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Development of a Children Learning in Science E-Module Oriented toward Science Process Skills to Improve Higher-Order Thinking Skills in Science Learning

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Abstract

The urgency of this research is to develop a science e-module oriented toward science process skills to improve students' higher-order thinking skills. This study was motivated by students' relatively low Higher-Order Thinking Skills (HOTS) and the limited use of digital learning materials capable of integrating science process skills into science learning. The study aimed to develop a Children Learning in Science (CLIS)-based e-module oriented toward science process skills on the topic of Ecology and Indonesian Biodiversity that meets the criteria of validity, practicality, and effectiveness for improving students' HOTS. The study employed a Research and Development (R&D) method using the ADDIE model, which comprises the Analysis, Design, Development, Implementation, and Evaluation stages. The trial participants consisted of 21 Grade VII A students at MTs PSM Tanen. Data were collected through interviews, material-expert and media-expert validation sheets, student-response questionnaires, and HOTS tests in the form of a pretest and posttest. Data were analyzed quantitatively and descriptively using feasibility percentages, practicality percentages, and N-Gain analysis. The results showed that the developed e-module achieved a very high level of validity, with material-expert validation of 91.52% and media-expert validation of 95.42%. The practicality level based on student responses reached 86.19%, categorized as highly practical. The effectiveness of the e-module was indicated by an increase in the mean HOTS score from 59.18 on the pretest to 72.24 on the posttest, with an N-Gain value of 0.31 in the moderate category. In addition, all HOTS indicators increased: analyzing (C4) by 11.72%, evaluating (C5) by 10.21%, and creating (C6) by 20.24%. Thus, the CLIS-based e-module oriented toward science process skills was declared valid, practical, and effective and is feasible for use as a digital learning resource to support science learning and improve junior high school/MTs students' HOTS.

Keywords: *E-Module, Children Learning In Science, Science Process Skills, Higher-Order Thinking Skills, Ecology*

Introduction

The development of science and technology in the 21st century requires students not only to master knowledge concepts but also to possess higher-order thinking skills needed to address various complex problems in real life. These abilities are known as Higher-Order Thinking Skills (HOTS), which encompass analyzing, evaluating, and creating according to the revised Bloom's Taxonomy. HOTS are important competencies that need to be developed in learning because they contribute to critical thinking, creativity, problem solving, and rational decision making (Mutmainah et al., 2026). In line with this, the implementation of Kurikulum Merdeka emphasizes learning that encourages students to actively construct knowledge, develop scientific reasoning, and apply learned concepts in various life contexts

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(Kemendikbudristek, 2022). Nevertheless, various studies show that Indonesian students' HOTS still need to be improved. International assessment results indicate that students continue to experience difficulties in solving problems that require analysis, evaluation, and context-based problem solving. This condition suggests that learning processes in schools have not yet fully provided experiences that optimally develop higher-order thinking skills. Learning still tends to emphasize conceptual mastery and memorization, leaving students less accustomed to problems that require in-depth reasoning and the application of concepts in real situations (Hasnah et al., 2021).

Developing HOTS in science learning is particularly important because the nature of science emphasizes not only mastery of scientific products but also the scientific processes used to acquire knowledge (Huda et al., 2025). Science learning should provide students with opportunities to observe phenomena, formulate problems, propose hypotheses, conduct investigations, analyze data, and draw conclusions based on evidence. These activities are closely related to science process skills, which constitute an important component of modern science education (Suryawanto et al., 2022; Kurniahtunnisa et al., 2024). Science process skills are a set of skills used by students to acquire, develop, and apply scientific knowledge through inquiry. These skills include observing, classifying, measuring, predicting, interpreting data, communicating results, and drawing conclusions based on facts obtained during learning (Nursan et al., 2025). Mastery of science process skills enables students to participate actively in learning and develop more meaningful conceptual understanding. In addition, science process skills provide an important foundation for the development of HOTS because students are required to perform various higher-order thinking activities during scientific inquiry (Safahi et al., 2020).

