

Development of an e-module based on virtual practicum integrated with local potential in invertebrate material

Herditiya, Mustika Sari *, Sri Koryati

Study Program of Biology Education, Faculty of MIPA and Tecnology Education, Institut Keguruan dan Ilmu Pendidikan PGRI Pontianak, Pontianak, West Kalimantan, Indonesia

*Corresponding Author Email: mvztika.sari@gmail.com

Article Information

Keyword:

E-module, Invertebrate material; Virtual practicum; Local potential

Kata Kunci:

E-modul; Materi avertebrata; Praktikum virtual; Potensi lokal

History:

Received : 14/02/2023

Accepted : 12/06/2023

Abstract

Invertebrate learning is integrated with practicum activities, while the learning outcomes are directly identifying and analyzing the general characteristics of species. The electronic module (e-module) illustrates the innovative use of technology in education, which helps limited facilities and infrastructure, to carry out actual practicum in invertebrate learning activities. This study aims to determine the validity, practicality, and effectiveness of using e-modules based on virtual practicum on invertebrate material. This research method is Research and Development (RnD) adapted from Borg and Gall. The application used to develop e-modules is PubHTML5. This study produced an e-module practicum systematized invertebrate based on virtual practicum integrated with local potential, with a very valid level of validity, a practical result of 92.87%, and the effectiveness of the N-Gain value of 0.97 in the high category. So that the e-module based on virtual practicum integrated with local potential that is developed is feasible and practical to use in invertebrate practicum activities, and effectively improves student learning outcomes. With e-modules based on virtual practicum integrated with local potential, hampered laboratory activities can be carried out efficiently.

Abstrak

Pembelajaran avertebrata terintegrasi dengan kegiatan praktikum, adapun capaian pembelajarannya ialah mengidentifikasi dan menganalisis ciri-ciri umum spesies secara langsung. Modul elektronik (e-modul) merupakan gambaran pemanfaatan inovatif teknologi dibidang pendidikan yang membantu keterbatasan sarana dan prasarana, untuk melakukan praktikum riil pada kegiatan pembelajaran avertebrata. Penelitian ini bertujuan untuk mengetahui validitas, kepraktisan, dan keefektifan penggunaan e-modul berbasis virtual praktikum pada materi avertebrata. Metode penelitian ini adalah *Research and Development* (RnD) yang diadaptasi dari Borg dan Gall, Aplikasi yang digunakan untuk mengembangkan e-modul ialah *PubHTML5*. Penelitian ini menghasilkan e-modul praktikum sistematis avertebrata berbasis virtual praktikum terintegrasi potensi lokal, dengan tingkat kevalidan sangat valid, hasil kepraktisan sebesar 92,87%, dan keefektifan dari nilai N-Gain sebesar 0,97 dengan kategori tinggi. Sehingga e-modul berbasis virtual praktikum terintegrasi potensi lokal yang dikembangkan layak dan praktis digunakan dalam kegiatan praktikum avertebrata, serta efektif meningkatkan hasil belajar mahasiswa. Adanya e-modul berbasis virtual praktikum terintegrasi potensi lokal, kegiatan laboratorium yang terhambat dapat dilaksanakan dengan mudah.

A. Introduction

Biology learning is a place to improve knowledge, skills, character and values, and responsibility towards nature. The acquisition of knowledge must include process capabilities through scientific strategies. Thus, in science learning, activities in the laboratory are characteristic and integrated into the learning system (Sukenti, 2021). Several biology courses require laboratories with tools and materials that cannot be obtained quickly and cheaply and must meet proper standards. One of them is the invertebrate course. The achievements that students must obtain in this course are identifying and analyzing general and particular characteristics along with examples of species from each invertebrate phylum. However, laboratory activities become hampered in distance learning, so internet-based alternative media is an option to assist the learning process, one of which is an electronic module.

The electronic module (e-module) illustrates the use of technology in education. The development of Information and Communication Technology (ICT) encourages efforts to update the progress of innovative learning systems (Mirawati et al., 2021). The advantages of using e-modules are as products that users can use through applications and internet access freely.

