

## **Development E-Module of Traditional Balinese Medicinal Plants To Increase Learning Motivation in Biodiversity Material for Class X**

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### **Abstract**

The electronic modul (e-module) is a digital learning resource designed to enhance the educational experience. However, at SMA 06 Seluma, there is a noticeable lack of electronic teaching materials, particularly those based on local environmental content, like biodiversity. This study aims to develop a biodiversity e-module that draws from the surrounding environment and describe the readability and suitability of the e-module. The development process followed the 4-D model, which includes four stages: defining, designing, developing and disseminating but is limited to the developing stage. The research involved interviews and observations of medicinal plants. The findings identified 37 species of medicinal plants across 22 families utilized by the Bali tribe in Tawang Rejo Village. Validation results for the e-module were positive: content experts rated it 92% "very valid," media experts rated it 97.9% "very valid," and practical experts gave it a 94.3% "very valid" rating. Additionally, the readability test with students from class X Science 1 at SMA 6 Seluma resulted in a 97% "very practical" rating. These outcomes suggest that the medicinal plant biodiversity e-module is a valuable and effective supplementary learning tool for students.

**Kata kunci:** Electronic module, Biodiversity, Medicinal plants

## **Pengembangan E-Modul Tumbuhan Obat Tradisional Suku Bali Untuk Meningkatkan Motivasi Belajar Pada Materi Keanekaragaman Hayati Kelas X**

### **Abstrak**

Modul elektronik atau dikenal dengan sebutan "E-modul" adalah sumber belajar digital yang dirancang untuk meningkatkan pengalaman pendidikan. Di SMA 06 Seluma, terdapat kekurangan yang mencolok dalam bahan ajar elektronik, terutama yang berbasis konten lingkungan lokal seperti keanekaragaman hayati. Penelitian ini bertujuan untuk mengembangkan e-modul keanekaragaman hayati yang bersumber dari lingkungan sekitar dan mendeskripsikan keterbacaan dan kelayakan. Proses pengembangan mengikuti model 4-D, yang mencakup empat tahap: pendefinisian, perancangan, pengembangan dan penyebaran namun dibatasi sampai pada tahap pengembangan. Penelitian ini melibatkan wawancara dan observasi terhadap tumbuhan obat. Hasil penelitian mengidentifikasi 37 spesies tumbuhan obat dari 22 famili yang dimanfaatkan oleh suku Bali di Desa Tawang Rejo. Hasil validasi untuk e-modul ini menunjukkan hasil yang positif: ahli materi menilai modul ini dengan persentase 92% dan kategori "sangat valid," ahli media memberikan nilai 97,9% dengan kategori "sangat valid," dan praktisi pendidikan memberikan nilai 94,3% dengan kategori "sangat valid." Selain itu, uji keterbacaan atau kepraktisan dengan siswa kelas X IPA 1 di SMA 6 Seluma menghasilkan persentase 97% dengan kategori "sangat praktis". Hasil menunjukkan bahwa e-modul keanekaragaman hayati tumbuhan obat adalah alat belajar tambahan yang berharga dan efektif bagi siswa.

**Kata kunci:** Modul elektronik, Keanekaragaman hayati, Tumbuhan obat

## **INTRODUCTION**

The implementation of the 2013 Curriculum, which focuses on using a scientific approach to learning, will help students process skills through actions like observing, asking questions, collecting data, analyzing, and communicating, referred to as the "5M" method (Nurulloh & Puspasari, 2020; Wicaksono et al., 2020). The 5M learning experience makes students take on a more active role in their learning process. This shift moves the focus away from the teacher and towards the students, who become actively engaged in the learning activities, as is the main characteristic of scientific learning. In line with this goal, the implementation of scientific learning in the 2013 Curriculum is expected to properly foster the enhancement of students' problem-solving and critical thinking skills, which are essential aspects required in Biology learning (Yahdiyani et al., 2022; Yuliyanto et al., 2021). This is because Biology learning focuses on scientific processes, scientific products, scientific attitudes, and direct learning experiences (Suryaningsih & Aripin, 2020; Suryaningsih, 2016).

