Indonesian Journal of
Mathematics and Natursal Science Education
p-ISSN: 2721-172x e-ISSN: 2721-1746
Vol. 5 No. 1 Th 2022; Hal 1-15
http://mass.uinkhas.ac.id DOI: 10.35719/mass.v5i1.142

Development of Pisces Diversity E-Module based on Fish Identification Research in Plalangan Village, Jember, Indonesia

Nanda Eska Anugrah Nasution [1 *], Moch Sofyan [1]
[1] UIN Kiai Haji Achmad Siddiq Jember, Jember, East Java, Indonesia
[*]E-mail: nsteska@gmail.com

Abstract

Integrating the local potential as a learning resource is a vital component of the curriculum. Transforming biodiversity identification data from students' environments into learning media may improve students' understanding of biodiversity by providing them with a deeper insight into the contextual aspects of biodiversity. The aims of this study are as follows: to ascertain the validity of the pisces diversity e-module product containing fish identification results in the developed village of Plalangan Kalisat; and to determine the practicality of the aforementioned product in the developed village of Plalangan Kalisat. This study used the Lee & Owens development model. The product validation conducted by material experts yielded an average percentage of 89.83% (highly valid), by media specialists yielded an average percentage of 89.78% (highly valid), by Indonesian language experts yielded an average percentage of 92.22% (highly valid), and by biology teachers yielded an average percentage of 93.33% (highly valid). The small group trial yielded an average percentage of 92.83% (highly appealing). The findings from the large group trial revealed an average score of 94.91% (highly appealing). Based on these two test results, it can be concluded that the developed e-Module has proven to be valid and practical.

Keywords: fish identification research, Lee & Owens development model, pisces diversity e-module, Plalangan village Jember

INTRODUCTION

human beings (Amin, 2016). The content covered in biology courses is comprehensive and diverse, encompassing topics relevant to humans, animals, plants, and the surrounding ecosystem. The extensive volume of content demands a major need for educational resources to facilitate students' comprehension of biology understanding (Romdaniyah et al., 2023; Afriza & Nasution, 2022; Harahap & Nasution, 2022; Sofyan & Nasution, 2022; Harahap & Nasution, 2020).

Biodiversity, as highlighted by Sunarsih et al. (2020), is a crucial component in the field of biology, covering a variety of animal material. Understanding biodiversity is essential for students to fully comprehend the enormous number and variety of living organisms (Fikriyah et al., 2020). According to the preliminary research conducted at MA Miftahul Ulum Suren Jember, the observations and interviews revealed that the study of animalia is considered challenging due to the extensive recognition required for various animal organisms, in addition to the conceptual and procedural theories involved. The mean student attainment score in biology is likewise lower than

the minimum benchmark level. This poor biology grade is common throughout Indonesia (Sholihah et al., 2024) and requires treatments. Students require educational resources that facilitate their understanding of animalia and provide contextual information regarding the biodiversity in their immediate surroundings, encompassing both the school and their home environment.

According to the subsequent needs analysis conducted at MA Miftahul Ulum Suren Jember, the interviews showed that the tenth-grade students and teachers needed educational resources on animalia that were comprehensive, more practical, and able to help students overcome obstacles. At that time, the sole educational resources employed by students at MA Miftahul Ulum Suren for studying animalia are student activity sheets and textbooks provided by the school. Learning media that is based on the actual world is an alternative that students really need to understand animalia content.

Based on a comprehensive examination of student needs, students expressed their desire in learning resources that are grounded in real-life circumstances. Contextual learning materials facilitate the comprehension of biology topics, hence enhancing the effectiveness of learning endeavors. Febriani (2021) states that teachers who possess a comprehensive understanding of learning materials and make appropriate choices have the ability to establish optimal and efficient learning environments. Utilizing the natural world as an educational tool allows students to gain knowledge about nature, hence fostering student engagement. In addition, students can enhance their comprehension of the topic due to its presence in their surroundings, thereby offering novel experiences and perspectives. The fisheries center in Plalangan Kalisat village serves as an ideal educational resource due to its near proximity to research and fisheries sites, allowing students to have a direct and comprehensive understanding of their studies. The Plalangan Kalisat Fisheries Center is a facility dedicated to the production and distribution of freshwater fish seeds in Jember Regency. The initial biology research done to classify the numerous species of fish present in the fisheries center located in Plalangan Kalisat village, and utilize them as an educational resource.

The surrounding environment of the school and the residential areas of students can serve as a valuable resource for learning, particularly when it can be integrated with biology curriculum (Suryaningsih, 2017). Indonesia has rich biodiversity and great local potential (Nasution et al., 2024), and that local natural environment is a readily available resource that can be used for learning purposes. The natural environment has the ability to be employed in supporting student activities during the learning process (Brahim, 2007). To develop educational materials that incorporate the diverse biodiversity surrounding schools and student houses, researchers initially conducted a study focused on biology education to identify the fish species

DOI : http://doi.org/10.35719/mass.v2i2.70

in Plalangan Kalisat village, located in Jember, East Java. Evidence suggests that the utilization of learning materials derived from rigorous biological research can effectively enhance biology education in both academic institutions and schools (Wurarah & Semuel, 2019).

