improvement in this aspect.

Meanwhile, the material substance aspect received a validity score of 0.87 with notes on improvements related to consistency of terms, proportionality of the number of questions, pictures, and assessment rubrics that need to be clarified to be more informative and easy for students to understand. The aspects of writing style and readability, each of which is worth 0.87, received some input, such as adjusting the font size, synchronising the writing in the table, and improving the writing rules of titles and sentences to be in accordance with the General Guidelines for Indonesian Spelling (PUEBI) and more clear and straightforward. The ease of use aspect obtained a very high score of 0.97, with the suggestion that the e-module can be accessed offline to increase the ease of access of students without relying on an internet connection. Finally, the integration of ethnoscience in the e-module received a score of 0.97, which includes the incorporation of local cultural content with biotechnology materials as well as innovative practicum activities with ethnoscience content. The validator gave a recommendation that the practicum procedure be equipped with clearer material sizes. Overall, this e-module has met the eligibility criteria from the aspects of material, design, and learning media, making it suitable for use in the learning process with some minor revisions that can improve its quality and ease of use.

Practicality Analysis of E-Modules and Research Instruments

Analysis of the practicality of e-modules in this study was carried out by observing students during the learning process using e-modules. Observations were made by observers in each lesson. The results of the observation data obtained that the teaching e-module had an impact on increasing the score of each meeting as shown in the following graph.

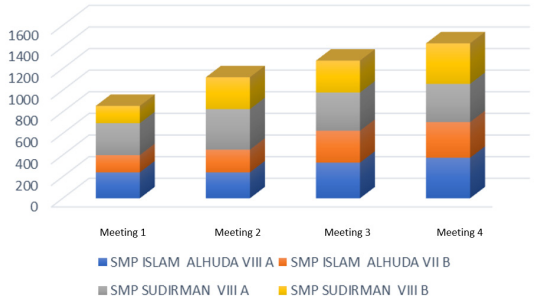

Figure 5. Improvement in Student Observation

In addition to observation, the practicality of e-modules is also obtained from the students' response questionnaire. From the students' response questionnaire, it can be seen the level of readability and ease of students in the learning process using e-modules. The number of students in this study consisted of VIII grade students of Alhuda Islamic Junior High School and Sudirman Junior High School Semarang. The results

of the analysis of the learner response questionnaire are presented in Table 3.

Table 3. Results of Student Response Questionnaire Analysis

Indicator	Rating (%)	Criteria
Design	85.7	Very Practical
Ease of Use	84.9	Practical
Efficiency	85.6	Very Practical
Ethnoscience	89.1	Very Practical
Average	86.4	Very Practical

Based on Table 3, the results of students' responses to the practicality of ethnoscience-laden biotechnology e-modules obtained an average result of 86.4% classified in the very practical category. The effectiveness of e-modules is classified as very practical so that it can support students' science process skills.

The practicality of biotechnology teaching e-modules was measured through a learner response questionnaire, which obtained an average score of 86.4 (very practical category). This shows learner satisfaction and ease of use of e-modules that can support the improvement of science process skills (KPS). The e-module also helps learners understand the integration between science concepts and local culture (ethnoscience), so that learning becomes more contextual and meaningful.

Observations during the four meetings showed no decrease in science process skills in the indicators of observation, questioning, prediction, planning and conducting investigations, data processing, evaluation, and communication of results. Instead, the observation data indicated an increase in students' KPS. Science Process Skills are scientific methods that train learners in receiving information, developing innovations, and applying scientific concepts conceptually (Darmayanti & Setiawan, 2022; Hartati et al., 2022). In this study, KPS was assessed through six main indicators according to the literature (Saidaturrahmi et al., 2020; Safitri et al., 2022): observing, questioning, predicting, planning and conducting investigations, processing and analysing data, and evaluating and communicating results. Based on questionnaire and observation data, the use of ethnoscience-loaded e-modules significantly improved students' KPS in learning biotechnology.

Learning Effectiveness Analysis

Analysis of the effectiveness of learning using biotechnology e-modules with ethnoscience content in this study comes from the results of students' literacy skills. Analysis of students' science literacy skills was carried out using PISA standardised test questions. The following is presented the average pretest and posttest results of students in Table 4.

Table 4. Learner Pretest & Posttest Results

School Name	Class	Average Pretest	Average Posttest
SMP Islam Alhuda Semarang	VIII A	35.24	82.38
	VIII B	33.13	82.00
SMP Sudirman Semarang	VIII A	21.67	81.00
	VIII B	20.63	81.00

From Table 4., there is a significant increase in the average pretest-posttest in all groups of learners. Increased science literacy is obtained after students use ethnoscience-laden biotechnology e-modules in learning and can complete practice questions on e-modules. The standard deviation on this research data is 17.95 while the average is 38 for the pretest score. This shows that the data has a good distribution. N-Gain calculations obtained from pretest and posttest scores of students' science literacy skills are presented in the Table 5.

Table 5. N-gain Results

School Name	Class	N-Gain
SMP Islam Alhuda Semarang	VIII A	0.71
	VIII B	0.71
SMP Sudirman Semarang	VIII A	0.75
	VIII B	0.77
Average N-Gain	0.74	

In Table 5. shows the N-Gain results of 0.74 interpreted as an increase in students' science literacy is high. The ethnoscience-laden biotechnology e-module developed integrates PISA standard questions to improve students' science literacy. Evaluation of effectiveness was carried out by comparing pretest and posttest results in a single class, without a control group, given the uniformity of participants' abilities and learning styles. The results showed significant improvement with an N-Gain value of 0.74, high category. This improvement is driven by the e-module design that presents material descriptions, practical instructions for making traditional and innovative biotechnology products, and PISA standard question exercises. Practicum involving familiar and innovative materials helps learners integrate science knowledge and local culture

contextually, as well as train science literacy skills in the aspects of reading procedures, using tools and materials, and understanding cause-and-effect in the fermentation process. The developed science literacy includes three main aspects: content (understanding local and national issues), procedural (scientific explanation of fermentation phenomena), and epistemic (scientific analysis and evaluation). This finding is in line with previous research that confirms the importance of ethnoscience integration in learning to increase the meaning and relevance of learning for students (Wahyu, 2017).

CONCLUSION

Based on the results of the study, it can be concluded that the ethnoscience-laden biotechnology e-module has the main characteristics in the form of practical instructions for making biotechnology products of typical Indonesian food as well as a table listing the utilisation of microorganisms in traditional Indonesian food. This feature allows students to integrate and understand the concept of ethnoscience in biotechnology material more deeply. In addition, this e-module also provides practical instructions for eight biotechnology innovation products, which serves to provide the latest information and facilitate students to do practical simulations independently. The validity of the e-module is proven to be high with an average score of 0.92 based on seven indicators of expert assessment, including aspects of cover, format, systematics, writing style, material substance, readability, ease of use, and ethnoscience content. In terms of practicality, this e-module is very effective in the learning process, as evidenced by the increase in the observation value of students' science process skills from the first to the fourth meeting and the average student response questionnaire score of 86.4 which shows a very practical category. Furthermore, the effectiveness of e-modules can also be seen from the increase in students' science literacy with an average N-Gain value of 0.74, which is included in the high category. The literacy improvement occurred in the aspects of content, procedural, and epistemic knowledge. Based on these findings, it is recommended that further research be carried out with further development of ethnoscience-laden biotechnology e-modules, especially those that can support the achievement of students' science process skills through maximum observation activities. In addition, the addition of PISA-level question exercises is needed to optimise the improvement of students' science literacy so that learning becomes more effective and meaningful.

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