In the 21st century, scientific literacy and technological literacy have become parameters for the level of scientific achievement throughout the world. The challenges of the 21st century have changed the way we think about education and learning. Every individual must be aware of technological developments and use them as best as possible to help with their work. (Sureni et al., 2023). Current technological developments are also very continuous with the development of science. Currently, most modules are made in printed form. Because printed modules tend to be monotonous, this affects students' interest and enthusiasm for using them. One way to make modules more attractive to students is by creating modules in electronic form or e-modules which can be used as interactive media because they can be inserted with other media such as images, animation, audio or video (Herawati & Muhtadi, 2020).

Several studies on the development of e-modules state that electronic-based learning media such as e-modules are quite effective in the learning process today, but there is still a lack of development research that utilizes the surrounding environment as a research object, apart from that. The use of e-modules nowadays is very effective and practical, the use of e-modules in learning is not limited by place and time. In this way, the e-module developed can be used anytime and anywhere using smartphones which the average student has in this technological era so that students can also study the material independently anywhere. Apart from that, limited teaching materials when the

teacher explains can also be helped during the learning process or practicum. (Laili et al., 2019)

The findings from an interview with a teacher at SMAN 06 Seluma revealed that the teaching materials used in Biology learning, including biodiversity, only rely on Student Worksheets (LKS) and printed books from the library. According to the results of a student needs analysis survey of 10th-grade students at SMAN 6 Seluma, 88% of 10th-grade IPA 1 students stated that biodiversity material is one of the most difficult to understand and tends to be boring and confusing, so that the development of this module is expected to be able to increase the motivation and understanding of students in studying the material on biodiversity. The analysis also revealed that 100% of the students believe that new teaching materials as supplements to school materials are very much needed and beneficial as a form of varied teaching materials. Moreover, the questionnaire results showed that all students already use smartphones/handphones as learning aids, so integrating technology like smartphones into the learning process could be beneficial.

One of the best ways to leverage technology in the digital era is to utilize technology in developing teaching materials that can be easily accessed by students using their smartphones. It's crucial to provide more attractive and easier-to-learn Biology teaching materials as an important part of the 2013 curriculum era. E-modules can be a solution and a form of effective teaching material that can be developed because modules have five main characteristics which are their advantages, namely self-instructional (facilitates independent learning), self-contained (contains all material), stand-alone (does not depend on materials). teach others), adaptive, and use friendly (easy to use) (Lastri,2023).

One of the Biology topics that require direct learning experiences and scientific processes is the material on the Biodiversity of Living Things. Based on KD 3.2, this section focuses on analyzing the various levels of biodiversity in Indonesia, including its threats and conservation efforts. Biodiversity material is a term that encompasses all forms of life, including genes, plant and animal species, microorganisms, ecosystems, and ecological processes that occur within them. Moreover, this material contains intricate and detailed concepts because it studies the characteristics, variations, appearances, and sizes of living organisms (Angela & Aprianto, 2018; Novita et al.,2022).

Teaching materials such as textbooks used by students are also considered less interesting and less detailed in supporting learning, because the material presented in them is general in nature and has not been adapted to the surrounding learning environment. Meanwhile, in science learning, it is very important to integrate learning with the surrounding environment or certain local wisdom so that learning is relevant (Fadilah et al., 2024). The most effective way to develop teaching materials that support Biology learning, especially on biodiversity, is by incorporating local traditions and culture into the content of the e-module. Therefore, research on developing teaching materials by integrating the tradition of using medicinal plants by the Balinese community in Tawang Rejo Village in an e-module for biodiversity is important. Using e-modules as teaching materials in the K13 curriculum is highly appropriate and effective for learning. An e-module is a tool that offers independent learning through an electronic system (Fauziah et al., 2023).

## METHODS RESEARCH

Research and Development (R&D) was conducted in this study by following the steps of the 4D development model according to Thiagarajan. R&D is a type of research aimed at creating or developing a specific product and testing its effectiveness of that product (Lase & Harefa, 2022; Pitri et al., 2023). The 4D procedure consists of four key steps, as explained by Thiagarajan in 1974: define, design, develop, and disseminate (Indriana & Kamaludin, 2023; Khairi & Ikhsan, 2022). However, this research is limited to the development stage.