Incorporating local potential as a learning resource is a key requirement of the curriculum to ensure that learning is practical and relevant (Sarah & Maryono, 2014a). Using educational media that bases itself in environmental research might enhance students' comprehension of biological concepts with more effectiveness and efficiency (Sunarsih et al., 2020; Novana et al., 2014). The use of learning media assisted by biological research results can enhance not only understanding but also critical thinking skills (Wahyuni, 2015), life values (Sarah and Maryono, 2014b), and environmental care attitudes (Hasanah et al., 2016) among students.

The pisces diversity e-module, designed to assist students in studying biodiversity material effectively and based on the results of fish identification in the village of Plalangan Kalisat, remains unavailable to academics as of this writing. E-modules are an interactive form of educational media that are often well-received by students (Imani & Nurmawati, 2022). Electronic modules were designed to make it easier to implement lesson plans utilizing evolving technology to adapt to current learning demands (Phandini et al., 2023; Negara et al., 2019; Mijaya et al., 2021). Electronic modules assist teachers in making students more engaged and autonomous, allowing for the use of electronic modules as instructional tools (Syahrial et al., 2023; Herawati & Muhtadi, 2018).

Thus, it is essential to design an electronic module for pisces diversity in the village of Plalangan Kalisat that includes fish identification outcomes. Drawing from the aforementioned background information, the aims of this study are as follows: to ascertain the validity of the pisces diversity e-module product containing fish identification results in the developed village of Plalangan Kalisat; and to determine the practicality of the aforementioned product in the developed village of Plalangan Kalisat.

METHOD

The study used the research and development (R&D) approach, specifically using the Lee & Owens (2004) development model. The Lee & Owens (2004) approach is preferred by researchers because it is well-suited for the development of electronic media. This model is specifically tailored for this purpose, since it systematically arranges the sequence and steps of the development process. The development process is meticulously organized in a progressive manner (Ariyanti, 2022). The study utilized the developmental stages indicated by Lee & Owens (2004), which are illustrated in Figure 1.

During the Assessment and Need Assessment stages, researchers analyze the disparity between the current factual condition and the desired condition,

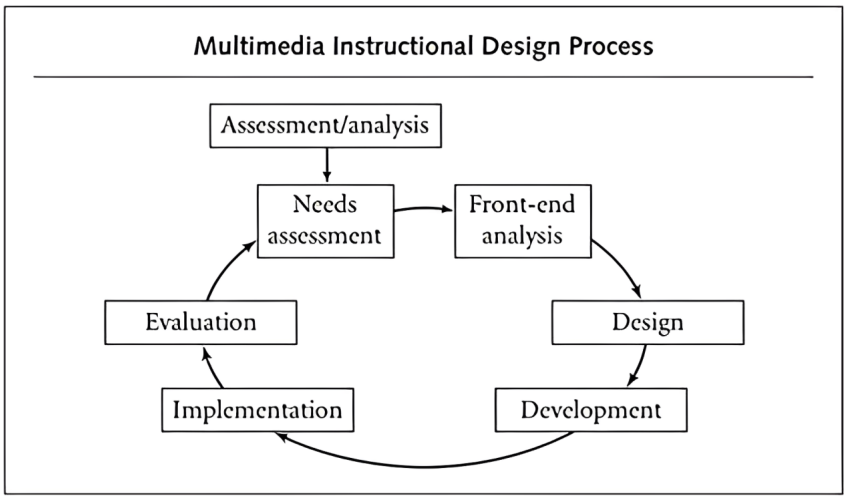

Figure 1. Lee & Owens (2004) development model process

subsequently determine the root cause of the problem, and lastly provide a solution to resolve the issue. During the Front-end analysis stage, researchers conduct a variety of analyses, such as potential user analysis, technology analysis, scenario analysis, task analysis, objective analysis, issue analysis, and media analysis.

At that stage, the researchers also performed an analysis to identify the fish species observed in Plalangan Kalisat village, Jember, East Java. The samples were collected and identified at the Plalang Jember Fisheries Center (Figure 2). This institution, created in 1952, covers an area of 2.5 hectares. It consists of 23 huge ponds, each covering up to 1200 square meters, and 13 medium-sized ponds, each measuring 6 by 26 meters. Writing equipment, a proper identity book, a camera, trays, nets, and alcohol were among the materials used.

Before initiating the sampling, the researchers received data of the fish species cultivated by the Plalang Jember Fisheries Center, resulting in primary data. However, data validation was required, which was accomplished through purposive sampling of the ponds to confirm the accuracy of the documentation obtained by the researchers. Fish were collected from each pond containing fish, identified, and photographed. The researchers performed three times in each pond. Fish species were identified using reference guides such as Kottelat et al. (1993), Saanin (1968), and White et al. (2013).