The relationship between science process skills and HOTS indicates that higher-order thinking cannot be improved merely by providing HOTS questions; it also needs to be supported by learning processes that train students to think and work scientifically. When students are involved in observing phenomena, collecting data, analyzing information, and drawing conclusions, they indirectly develop the abilities to analyze, evaluate, and create, which are the main components of HOTS. Therefore, integrating science process skills into learning is a strategy with the potential to improve students' higher-order thinking skills more effectively. In addition to learning models, the successful development of HOTS is also influenced by the availability of learning materials that correspond to students' characteristics and curriculum demands. Learning materials play an important role in helping students understand concepts, guiding learning activities, and providing systematic learning experiences. However, preliminary observations and interviews with a science teacher showed that the learning materials used were still dominated by textbooks and simple worksheets that had not optimally facilitated the development of science process skills or students' HOTS. The materials tended to focus on delivering information, while activities encouraging investigation, analysis, and problem solving remained limited.

The development of digital technology provides opportunities to address these problems through the development of more interactive and engaging electronic learning materials. One form of digital learning material increasingly used in education is the e-module. An e-module enables the integration of learning media such as text, images, video, animation, and interactive activities within a single learning platform. These characteristics allow students to obtain richer learning experiences than those offered by conventional printed materials. In addition, e-modules can be used flexibly both in classroom learning and independent study, thereby supporting the implementation of student-centered learning.

For the topic of Ecology and Indonesian Biodiversity, the use of an e-module is particularly relevant because the content includes concepts related to environmental phenomena and everyday life. The topic requires students to understand relationships among ecosystem components, analyze environmental problems, evaluate the effects of human activities on the environment, and formulate solutions to ecological problems. These contextual characteristics make the topic highly suitable for developing HOTS through structured learning activities based on scientific inquiry. Various studies have developed digital learning materials and learning models aimed at improving the quality of science learning. Interactive e-modules have been shown to increase learning motivation, independence, and learning outcomes by providing more engaging learning experiences through multimedia integration and interactive activities. E-modules also provide flexibility for students to learn according to their pace and needs, thereby supporting student-centered learning (Usiminda et al., 2025). Nevertheless, most e-modules that have been developed remain oriented toward content presentation and conceptual understanding, while learning strategies that systematically train higher-order thinking skills have not yet been widely integrated.

On the other hand, the Children Learning in Science (CLIS) model has frequently been reported to increase student learning activity through a constructivist approach that positions students at the center of the learning process. CLIS facilitates students in expressing initial ideas, conducting investigations, reconstructing concepts based on observations, and applying acquired concepts in different situations. These characteristics enable students to construct knowledge independently through meaningful learning experiences, so learning is oriented not only toward conceptual mastery but also toward scientific thinking processes (Hartati et al., 2021). Therefore, CLIS has considerable potential to support the development of higher-order thinking skills when implemented consistently in science learning.

Other studies indicate a close relationship between science process skills and HOTS. Students who are accustomed to scientific activities such as observing, classifying, interpreting data, formulating hypotheses, conducting experiments, and drawing conclusions tend to demonstrate stronger analytical and evaluative abilities than students who passively receive information. This indicates that science process skills function not only as a means of acquiring knowledge but also as a foundation for developing higher-order thinking skills (Safahi et al., 2020). Therefore, science learning should ideally integrate conceptual mastery with the development of science process skills so that students can construct knowledge through authentic learning experiences. Nevertheless, a review of previous studies reveals several limitations that create opportunities for further research. Most research on e-modules has placed greater emphasis on technology, media design, and interactivity, while the syntax of the learning model has not been fully integrated into the e-module structure. Conversely, studies of the CLIS model generally focus on classroom implementation using conventional learning materials and have rarely developed it in the form of interactive digital learning resources. In addition, studies of science process skills and HOTS have tended to examine the two separately, so few studies have explicitly integrated both within a systematic digital learning product.

Another limitation concerns the learning-content context and educational level. The development of CLIS-based e-modules that integrate science process skills as a strategy for improving HOTS on the topic of Ecology and Indonesian Biodiversity at the junior high school/MTs level remains relatively limited. Yet this topic is highly suitable for training higher-order thinking because it includes environmental phenomena that are close to students' everyday lives and requires them to analyze relationships among ecosystem components,

evaluate environmental problems, and formulate alternative solutions based on scientific evidence. Therefore, innovation is still needed in digital learning materials that are not only visually attractive but also capable of integrating learning models and scientific activities that support students' HOTS development.