Invertebrate practicum activities can also be supported by conducting field lectures in areas with a sea with diverse invertebrate animals. One location with a wealth of marine life in West Kalimantan is Lemukutan Island. This island is located in Bengkayang Regency and is approximately 100 Km from Pontianak City. This island has a wealth of marine life, including seaweed, coral reefs, fish, sea cucumbers, and sponges (Armaida & Khotimah, 2016). Herditiya et al. (2020), in their research, have utilized the local potential of Lemukutan Island by identifying invertebrate animals found on Lemukutan Island. Sponges (Porifera), jellyfish, coral reefs, sea cucumbers, and sea urchins are among the biota that can be found at this location so that it can be used as a location for field studies. Problems occur when conducting field lectures, including taking a long time, labor, and funds, which are expensive because of the location far from Pontianak City. In addition, if it occurs during a pandemic, it will cause restrictions on areas, spaces, and activities.

The conditions of limited facilities and infrastructure, inconvenience, and funds that must be spent to carry out real practicums in biology learning activities can be circumvented by virtual practicums that are carried out online (Ferreira et

al., 2010). In addition, practicum becomes more natural by presenting the actual location when learning occurs. The use of virtual practicum is more exciting and clarifies learning material, especially those that are conceptual and virtual practicum is appropriate for use in learning (Nisa & Rinanto, 2019; Anggrella et al., 2021). As shown by Mirawati et al. (2021), using virtual labs is a very practical and attractive tool for students and can lead students to concretize ideas of learning material. According to Lai et al. (2022), students reacted positively to the Science Virtual Lab in the experimental class compared to the control class. Besides, Vergara et al. (2022); Potkonjak et al. (2016) state virtual labs have tremendous potential to support science education and the learning process, especially for distance learning, for example, during the Covid pandemic.

This study aims to develop an e-module practicum based on a virtual practicum integrated with local potential to assist students in a remote practicum in invertebrate courses.

B. Material and Method

The research conducted was Research and Development (RnD) research adapted from Borg and Gall and modified by Sugiyono (2018). The Borg and Gall stages have ten stages. At the ten stages above, the implementation of the research can only be carried out up to the eighth stage, namely trial use, and not yet in mass production. This research has not yet been disseminated the product, due to limited time for research conducted during the Covid 19 pandemic. The sample in this study was 23 students of the Biology Education Study Program who took the Invertebrate Systematics practicum course. The Borg and Gall development charts according to Sugiyono (2018) as Figure 1.

This development research procedure will produce or develop a product as an e-module based on virtual practicum by carrying out several product validations, validated by media and material experts, and conducting product trials to its practicality and effectiveness. Data collection uses questionnaires and tests. The tests given are before the practicum (pre-test) and after the practicum (post-test). The questions are given in the written test in the form of essay test questions. The data analysis technique is based on the validation of material and media experts, carried out using a 1-4 scale questionnaire with Formula 1. The practicality is analyzed using Formula 2.

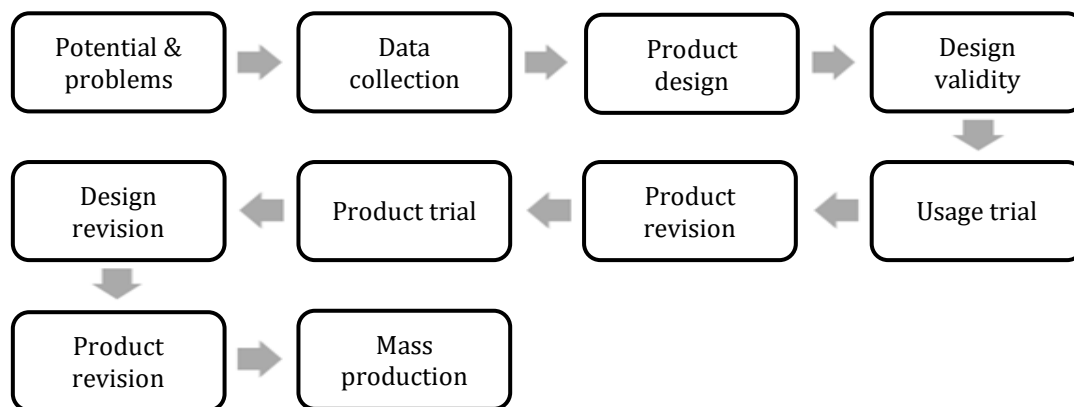


Figure 1 Bord and Gall chart (Sugiyono, 2018)