Figure 2. Plalang Jember fisheries center. (Researcher Documentation)

DOI : http://doi.org/10.35719/mass.v2i2.70

Afterwards, the researcher advanced to the design phase, during that researchers devised the development strategy, outlined the activities to be carried out by the team, specified the media needs, and implemented the configuration controls. Following that, the development phase commences, wherein the design findings are converted into a feasible form, namely the product prototype. After the completion of the product draft, the researcher advances to the implementation phase. The product prototype is subjected to expert evaluation, followed by testing on students. Upon collecting comments and advice, they serve as a basis for improving products to improve it's efficacy and efficiency.

Product validation takes place after the completion of the product draft. The validation process encompassed four distinct aspects: evaluation of material quality, evaluation of media quality, evaluation of language quality, and evaluation of practicality. The product material was validated by using two taxonomist professors who hold a master's degree in biology. The product media validation was carried out by involving two lecturers who are experts in educational media and possess a doctoral degree. The product language validation was carried out by involving an expert in the Indonesian language, specifically a language professor. The assessment of product practicality was carried out by involving a biology teacher who possessed a bachelor's degree and substantial expertise in biology education.

The data for product validation findings is obtained using a closed questionnaire, which contains a section for recommendations that can be filled out by the validator. The material validation questionnaire, based on the work of Nesri & Kristanto (2020), consists of 25 statement items that are divided into three categories: the subject appropriateness, presentation appropriateness, and language appropriateness.

The media validation questionnaire, based on work conducted by the Indonesia National Education Standards Agency (2018), consists of 30 statement items that evaluate two aspects: the appropriateness of the presentation and the appropriateness of the graphics. The language validation questionnaire, based on Astuti's (2018) study, consists of 12 statement items that evaluate six dimensions: Clarity, Communicativeness, Interactivity, Appropriateness for student growth, Adherence to language standards, and Terminology usage. The practicality validation questionnaire, based on Astiting's (2018) research, consists of 22 statement items that evaluate four dimensions: Content Appropriateness, Presentation Appropriateness, Graphics, and Material Profile. Each question offers 5 options that align with a Likert scale spanning from 1 to 5. The scale measures the level of consensus, where a score of 1 signifies significant disagreement and a score of 5 signifies significant agreement.

Validated product are then evaluated through small-scale trials by actively engaging students and assessing their

use of the product. The small-scale trials were done on a group of 6 students who had successfully finished studying the animal diversity content, each with different levels of academic competency. There were particularly two persons with high academic ability, two individuals with average academic ability, and two individuals with low academic ability. Data from small-scale trials were collected using a closed questionnaire that included a space for respondents to offer suggestions. The trial response questionnaire, based on the work of Nesri & Kristanto (2020), consists of 20 statement items that are divided into four categories: ease of use, visual appeal, graphics, and efficiency. Each question has 5 choice alternatives that correspond to a Likert scale ranging from 1 to 5. The option of strongly disagree is assigned a score of 1, while strongly agree is assigned a score of 5.

The large-scale trials involved a single class, specifically class X IPA MA Miftahul Ulum Suren Jember. There were 35 pupils who responded. Trials were conducted to get feedback from pupils. The data gathering method is identical to the questionnaire employed in small-scale trials.

To ascertain the validity and the practicality of the developed product, the validation evaluation scores obtained from experts and student trials are converted into percentages (P) by adding up the total scores given by validators or respondents, dividing by the highest possible score, and then multiplying by 100. Furthermore, the collected percentage is further categorized according to the criteria described in Table 1.

Table 1. Assessment Criteria

Criteria	Percentage Interval
Very valid/Very appealing	86% ≤ P ≤ 100%
Valid/Appealing	76% ≤ P ≤ 85%
Fairly valid/Fairly appealing	60% ≤ P ≤ 75%
Somewhat invalid/ Somewhat unappealing	55% ≤ P ≤ 59%
Not valid/not unappealing	P ≤ 54%

RESULT AND DISCUSSION

The result of this research and development work is the Pisces diversity E-Module, which exhibits fish identification findings in Plalangan Kalisat village.

Based to research findings on fish diversity in Plalangan Kalisat village, Jember, seven types of fish commonly cultivated in the area have been identified. Plalangan's fisheries area contains several fish species (Pisces), including Cyprinus rubrofuscus (Koi fish), Carassius auratus (Goldfish), Carassius auratus (Comet fish), Osphronemus goramy (Gourami), Colossoma macropomum (Tambaqui), Pangasius sp. (Pangasius), and Clarias batrachus and Clarias gariepinus (Catfish). Table 2 shows the complete results of fish identification in Plalangan Kalisat village, Jember.

This module is published in an electronic website format and can be accessed interactively by anyone with the URL, especially students and teachers, using a Smartphone, Personal Computer, or Laptop. The integration of e-modules

DOI : http://doi.org/10.35719/mass.v2i2.70

Table 2. Results of fish identification in Plalangan Kalisat village, Jember

Species	Local name
Cyprinus rubrofuscus	Koi Fish
Carassius auratus	Gold fish / Comet fish
Osphronemus goramy	Gourami / Gurami
Colossoma macropomum	Tambaqui
Pangasius sp	Pangasius
Clarias batrachus and *Clarias gariepinus*	Catfish / Lele

into the online platform is conducted on the fliphtml5 website, allowing users to navigate through the product by flipping pages, adjusting the zoom level, and utilizing other electronic functionalities. The fish diversity material used as material in the product is the result of pure biological research that researchers have previously carried out in Plalangan Kalisat village which is enriched with biological biodiversity material.