Based on these conditions, this study offers novelty through the development of an interactive flipbook-based e-module that integrates the syntax of the Children Learning in Science (CLIS) model with science process skill indicators at each learning stage. This integration was designed so that students not only study concepts of ecology and biodiversity but also actively make observations, identify problems, collect and analyze information, evaluate investigation results, and formulate solutions to the problems presented. The e-module is also equipped with interactive features such as learning videos, HOTS-based exercises, Student Worksheets (LKPD), educational games, and digital evaluation to support both independent and classroom learning. With these characteristics, the developed e-module is expected to become a more contextual and interactive learning resource that is consistent with students' characteristics in the implementation of Kurikulum Merdeka.

Based on the research-gap analysis, the research problem was how to develop a Children Learning in Science (CLIS)-based e-module oriented toward science process skills that meets the criteria of validity, practicality, and effectiveness for improving students' Higher-Order Thinking Skills (HOTS) on the topic of Ecology and Indonesian Biodiversity. Therefore, this study aimed to develop a CLIS-based e-module oriented toward science process skills, describe its levels of validity, practicality, and effectiveness, and analyze its potential to improve junior high school/MTs students' HOTS. The results are expected to contribute to the development of innovative digital learning materials that integrate a constructivist learning model, science process skills, and HOTS development, thereby providing an alternative science learning resource relevant to the demands of 21st-century education.

Method

This study employed a Research and Development (R&D) method aimed at producing a Children Learning in Science (CLIS)-based e-module oriented toward science process skills to improve students' Higher-Order Thinking Skills (HOTS) on the topic of Ecology and Indonesian Biodiversity. The R&D method was selected because it enables researchers to develop an educational product while systematically examining its feasibility for use (Sugiyono, 2017). Development research aims to produce and validate educational products through structured stages so that the resulting product corresponds to learning needs. In this study, the developed product was an interactive e-module integrating CLIS learning syntax with science process skill indicators to facilitate improvement in students' HOTS. Product development used the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) because its stages are systematic and interconnected and allow evaluation at each development phase to produce a valid, practical, and effective product (Waruwu, 2024).

The Analysis stage was conducted to identify the need for e-module development through curriculum analysis, analysis of student characteristics, content analysis, analysis of facilities and infrastructure, and analysis of learning problems based on interviews with a science teacher at MTs PSM Tanen. The Design stage included developing the e-module structure, formulating learning outcomes and objectives, preparing the content, designing learning activities based on CLIS syntax, preparing research instruments, and designing the e-module interface. The Development stage involved preparing the e-module using Microsoft Word for

manuscript development, Canva for visual design, and Heyzine Flipbook as the digital publication platform. The developed product was then validated by material and media experts before implementation. The Implementation stage involved a limited trial using a One-Group Pretest-Posttest Design to determine the practicality and effectiveness of the e-module. The Evaluation stage was conducted continuously at each phase of development as a basis for product revision according to validation results, implementation results, and feedback from validators and students (Adrianus et al., 2023).

The study was conducted at MTs PSM Tanen. The trial participants consisted of 21 Grade VII A students selected using purposive sampling. The class was selected based on discussion with the science teacher and consideration of class characteristics suitable for the product trial. In addition to involving students as trial participants, the study involved material-expert and media-expert validators with relevant competencies to assess product feasibility before its use in learning (Wahfiudin et al., 2023).

The research data consisted of qualitative and quantitative data. Qualitative data were obtained through interviews and validator comments and were used as a basis for product revision, while quantitative data were obtained from material-expert validation sheets, media-expert validation sheets, student-response questionnaires, and HOTS test results. Data-collection techniques included interviews, questionnaires, tests, and documentation. Structured interviews were conducted with the science teacher during the needs-analysis stage to obtain information about learning conditions, student characteristics, the availability of learning materials, and problems encountered during learning. Questionnaires were used to obtain data on e-module validity from material and media experts and practicality from student responses (Cahaya et al., 2024). Tests were used to measure HOTS through pretest and posttest items developed according to HOTS indicators at cognitive levels C4 (analyzing), C5 (evaluating), and C6 (creating), while documentation was used to complement the data collected during product development and implementation (Ardiansyah et al., 2023).