Effectiveness seen from the results of student practicum is measured using N-gain. Gain is said to increase learning outcomes if the cognitive ability of the N-gain value is at least > 0.7 with moderate criteria. Assessment of student learning outcomes can be adjusted according to high, low, and medium criteria and can be seen in the N-gain score criteria. The N-gain index is calculated using Formula 3, while the normalized N-Gain can be seen in Table 1.

$$P = \frac{f}{n} \times 100\% \dots \dots \dots \text{Formula 1}$$

Descriptions:

- P = Percentage
- f = Answer Frequency
- n = Maximum score total of assessment aspect

$$Vp = \frac{TSEp}{S-max} \times 100\% \dots \dots \dots \text{Formula 2}$$

Descriptions:

- Vp = Practicality
- TSEp = Empiric score total of practicality
- S-max= Maximum Score

$$N-Gain = \frac{S_{postest} - S_{pretest}}{S_{Maximum} - S_{Pretest}} \dots \dots \dots \text{Formula 3}$$

Table 1 The N-Gain Index Criteria

Intervals	Criteria
<g > ≥ 0,7	High
0,3 <<g > ≤ 0,7	Medium
<g > ≤ 0,3	Low

(Source: Hake, 1999)

C. Results and Discussion

The e-Module practicum of Invertebrate Systematics based on a virtually integrated practicum of local potential has been validated by material experts and media experts. Trials have been carried out on a limited and expansive scale. Its effectiveness has been seen for biology

education students IKIP PGRI Pontianak who have taken practicum for the Systematics course invertebrate.

a. Validity of E-Module Practicum Invertebrate Systematics Based on Virtual Practical Integrated Local Potential

The e-Modules that have been developed are then validated by material experts and media experts. This stage is done to see the feasibility of the e-module according to the assessment and views of experts following the field. In line with Mailani & Wulandari (2022), the results of the book analysis aim to show the eligibility of the contents of the book according to the validator's assessment. The recapitulation of the validity results by material and media experts is presented in Table 2.

Based on the validation Table 2 by material experts, the average validity is 84.62 and is categorized as very valid. The e-module is said to be very feasible because the material contained in the module is brief material that fits practicum needs. In contrast, the material presented in the e-module is presented according to the phylum group that will be practiced, namely a brief theoretical basis that discusses phylum Porifera, phylum Cnidaria, phylum Mollusca, phylum Arthropoda, and phylum Echinodermata. The language used in the module is a standard language easily understood by students. The material discussed includes the characteristics of each phylum, the morphology of each phylum, the reproduction of each phylum, and the types of invertebrates based on their phyla.

Based on the practicum e-module media validation, the validator average was 89.32, with a very valid category. The highest aspect of the media assessment given by the validator is the aspect of ease in operating this practicum e-module, which is 97.92%. The development of this e-module is based on an analysis of the needs required by students

during the invertebrate practicum. Besides that, the e-module can also be used for a long time. This is in line with the results of research Winatha et al. (2018), which state that the form of presenting teaching materials in electronic form is based on several factors, including.

- 1) Technological developments have shifted the existence of printed teaching materials because they are considered more practical and efficient and can support all media components that are needed in learning, such as images, audio, and video;
- 2) Electronic modules have advantages and components contained in printed modules; and
- 3) Electronic teaching materials are proven to be effectively used in learning.