The Pisces Diversity e-Module, which includes fish identification findings in Plalangan Kalisat village, requires an internet connection for initial loading. Once the website page is successfully obtained, pupils can promptly utilize it on their smartphones, laptops, or school computers. The e-module is developed in accordance with the framework provided by the regulation of the Minister of Education and Culture of the Republic of Indonesia (2017). The comprehensive pisces diversity e-module product framework comprises various components such as the cover, editorial, foreword, table of contents, learning competencies, instructions for use, observations conducted in the Jember Plalangan Fisheries Hall area, concept maps, learning activities, learning objectives, material description, summary, independent assignment, practice questions, evaluation, glossary, bibliography, and biography. The content covered in this e-module includes the fundamental classification of animals into invertebrates and vertebrates, with a specific focus on pisces. Additionally, there is a dedicated chapter that explores the findings of biology research on the identification of pisces in Plalang

Figure 3. E-module cover page

Figure 4. Instructions for Using the e-module

Figure 5. E-module material showing fish identification results in Plalangan Kalisat village

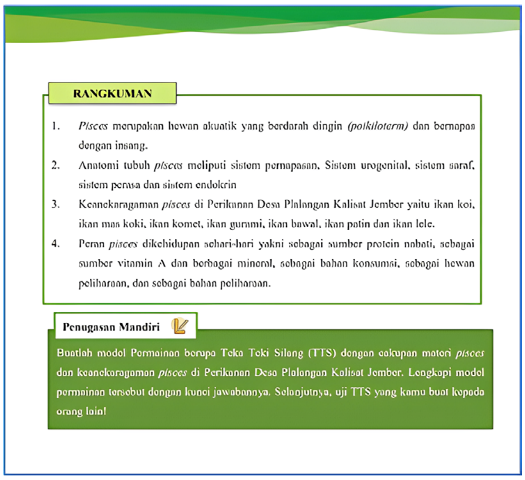

Figure 6 Summaries and student independent assignments

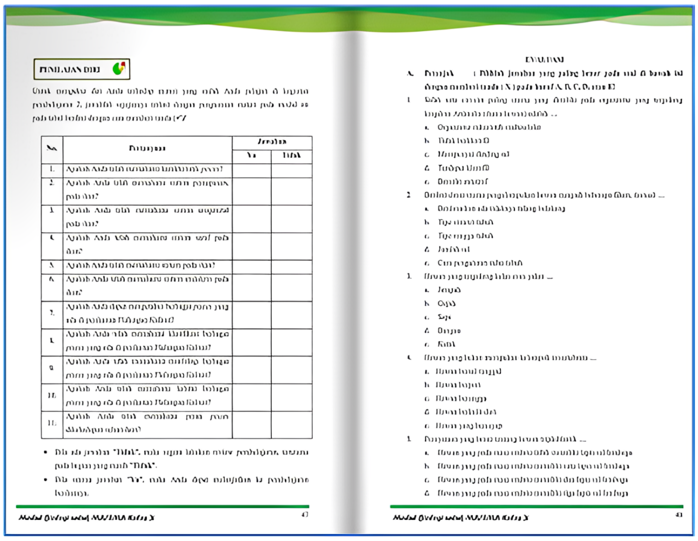

Figure 7 Self-assessment and Evaluation in e-module

Kalisat village. The module also includes supplementary materials discussing topics such as geographical areas and research methods for identifying fish. Figure 3 to Figure 7 showcase multiple instances of the e-module.

The product validation conducted by material experts yielded an average percentage of 89.83% (Table 3), indicating a high level of material quality validity. The product validation conducted by media specialists yielded an average percentage of 89.03% (Table 4), indicating a high level of media quality validity. The validation

Table 3. Material expert validation results

Aspect	Percentage (%)	Criteria
Subject appropriateness	91.25	Very Valid
Presentation appropriateness	91.11	Very Valid
Languange appropriateness	87.14	Very Valid
Average	**89.83 ± 2.33**	**Very Valid**

DOI : http://doi.org/10.35719/mass.v2i2.70

Table 4. Media expert validation results

Aspect	Percentage (%)	Criteria
Appropriateness of the presentation	91.22	Very Valid
Appropriateness of the graphics	86.84	Very Valid
Average	**89.03 ± 3.10**	**Very Valid**

results conducted by Indonesian language experts revealed an average percentage of 92.22% (table 5), indicating a highly valid product in the Indonesian language.

Table 5. Indonesian languaege expert validation results

Aspect	Percentage (%)	Criteria
Clarity	93.34	Very Valid
Communicativeness	100	Very Valid
Interactivity	90	Very Valid
Appropriateness for Student Growth	100	Very Valid
Adherence to Language Standards	90	Very Valid
Terminology Usage	80	Very Valid
Average	**92.22 ± 7.50**	**Very Valid**

The practical validation conducted by biology teachers yielded an average percentage of 93.34% (table 6), indicating a highly valid product in practical terms.