The research instruments included an interview guide, material-expert validation sheet, media-expert validation sheet, student-response questionnaire, and HOTS test instrument. The validation instruments were used to assess content feasibility, presentation, language, media appearance, multimedia quality, interactivity, and ease of e-module use. The student-response questionnaire was used to determine the practicality of the e-module in terms of ease of use, visual attractiveness, media benefits, and usefulness of the exercises. The HOTS test instrument consisted of multiple-choice and essay questions measuring analyzing, evaluating, and creating abilities in accordance with the research objectives. All instruments were validated before data collection to ensure that they were suitable for measuring the intended aspects.

Data were analyzed quantitatively and descriptively. Expert-validation data were analyzed using percentages to determine e-module validity, while student-response questionnaire data were analyzed using percentages to determine product practicality. E-module effectiveness was analyzed based on improvement between pretest and posttest scores using Normalized Gain (N-Gain). The N-Gain value was calculated to determine the magnitude of improvement in students' HOTS after using the e-module and was then interpreted as low, moderate, or high according to the criteria used in the study (Jumaniar et al., 2024). The product was considered feasible if it met three main criteria: validity based on expert assessment, practicality based on student responses, and effectiveness based on HOTS improvement analyzed using N-Gain (Waruwu et al., 2025).

Results

Development of the Children Learning in Science (CLIS)-Based E-Module

This study produced a Children Learning in Science (CLIS) e-module oriented toward science process skills on the topic of Ecology and Indonesian Biodiversity for Grade VII junior high school/MTs students. Product development used the ADDIE model, comprising the Analysis, Design, Development, Implementation, and Evaluation stages. The analysis stage involved interviews with a science teacher to identify learning problems, student characteristics, and learning-material needs. The analysis showed that the learning resources used were still dominated by textbooks and worksheets that were less interactive, did not systematically integrate science process skills, and had not yet adequately facilitated the development of Higher-Order Thinking Skills (HOTS).

Based on the analysis, a digital flipbook e-module was developed using Canva and published through the Heyzine platform. The e-module was structured according to the Children Learning in Science (CLIS) model syntax: orientation, elicitation of ideas, restructuring of ideas, application of ideas, and review of changes in ideas. At each learning stage, science process skill indicators were integrated, including observing, questioning and predicting, planning and conducting investigations, processing and analyzing data, evaluating, reflecting, and communicating results. In addition to learning content, the e-module was equipped with interactive features such as contextual images, learning videos, hyperlinks, HOTS-based exercises, digital LKPD, evaluation using Quizizz, and assignment-submission links through Google Forms. These features were designed to support more interactive, contextual, and student-centered learning, thereby facilitating the development of science process skills while improving HOTS.



Figure 1. *Developed E-Module*

Product Validation Results

The Development stage produced a Children Learning in Science (CLIS) e-module oriented toward science process skills on the topic of Ecology and Indonesian Biodiversity. Before implementation in learning, the product was validated by material and media experts to determine the feasibility of the e-module. Material-expert validation showed that the e-module was categorized as highly valid across all assessed aspects. Content feasibility obtained 89.83%, presentation feasibility 93.75%, and language feasibility 90.97%, resulting in an average percentage of 91.52%. The material-expert validation results are presented in Table 1.

Table 1. *Material-Expert Validation Results*

No.	Aspect	Percentage	Description
1.	Content Feasibility	89.83%	Highly Valid
2.	Presentation Feasibility	93.75%	Highly Valid
3.	Language Feasibility	90.97%	Highly Valid
Total		91.52%	Highly Valid

The material-expert validation results are presented in Table 1 The Development stage produced a Children Learning in Science (CLIS) e-module oriented toward science process skills on the topic of Ecology and Indonesian Biodiversity. Before implementation in learning, the product was validated by material and media experts to determine the feasibility of the e-module. Material-expert validation showed that the e-module was categorized as highly valid across all assessed aspects. Content feasibility obtained 89.83%, presentation feasibility 93.75%, and language feasibility 90.97%, resulting in an average percentage of 91.52%.

Table 2. *Media-Expert Validation Results*

No.	Aspect	Percentage	Description
1.	Media Design	96.67%	Highly Valid
2.	Multimedia Quality and Interactivity	91.67%	Highly Valid
3.	Ease of Use (Usability)	96.67%	Highly Valid
4.	Technical Media Feasibility	96.67%	Highly Valid
Total		95.42%	Highly Valid

The media-expert validation results are presented in Table 2 Media-expert validation also showed that the e-module was categorized as highly valid. Media design obtained 96.67%, multimedia quality and interactivity 91.67%, usability 96.67%, and technical feasibility 96.67%. The average media-expert validation percentage reached 95.42%.