The update of this E-Module is that it is compiled and operated through the PubHTML5 online application www.pubhtml5.com. Rahima et al. (2022) states Flip HTML5 is an application or website that is used to convert PDF doc files to flipbook form, which makes teaching materials interactive. Students can start the practicum when they have opened the link and read the instructions for use. The appearance of the e-module design created is as Figure 2 and Figure 3.

Based on Laili et al. (2019); Permatasari et al. (2022), E-modules that provide light text to understand and images closer to the natural form of a component help students more easily remember when the original component is used.

Practicum materials can be opened by scanning the barcode code in each material. The barcode already contains the basic theory of practicum, practicum tools and materials, how practicum works, practicum videos, observation tables, and post-test questions as evaluation. The practicum e-module that has been prepared follows the presentation of the contents of the characteristics of the module. According to Mentu et al. (2022), five aspects can be assessed: self-instruction, self-contained, stand-alone, adaptive, and user-friendly. This e-module follows the characteristics of self-instruction because students can use it independently without help from other people. This is because the e-module already

contains a guide for using the e-module and its virtual practicum guide. This module also follows the characteristics of self-contained, where the material's content in this e-module is adapted to the learning outcomes of invertebrate systematics through practicum activities.

The stand-alone characteristic means the developed e-module does not depend on media or other teaching materials. The e-module is equipped with a link to the virtual practicum via video, which can be accessed itself. So that students can use it outside the laboratory without instructions from assistants or practicum supervisors. The characteristics of the next module are adaptive, namely e-modules that are developed according to the development of science and technology. This e-module utilizes a web application with a flipbook feature so that the appearance of the e-module becomes attractive and innovative. The next characteristic is user-friendly. Students can easily use the developed e-module, which can be seen from the material and media expert validator's assessment of language that is easily understood by 94.00%, and the ease of use of the e-module is 97.92%. The results of improvements from media experts and material experts were then tested on a limited scale with 12 students, with an average response of 91.67%. The readability aspect with a high percentage of students is the cover design, size, color, and image of 95.83%. This is because the cover design is attractive and compatible with the material's contents to be discussed, while the sizes, colors, and images used in this e-module follow the topics in each practicum material. The practicum e-module is made as attractive as possible so that students can read it well and easily understand the contents and workings of the practicum. This e-module questionnaire analysis aims to look at the practicum e-module from the side of the reader or user of the practicum e-module. So that the development of this e-module can indeed be applied according to its function and purpose. Crossley et al. (2019); Tekad & Rina (2021) states that the readability of a text is a measure of whether or not a reading is appropriate in terms of the difficulty or ease of discourse.

Table 2 Recapitulation of Media and Material Experts

No.	Component	Percentage	Criteria
Material Expert			
1.	Content validity	89,00	Very Valid
2.	Presentation	68,50	
3.	Language	94,00	
4.	Characteristic	87,00	
	Average	84,62	
Media Expert			
1.	Graphics quality	89,32	Very Valid



Figure 2
 Display of the e-module front page (in Indonesian)