The small group trials yielded an average percentage of 92.83%, indicating a high level of appeal among students for the product. The findings from large group trials revealed a mean percentage of 94.91%, indicating that the product holds significant appeal among students. The data from the small group trials and the large group trials is presented in Table 7.

Table 6. Practitiioner validation results

Aspect	Percentage (%)	Criteria
Content appropriateness	93.34	Very Valid
Presentation appropriateness	85	Very Valid
Graphics	95	Very Valid
Material profile	100	Very Valid
Average	**93.34 ± 6.24**	**Very Valid**

The final product of this research is the pisces diversity E-Module, featuring fish identification results in Plalangan Kalisat village. The validity of this module has been confirmed by examinations conducted by experts and practitioners, and its practicality has been proven through trials with students. The pisces diversity e-module, which includes fish identification results in Plalangan Kalisat village, was created with several computer programs which include Corel draw X7, Adobe photoshop CS6, dan Microsoft Word 2010. The hardware used in making this product is a laptop with 2 GB RAM, Windows operating system, and Intel Dual-Core CPU. The decision to develop an E-module was based on its ability to address the limitations of printed teaching materials. E-modules offer interactive simulations and the ability to convey historical messages through visuals,

Table 7. Results of small group and large group trials

Group	Number of Respondent	Average Percentage (%)	Criteria
Small	6	92 ± 0.03	Very Valid
Large	35	95 ± 0.01	Very Valid

animations, and videos (Wijaya et al., 2022; Agung et al., 2020; Herawati & Muhtadi, 2018).

The validity of an e-module is a criterion that determines if the e-module is appropriate for usage or not (Irdawati et al., 2023). The product validation results indicate that the fish diversity E-Module, containing fish identification in Plalangan Kalisat village, has been found to be valid. The material validity is 89.83% (very valid), media validity is 89.78% (very valid), linguist validity in Indonesia is 92.22% (very valid), and practical validity is 93.33% (very valid).

In terms of material validity, the assessment facet that has the highest percentage is Subject Appropriateness, which scored 91.25% with Very Valid criterion. According to material experts, the product being created has excellent content quality. The presence of high-quality content in educational media is of utmost importance as it directly impacts the accuracy of learning and engages students' attention in the learning process (Agustina & Koeswanti, 2022). The element of material evaluation that has the second greatest percentage is Presentation Appropriateness, namely 91.11%, with criteria that are considered Very Valid. Following that is the aspect of Language Appropriateness, which has a percentage of 87.14% and also meets the requirements of being Very Valid. The material expert evaluated the suitability of presenting the material in the media as it was produced based on the results of his assessment. The visual aspects of educational products are enhanced by elements such as well-crafted words, clear visuals, and legible fonts in games (Harahap & Nasution, 2020). The linguistic factor is equally crucial in ensuring that the target audience comprehends the learning material effectively (Nadifah, 2018).

Within the context of Media validity, the evaluation component that holds the highest percentage is the appropriateness of the presentation, specifically at an average percentage of 91.22% by means of criteria that are highly valid. According to media experts, the product's appearance is of exceptional quality. Presenting visually appealing media can enhance students' engagement with educational materials (Nasution, 2022). The appropriateness of the graphics in media is likewise highly regarded by media specialists, with a substantial percentage of 86.84%. Media validators confirm that the product possesses noteworthy visuals. It is crucial for learning media visuals to undergo validation by specialists, as the quality of visuals plays a significant role in learning media (Wardani, 2013).

The material profile has the maximum percentage in Practical validity, specifically 100%, and meets the criteria for Very Valid. Practitioners evaluate that the material composition of the generated learning media products is highly commendable and deserving of deployment. The assessment component with the second highest percentage is graphics, specifically 95% with very valid criteria. Consequently, practitioners evaluate the quality of learning media visuals as

DOI : http://doi.org/10.35719/mass.v2i2.70

excellent for educational purposes. The other component of the assessment that is excellent is the content appropriateness indicator, specifically measuring at 93.34%, and the presentation appropriateness indicator, specifically measuring at 85%, both with very valid and valid criteria.

Once the validity of the generated product draft has been confirmed, the subsequent step is to assess the practicality of the product. Another aspect of the criterion measuring the suitability of an e-module for a particular purpose is its practicality (Irdawati et al., 2023). Individual students responses were collected for a product acceptance survey to determine its viability (Agustina et al., 2022). Trials of an educational product carried out in stages starting with a smaller number of respondents is a common standard in development research as in Branch (2009) and Borg & Gall (1983).

The small group trial yielded an average percentage of 92.83%, indicating that the product under development was deemed highly appealing by the average student in the experiment. The findings from the large group trial revealed an average score of 94.91%, indicating that the average participant in the trial perceived the product under development as highly appealing. students often have a positive reception towards products that are built using environmental data gathered from pupils (Erawati & Susanti, 2022). The electronic module goods are enriched with sufficient content and visually appealing graphics, which are crucial factors to consider in order to engage students with the educational products being developed (Muttaqin & Suarni, 2021).