Practicality Test Results

After being declared feasible based on the validation results, the e-module was implemented with 21 Grade VII students at MTs PSM Tanen. E-module practicality was measured using a student-response questionnaire covering ease of use, attractiveness and interactivity, learning benefits, and usefulness of the exercises.

Table 3*. E-Module Practicality Results Based on Student Responses*

No.	Aspect	Percentage
1.	Ease of Using the E-Module	83.25%
2.	Attractiveness and Interactivity	86.75%
3.	Benefits of the Learning Media	87.25%
4.	Usefulness of the Exercises	87.50%
Overall Average		86.19%
Category		Highly Practical

A summary of the practicality-test results is presented in Table 3 The questionnaire results showed that the e-module obtained an average practicality percentage of 86.19%, categorized as highly practical. This result indicates that students responded positively to the use of the e-module during the learning process.

Effectiveness Test Results

Table 4. *E-Module Effectiveness Test Results*

Sample	Test	Total Score	Mean	Ideal Score	N-Gain Index	Criteria
(1-21)	Pretest	1242	59.18	2100	0.31	Moderate
	Posttest	1517	72.24			
	Total	2760	131.43			

A summary of the effectiveness-test results is presented in Table 4 The effectiveness of the e-module was analyzed based on HOTS test results obtained through students' pretest and posttest. The analysis showed an increase in the mean score after the use of the e-module. The mean pretest score was 59.18, while the mean posttest score increased to 72.24. The N-Gain analysis produced a value of 0.31, categorized as moderate.

Table 5. *Increase in Pretest and Posttest Scores for Each HOTS Indicator*

HOTS Indicator	Pretest Score	Posttest Score	Increase (%)
Analyzing (C4)	73.99%	85.71%	11.72%
Evaluating (C5)	60.54%	70.75%	10.21%
Creating (C6)	32.74%	52.98%	20.24%

The increase for each HOTS indicator is presented in Table 5 In addition to the mean score, improvement in HOTS was analyzed according to cognitive indicators. The results showed that all indicators increased after the use of the e-module. Analyzing (C4) increased by 11.75%, evaluating (C5) increased by 10.21%, while creating (C6) showed the greatest improvement at 20.24%.

Discussion

This study aimed to develop a Children Learning in Science (CLIS) e-module oriented toward science process skills on the topic of Ecology and Indonesian Biodiversity that meets the criteria of validity, practicality, and effectiveness in improving students' Higher-Order Thinking Skills (HOTS). The results showed that the developed product met all three criteria. The following discussion describes the relationship between the findings and relevant theories and previous studies.

E-Module Validity

The validation results showed that the e-module was categorized as highly valid based on both material-expert and media-expert assessments. The high level of validity indicates that the content, presentation, language, media design, interactivity, ease of use, and technical aspects were aligned with the learning objectives and the characteristics of junior high school/MTs students. The high content-feasibility score was closely related to the development process, which referred to the learning outcomes of Kurikulum Merdeka and integrated Children Learning in Science (CLIS) syntax with science process skill indicators in each learning activity. Systematic content organization accompanied by activities directing students to observe, identify problems, conduct investigations, analyze results, and communicate findings enabled the e-module to achieve alignment among content, learning objectives, and learning activities. In addition, communicative language and gradual content presentation made it easier for students to understand concepts of ecology and biodiversity (Darsanianti et al., 2024).

From the media perspective, the high validation score was influenced by the use of digital features such as hyperlinks, learning videos, pop-up information, interactive exercises, and navigation that facilitated student access to each section of the e-module. These characteristics support the concept of an e-module as a digital learning resource capable of providing a more engaging learning experience than conventional learning materials (Anjani & Usman, 2024). These results are consistent with the view that content quality and media quality are two major components determining the feasibility of a digital learning resource before it is used in instruction. These findings also support by previous studied, who reported that systematically developed interactive e-modules can achieve high validity because they integrate content, media, and learning activities within a single digital product (Usiminda et al., 2025). Thus, the validation results indicate that the developed e-module is feasible for use as a science learning resource on the topic of Ecology and Indonesian Biodiversity.