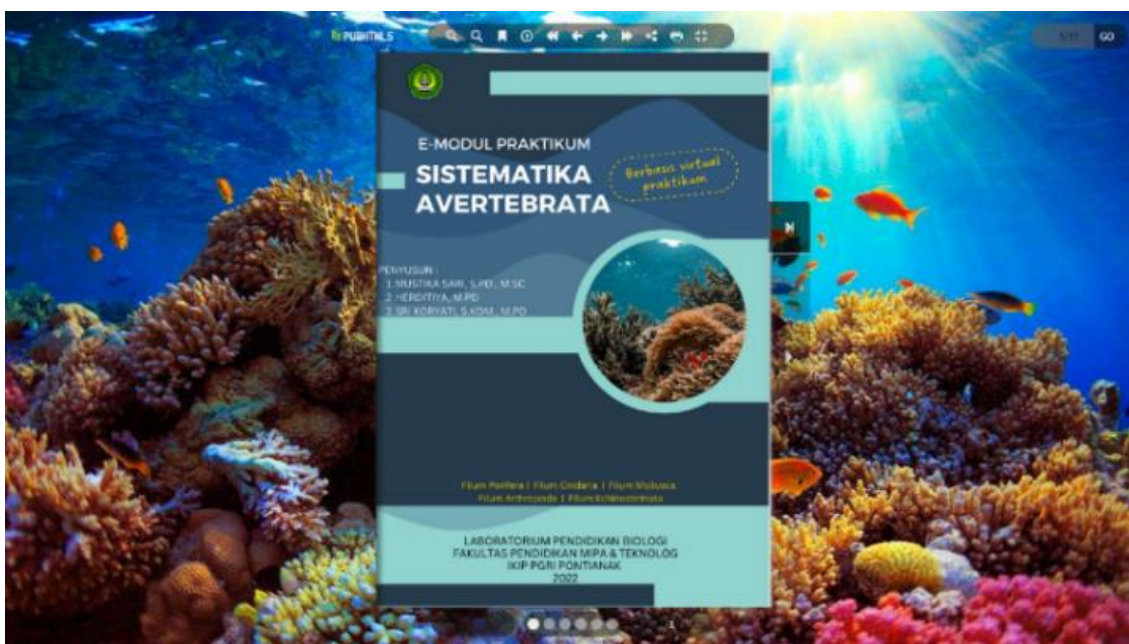


Figure 3
 Display of practicum achievements and practicum material pages that can be opened by scanning each barcode (in Indonesian)

b. Practicality of E-Module Practicum Invertebrate Systematics Based on Virtual Local Potential Integrated Practicum

Based on the results of the validation of material and media experts and limited-scale trials, the e-module can be used in large-scale trials of 23 Biology Education Study Program students conducting practicums. This wide-scale test was conducted to see students' responses to practicality when using the practicum e-module (Table 3).

The aspect with the highest average is using e-modules, which has an average of 95.65%. This means that the e-module that has been developed can be used easily by students during practicum. This aligns with Muzijah et al. (2020), which states that practicality is the ease of using e-modules in the learning process. The e-module is easy to use. Darmaji et al. (2020) states that during the practicum, students can read the instructions for using the e-module and the practicum instructions

printed on the e-module. They can do the practicum because a practicum video and observation table have been provided.

Assessment of the feasibility and practicality of this e-module of invertebrate systematics practicum produced several advantages and disadvantages. The advantages of this practicum e-module are developed as product updates, including.

- 1) Invertebrate practicum e-module integrated with virtual practicum, which utilizes exploratory videos as practicum media.
- 2) Make it easier for students and lecturers to carry out practicum activities because they are not limited by space and time, so time is efficient in carrying out practicums.
- 3) Students are more active and critical because they carry out independent practicum activities because students explore for themselves, and conclude their observations.
- 4) The types of invertebrates displayed in the e-module are part of the diversity of local potential in West Kalimantan.
- 5) Post-test questions are available as a competency test after completing the practicum. Students can quickly evaluate

practicum material by working on post-test questions.

This is in line with research Rismayanti et al. (2022) that the use of e-modules can divert users' attention to learning content that is more useful to provide solutions to address challenges to technological and information advances in the world of education.

The disadvantages of this e-module are:

- 1) Not all types of invertebrates in West Kalimantan are listed in this e-module,
- 2) Accessibility of the practicum e-module is connected if there is an internet network,
- 3) The quality of the virtual practicum video is still not HD because the practicum video does not come from personal documentation.

Practicum e-Modules can be an alternative solution for students carrying out practicum activities, especially on natural biology practicum material. The use of e-modules in biology learning is also supported by research by Bahri (2021), which states that electronic modules (e-modules) can make it easier for students to understand the material besides being superior in fostering learning motivation, especially Biology material.

Table 3 Recapitulation of E-Module Practicality Responses

No	Assessment Aspects	Percentage
1	Easy to understood	93,48
2	Independent learning	91,30
3	Learning effectiveness	93,48
4	Learning interest	91,30
5	Presentation	92,03
6	Usage	95,65
Average		92,87

c. The Effectiveness of E-Module Practicum Invertebrate Systematics Based on Virtual Local Potential Integrated Practicum

Effectiveness was taken to see the effectiveness of using e-modules during invertebrate systematics practicum through pre-test and post-test. Furthermore, this Prepost is carried out by analyzing the N-Gain value to see an increase in learning outcomes during practicum. The N-Gain data is shown in Table 4.