These two test results confirm the practicality of the fish diversity E-Module product with recognizing aquatic findings in Plalangan Kalisat village. Febrila & Yerimadesi (2021) and Irdawati et al. (2023) stated that an e-module that is proven to be practical indicates that the e-module is easy to use, makes the learning process more efficient, uses language that is easy to understand, and can be used by students according to their respective learning speeds.

CONCLUSION

The product validation conducted by material experts yielded an average percentage of 89.83%, indicating a high level of material quality validity. The product validation conducted by media specialists yielded an average percentage of 89.78%, indicating a high level of media quality validity. The validation results conducted by Indonesian language experts revealed an average percentage of 92.22%, indicating a highly valid product in the Indonesian language. The practical validation conducted by biology teachers yielded an average percentage of 93.33%, indicating a highly valid product in practical terms.

The small group trial yielded an average percentage of 92.83%, indicating that the product under development was deemed highly appealing by the average student in the experiment. The findings from the large group trial revealed an average score of 94.91%, indicating that the

average participant in the trial perceived the product under development as highly appealing. Based on these two test results, it can be concluded that the fish diversity E-Module product with fish identification results in Plalangan Kalisat village that was developed has proven to be practical.

REFERENCES

Afriza, D. A., & Nasution, N. E. A. (2022). Comparison of The Learning Outcomes of Junior High School Students Utilizing Audio-Visual and Chart Learning Media to Study Ecosystem. META: Journal of Science and Technological Education, 1(1), 46-57.

Agung, F. P., Suyanto, S., & Aminatun, T. (2020). E-Modul Gerak Refleks Berbasis Pendekatan Kontekstual untuk Meningkatkan Pemahaman Konsep Siswa SMA. Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan, 5(3), 279. https://doi.org/10.17977/jptpp.v5i3.13238

Agustina, R., Irhasyuarna, Y., & Sauqina, S. (2022). Pengembangan Media Articulate Storyline Topik Mekanisme Pendengaran Manusia Dan Hewan Untuk Peserta Didik Smp. Jupeis: Jurnal Pendidikan Dan Ilmu Sosial, 1(3), 81-89. https://doi.org/10.55784/jupeis.Vol1.Iss3.119

Agustina, R. C., & Koeswanti, H. D. (2022). Pengembangan Media Pembelajaran Bucergam untuk Meningkatkan Kemampuan Membaca Siswa Kelas I SD. Jurnal Basicedu, 6(5), 8736-8745. https://doi.org/10.31004/basicedu.v6i5.3935

Ariyanti, I. (2022). Pengembangan Multimedia Pembelajaran Untuk Peserta Didik Di Tingkat Taman Kanak-Kanak. Educational Technology Journal, 2(1), 34-44. https://doi.org/10.26740/etj.v2n1.p34-44

Astiting, A. (2018). Pengembangan Buku Ajar Berbasis Ensiklopedia Plus Mind Mapping Materi Zoologi Vertebrata pada Prodi Pendidikan Biologi UIN Alauddin Makassar. Thesis, Universitas Islam Negeri Alauddin Makassar.

Astuti, M.S.D. (2018). Pengembangan Modul Pembelajaran Biologi Bernuansa Islami Berbasis Inquiry Terbimbing untuk Memberdayakan Kreativitas Belajar Peserta Didik, Thesis, Universitas Islam Negeri Raden Intan Lampung.

Borg, W.R. & Gall, M.D. (1983). Educational Research. An Introduction. New York: Longman Inc.

Brahim, T. K. (2007). Peningkatan hasil belajar sains siswa kelas IV sekolah dasar, melalui pendekatan pemanfaatan sumber daya alam hayati di lingkungan sekitar. Jurnal Pendidikan Penabur, 9(6), 37-49. https://doi.org/10.36989/didaktik.v8i2.559

Branch, R. M. (2009). Instructional design: The ADDIE approach (Vol. 722). New York: Springer.

Erawati, A., & Susanti, L. Y. (2022). Development of E-Booklet Learning Media in the Topic of Environmental Pollution for Junior High School Students. Indonesian Journal of Mathematics and Natural Science Education, 3(2), 96-106. https://doi.org/10.35719/mass.v3i2.82

Febriani, A. V. (2021). Pengembangan Ensiklopedia Keanekaragaman Cendawan di Desa Bleber Bener Purworejo sebagai Sumber Belajar Mandiri Siswa SMA/MA. Neuron: Journal of Biological Education, 1(1), 39-50. https://doi.org/10.14421/neuron.2021.11-04

Fikriyah, A., Sandika, B., & Wijaya, E. Y. (2020). Evaluating pre-service science teachers' concept mastery in the topic of biodiversity during distance learning under circumstance of Covid-19 pandemic. Jurnal Inovasi Pendidikan IPA, 6(2), 209-216. https://doi.org/10.21831/jipi.v6i2.35033

Harahap, M. P., & Nasution, N. E. A. (2022). Validity of Computer Based Learning Media to Improve Junior High School

DOI : http://doi.org/10.35719/mass.v2i2.70

Students' Learning Outcomes on Ecosystem Topics. META: Journal of Science and Technological Education, 1(1), 31-45. https://meta.amiin.or.id/index.php/meta/article/view/3