E-Module Practicality

The practicality test showed that the e-module was categorized as highly practical based on student responses. This indicates that the e-module was easy to use during learning, had an attractive appearance, and helped students understand the material. The practicality of the e-module was supported by content presentation complemented by illustrations, learning videos, digital LKPD, HOTS-based exercises, and simple navigation, enabling students to access each part of the e-module independently. In addition, the Heyzine platform allowed students to operate the e-module through smartphones and computers without requiring an additional application. This provided flexibility for learning both inside and outside the classroom.

The CLIS learning syntax embedded in the e-module also contributed to its practicality. Each learning stage was arranged sequentially from orientation to review of changes in ideas, providing students with a clear learning pathway. Learning activities did not focus solely on content delivery but also provided opportunities for students to conduct investigations and independently construct concepts through various scientific activities (Darsanianti et al., 2024). These findings are consistent with the previous studied, who reported that CLIS-based learning can increase student engagement because it provides opportunities to construct knowledge through direct learning experiences (Hartati et al., 2021). In addition, the previous studied showed that interactive e-modules provide learning experiences that are more flexible, attractive, and easy to use, thereby generating positive student responses (Usiminda et al., 2025).

Effectiveness of the E-Module in Improving HOTS

The effectiveness test showed an improvement in students' HOTS after using the e-module, as indicated by a higher mean posttest score than the pretest score and an N-Gain value in the moderate category. This result suggests that the use of the e-module made a positive contribution to the improvement of students' higher-order thinking skills. The improvement in HOTS occurred because the e-module not only presented learning content but also integrated CLIS syntax with science process skill indicators in each learning activity. During the orientation stage, students were introduced to contextual phenomena that stimulated curiosity. The elicitation stage encouraged students to express their prior knowledge, while the restructuring stage provided opportunities to conduct investigations and compare observations with scientific concepts. In the application stage, students applied concepts to new situations, and in the final stage they reflected on learning outcomes. This sequence trained analyzing, evaluating, and creating abilities, which are the main HOTS indicators (Hidayat et al., 2024).

Furthermore, the integration of science process skills such as observing, questioning, conducting investigations, analyzing data, evaluating results, and communicating findings provided more meaningful learning experiences. Students did not merely receive information but actively participated in discovering concepts, allowing higher-order thinking skills to develop throughout the learning process (Safahi et al., 2020). The greatest improvement occurred in the creating (C6) indicator. This result indicates that students began to formulate solutions to environmental problems based on information obtained during learning. Nevertheless, the moderate N-Gain value indicates that improvement in HOTS was not yet optimal. This was presumed to be influenced by the relatively short implementation period of four meetings, meaning that students still needed time to adapt to the CLIS learning model and the use of the e-module as a digital learning resource.

These findings support the previous studied, who state that science process skills provide an important foundation for the development of higher-order thinking skills because students become accustomed to conducting scientific inquiry, analyzing information, and drawing evidence-based conclusions (Safahi et al., 2020). The findings are also consistent with Hartati et al. (2021), who showed that the Children Learning in Science model can improve students' thinking skills through active concept construction. Thus, integrating the CLIS model and science process skills within the e-module was one factor supporting the improvement of HOTS on the topic of Ecology and Indonesian Biodiversity.

Conclusion

This study successfully developed a Children Learning in Science (CLIS) e-module oriented toward science process skills on the topic of Ecology and Indonesian Biodiversity using the ADDIE development model. The results showed that the developed e-module met the highly valid criterion based on material- and media-expert assessments, was highly practical based on student responses, and was effective in improving Higher-Order Thinking Skills (HOTS), as indicated by higher posttest than pretest scores and an N-Gain value in the moderate category. These findings indicate that integrating the CLIS model with science process skills in an e-module can support science learning that is more interactive and student-centered while facilitating the development of higher-order thinking skills. Thus, this study contributes to the development of innovative digital learning materials as an alternative science learning resource on the topic of Ecology and Indonesian Biodiversity. This study was limited because product implementation was conducted only as a limited trial in one class at one school over a relatively short instructional period. Therefore, the effectiveness of the e-module has not yet been examined across a broader and more diverse group of students. Future studies are recommended to implement the e-module with larger numbers of students and across more schools to examine product effectiveness among learners with different characteristics. In addition, similar e-modules may be developed for other science topics or combined with different learning models or approaches to generate more optimal learning innovations for improving science process skills and Higher-Order Thinking Skills (HOTS).

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