Based on the results of student responses, it can also be seen that students' cognitive level through the effectiveness of the practicum e-module is based on the results of the pre-test and post-test. The pre-test and post-test values are carried out by N-Gain analysis. The N-Gain value of 0.96 refers to the high category, so it can be said that the e-module Practicum Based Virtual Practical Integrated Local Potential is effectively used during

practicum in invertebrate systematics. The effectiveness test is carried out as a measure of the success rate of a learning process. According to Laili et al. (2019), e-modules can be said to be effective if they have a good impact on student learning outcomes.

This practicum e-module is said to be effective based on the results of the post-test, which has a higher score than the previous pre-test score, meaning that the practicum e-module has an instructional impact on student abilities seen from cognitive abilities, namely the difference in pre-test and post-test scores and student skills in operating the e-module and conducting virtual invertebrate systematics practicums using virtual video-based e-modules.

Based on the results of the pre-test-post-test that has been carried out, the average post-test value is 72.45, while the classical class value in the

invertebrate systematics practicum is 75%. According to Puspridayanti & Agus (2018); Arizka & Khairuna (2022); Pantiwati & Sari (2022),

learning success is achieved when more than half of the students achieve the Minimum Mastery Criteria (KKM).

Table 4 Data on N-gain Effectiveness of the E-Module Invertebrate Systematics Practicum

No	Data	Result		N-gain	N-gain Category
		Pre-test	Post-test		
1	Average	47	72	0,96	High
2	Highest	79	88		
3	Lowest	12	60		
4	Complete		75%		
5	Not completed		25%		

This practicum e-module is also effectively used as a practicum e-module that helps students carry out practicums when they are far from coastal areas, seas, or islands. Students can still carry out practicums even though the conditions and circumstances are far from the sea coasts and islands.

This result aligns with the research by Suryanda et al. (2017), in which the virtual practicum could be utilized as a learning media for Biology. Besides, according to research by Suryaningsih et al. (2020), virtual practicum learning media on the concept of invertebrate animals can be used as an alternative learning biology, especially performance practicum activities, and increasing students' creative thinking. However, in contrast to the results of this study, Widodo et al. (2016) explained that the average score for the real practicum class was higher than that for the virtual practicum class. The actual practicum provides better conditions for developing students' creative thinking skills.

Based on these differences of opinion and from the results of research in the field, it is known that the limitations of this virtual practicum-based e-module are that not all of the diversity of invertebrates on Lemukutan Island can be presented through virtual practicum videos. Exploration of invertebrate diversity is still limited through discovery videos from YouTube search results. It is hoped that for the perfection of the virtual video practicum, it will be added based on the researcher's exploration. In the future, there will be more invertebrates presented.

D. Conclusion

This research resulted in an E-Module Practical Invertebrate Systematics Practicum Based on a Virtual Local Potential Integrated Practicum, which has been subjected to validation tests by material experts and media experts. The average result of material experts' validation of the practicum module was 89.64% and was declared very valid.

The average validation result by media experts was 89.32% and was declared very valid. Based on the results of the practical responses given to 23 students, an average practicality of 92.87% was obtained. It was stated to be very practical, meaning that the practicum e-module was practical and easy to implement during the invertebrate systematics practicum activities. Based on the effectiveness results, the N-Gain value was 0.96 with the high category, meaning that the e-module of effective practicum can increase the value of practicum when practicum activities of invertebrate systematics occur. This e-Module has the advantage that it is operated through the PubHTML5 application and is integrated with virtual practicums so that time is efficient in carrying out practicums. The types of invertebrates displayed in the e-module are part of the diversity of local potential in West Kalimantan.

E. Acknowledgement

Thank LPPM IKIP PGRI Pontianak for the funding provided so that this research could be carried out.

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