Harahap, F., & Nasution, N. E. A. (2020). Pengembangan Ensiklopedia Perbanyakan Tanaman Melalui Kultur Jaringan Sebagai Sumber Belajar Tambahan Untuk Siswa SMA. Jurnal Pelita Pendidikan, 8(1), 52-61. https://doi.org/10.24114/jpp.v8i1.17301

Harahap, F., Nasution, N. E. A., & Manurung, B. (2019). The Effect of Blended Learning on Student's Learning Achievement and Science Process Skills in Plant Tissue Culture Course. International Journal of Instruction, 12(1), 521-538. https://doi.org/10.29333/iji.2019.12134a

Hasanah I., Wahyuni S, & Bachtiar R.W. (2016). Pengembangan modul mitigasi bencana berbasis potensi lokal yang terintegrasi dalam pelajaran IPA di SMP. Jurnal Pembelajaran Fisika 5(3), 226 – 234.

Herawati, N. S., & Muhtadi, A. (2018). Pengembangan modul elektronik (e-modul) interaktif pada mata pelajaran Kimia kelas XI SMA. Jurnal Inovasi Teknologi Pendidikan, 5(2), 180–191. https://doi.org/10.21831/jitp.v5i2.15424

Lee, W. W., & Owens, D. L. (2004). Multimedia-based instructional design: computer-based training, web-based training, distance broadcast training, performance-based solutions. John Wiley & Sons.

Imani, M. F., & Ira Nurmawati. (2023). Development of Interactive Learning Media Using Lectora Inspire on Nervous System Topic for Senior High School Students. Indonesian Journal of Mathematics and Natural Science Education, 3(2), 87-95. https://doi.org/10.35719/mass.v3i2.77

Indonesia National Education Standards Agency. (2018). Standar Nasional Pendidikan.

Irdawati, I., Chatri, M., Wulansari, K., Razak, A., & Fajrina, S. (2023). Development of stem-based biology e-module to improve student learning outcomes. Jurnal Penelitian Pendidikan IPA, 9(8), 6694-6700. https://doi.org/10.29303/jppipa.v9i8.4737

Kottelat, M., J.A. Whitten., S. Wirjoatmodjo, S.N. Kartikasari. (1993). Freshwater Fishes of Western Indonesia and Sulawesi. Jakarta: Periplus Edition Ltd.

Mijaya, N. P. A. P., Sudiatmika, A. A. I. A. R., & Suardana, I. N. (2021). Pengembangan e-modul pemebelajaran IPA SMP kelas VII berbasis model pembelajaran levels of inquiry untuk meningkatkan literasi sains siswa Development of Sains Learning E-Module for Class VII Junior High School Based on The Levels of Inquiry Learning Mode. 12(2), 220–237. http://dx.doi.org/10.20527/quantum.v12i2.11258

Muttaqin, H. P. S., & Suarni, N. K. (2021). Pengembangan media pembelajaran interaktif berbasis android pada mata pelajaran IPA pokok bahasan perkembangbiakan hewan untuk siswa kelas VI SD. Jurnal Teknologi Pembelajaran Indonesia, 11(1), 1-15. https://doi.org/10.23887/jurnal_tp.v11i1.613

Nadifah, L. U. (2018). Pengembangan game "PADUKA. exe" berbasis RPG Maker MV sebagai media belajar mandiri pada materi Fungsi Komposisi. Thesis, UIN Sunan Ampel Surabaya.

Nasution, N. E. A., Rizka, C., Wardani, I. B., & Nurlim, R. (2024). Upaya dan Manfaat Pelestarian Sungai Masyarakat Panyabungan Barat Sumatera Utara Berbasis Kearifan Lokal Lubuk Larangan. Symbiotic: Journal of Biological Education and Science, 5(1), 15-33. https://doi.org/10.32939/symbiotic.v5i1.104v

Nasution, N.E.A., Al Muhdhar, M.H.I., Sari, M.S., & Balqis (2023). Relationship between Critical and Creative Thinking Skills and Learning Achievement in Biology with Reference to Educational Level and Gender. Journal of Turkish Science Education (TUSED), 20(1), 66-83. https://doi.org/10.36681/tused.2023.005

Nasution, N.E.A. (2022). Media

pembelajaran untuk pendidikan di abad 21. Lumajang: Klik Media.

Negara, R. M. H. ., Suherman, A., & Yayat. (2019). Pengaruh Penggunaan Modul Pembelajaran Berdasarkan Kurikulum Smk 2013 Terhadap Hasil Belajar Siswa Pada Mata Pelajaran Sistem Dan Instalasi Refrigerasi. Journal of Mechanical Engineering Education, 6(1), 64–70. https://doi.org/10.17509/jmee.v6i1.18244

Nesri, F. D. P., & Kristanto, Y. D. (2020). Pengembangan modul ajar berbantuan teknologi untuk mengembangkan kecakapan abad 21 siswa. AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 9(3), 480-492. http://dx.doi.org/10.24127/ajpm.v9i3.2925

Novana T, Sajidan, & Maridi. (2014). Pengembangan modul inkuiri terbimbing berbasis potensi lokal pada materi tumbuhan lumut (bryophyta) dan tumbuhan paku (pteridophyta). Jurnal Inkuiri 3(1), 108-122. https://doi.org/10.20961/inkuiri.v3i2.9720

Phandini, I., Miharja, F. J., Husamah, H., Fauzi, A., & Nuryady, M. M. (2023). STEM-PBL integrative electronic module: Is that effective in improving students' critical thinking skills?. Jurnal Inovasi Pendidikan IPA, 9(2), 118-126. http://dx.doi.org/10.21831/jipi.v9i2.60871

Regulation of the Minister of Education and Culture of the Republic of Indonesia (2017). E-Module Creation Guide.

Romdaniyah, S., Nasution, N. E. A., & Rizka, C. (2023). Analysis of Biology Learning Planning on Plant Tissue Course in the Independent Learning Activity Unit (UKBM) based on Scientific Approach Class XI MIPA 5 at MAN Sumenep. META: Journal of Science and Technological Education, 2(2), 87-95. https://meta.amiin.or.id/index.php/meta/article/view/57

Saanin, H. (1968). Taksonomi dan Kuntji Identifikasi Ikan. Binatjipta, Bandung.

Sandika, B., & Fitrihidajati, H. (2018). Improving creative thinking skills and scientific attitude through inquiry-based learning in basic biology lecture toward student of biology education. JPBI (Jurnal Pendidikan Biologi Indonesia), 4(1), 23-28. https://doi.org/10.22219/jpbi.v4i1.5326

Sarah,S&Maryono.(2014a).Pengembangan perangkat pembelajaran berbasis potensi lokal untuk meningkatkan living values peserta didik SMA di kabupaten Wonosobo. Jurnal Teknologi Technoscientica, 6(2), 185-194. https://doi.org/10.34151/technoscientia.v6i2.570

Sarah, S.& Maryono. (2014b). Keefektivan pembelajaran berbasis potensi lokal dalam pembelajaran fisika SMA dalam meningkatkan living values siswa. Jurnal Pendidikan Sains, 2(1), 36-42. https://doi.org/10.26714/jps.2.1.2014.36-42

Sholihah, L. R., Nasution, N. E. A., & Rizka, C. (2024). Analysis of Peer Friendship, Learning Interests, and Biology Learning Results of Class X Students at Plus Bustanul Ulum Puger Jember Senior High School. META: Journal of Science and Technological Education, 3(1), 76-88.

Sofyan, M., & Nasution, N. E. A. (2022). Need Analysis of Animalia Learning Media for Class X at MA Miftahul Ulum Suren Jember After the Covid-19 Pandemic. META: Journal of Science and Technological Education, 1(2), 132-137. https://meta.amiin.or.id/index.php/meta/article/view/19

Sunarsih, S., Rahayuningsih, M., & Setiati, N. (2020). The Development of Biodiversity Module Using Discovery Learning Based on Local Potential of Wonosobo. Journal of Innovative Science Education, 9(1), 1-11. https://doi.org/10.15294/jise.v8i1.31178

Suryaningsih, Y. (2017). Pembelajaran berbasis praktikum sebagai sarana siswa untuk berlatih menerapkan keterampilan proses sains dalam materi biologi. Bio Educatio, 2(2), 49-57. http://dx.doi.org/10.31949/be.v2i2.759

Syahrial, S., Asrial, A., Kurniawan, D. A., & Damayanti, L. (2021). Comparison of Print Modules and E-Modules to

DOI : http://doi.org/10.35719/mass.v2i2.70

the Tolerance Character of Students. International Journal of Elementary Education, 5(2), 298-307. https://doi.org/10.23887/ijee.v5i2.34351

Wurarah, M., & Semuel, M. Y. (2019). Development of audio visual learning media of biology on the concept of DNA, based on the results of molecular identification of Payangka Fish from Lake Tondano. European Journal of Health and Biology Education, 8(1), 1-17. https://doi.org/10.12973/ejhbe.8.1.1

Wahyuni, S. (2015). Developing science learning instruments based on local wisdom to improve students' critical thinking skills. Jurnal Pendidikan Fisika Indonesia, 11(1), 1-7. https://doi.org/10.15294/jpfi.v11i2.4228

White, W.T., P.R. Last, Dharmadi, R. Faizah, U. Chodrijah, B.I. Prisantono, J.J. Pogonoski, M.Puckridge & S.J.M. Blaber. (2013). Market Fishes of Indonesia. Australian Centre for International Agricultural Research. Canberra.

Wijaya, D. M., Arnyana, I. B. P., & Citrawathi, D. M. (2022). Development of a Biology E-module Based on Guided Discovery Learning on Ecosystem and Environmental Topics to Improve High School Student Learning Outcomes. Wahana Matematika dan Sains: Jurnal Matematika, Sains, dan Pembelajarannya, 16(1), 29-39. https://doi.org/10.23887/wms.v16i1.42749

BRIEF PROFILE

Nanda Eska Anugrah Nasution is a lecturer at the biology education study program at UIN Kiai Haji Achmad Siddiq Jember. Moch Sofyan is a graduate of the biology study program at UIN Kiai Haji Achmad Siddiq Jember.