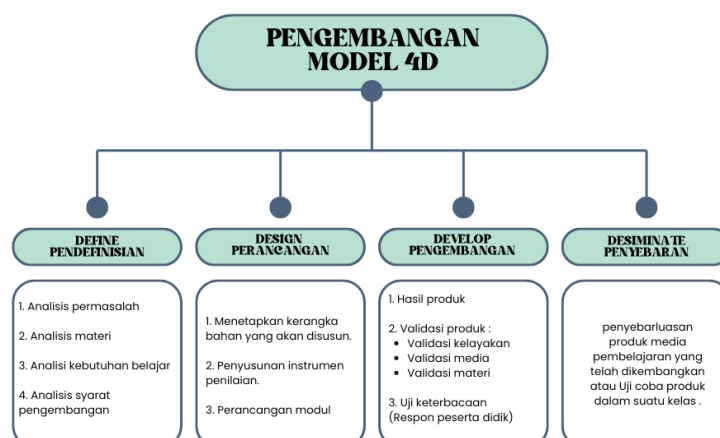


Figure 1. 4D Development model

The product developed in this research is an electronic module (e-module) that incorporates the utilization of various types of medicinal plants used by the Balinese people in Tawang Rejo Village. The research was conducted from January 2023 to June 2023. The research began with data collection and observation in Tawang Rejo Village, Seluma Regency, the major location for identifying medicinal plants. The data collected by the researchers include the morphology of plants, such as the shape of roots, leaves, stems, fruits, and flowers. The observations formed the basis of the content included in the e-module.

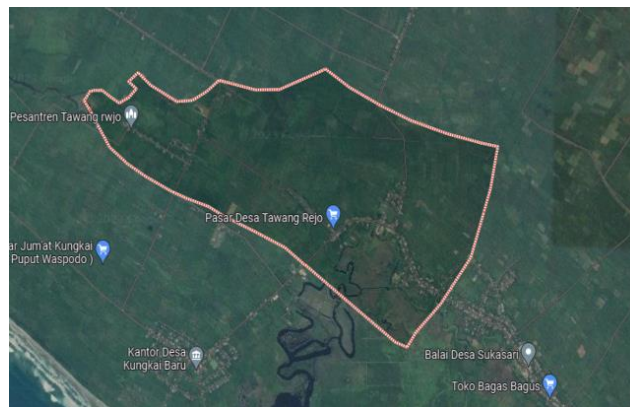


Figure 2. Location of tawang rejo village

In this research there are research subjects and objects, the subjects in this research are three validators, namely media experts, material experts and educational practitioners (1 high school biology teacher). As well as the subjects testing the readability of the e-module, namely 20 students of class X Science at SMAN 6 Seluma, while the research object is medicinal plants that are used by the Balinese tribal community of Tawang Rejo village using the *snowball sampling* technique. The instruments in this development research include interview sheets, questionnaire sheets, expert validation sheets and medicinal plant observation sheets.

The data analysis techniques used in this research include analysis of medicinal plant identification data, the feasibility test analysis of the medicinal plants e-module, and the readability test analysis for students. Four types of questionnaires were used during e-module development: expert validation questionnaires for media, material, and education practitioners, as well as student readability questionnaires. The analysis of medicinal plant identification data is aimed at observing the morphology of medicinal plants, such as root shape, leaves, stems, flowers, and fruits, by referencing them with plant identification books (flora), plant morphology books, medicinal plant books, and supporting literature.

The analysis of e-module feasibility testing was conducted based on the questionnaire data provided by three validators. The data from the feasibility validation test were analyzed by converting the quantitative data obtained into qualitative data. The percentage of feasibility validity testing was calculated using the following equation (Ningrum et al., 2022).

$$\text{Percentage of Validation Score: } \frac{\sum \text{Total Score}}{\sum \text{Maximum Score}} \times 100\%$$

The criteria for the feasibility validation test of the e-module, according to Teguh and Jempel in 2017, are presented in Table 1.

Table 1. Feasibility Test Criteria

Achievement Level	Qualification	Note
90%-100%	Very good	No revision needed
75%-89%	Good	Minor revisions needed
65%-74%	Fair	Some revisions needed
55%- 64%	Poor	Many revisions needed
0-54%	Very poor	Redo the product

Table 1 shows the feasibility test criteria with the lowest scale being very poor to the highest being very good. The final analysis of the product includes the student readability test, which involved giving a questionnaire to students. The readability test questionnaire was based on three assessment aspects, including the attractiveness aspect, material aspect, and language aspect. The questionnaire sheet used a Likert scale of 1 to 5 (1 = strongly disagree; 5 = strongly agree). The criteria for analyzing the results of the student readability test are presented in Table 2. The percentage calculation of the student readability test was calculated using the following formula based on the data obtained from the questionnaire sheet.

$$\text{Percentage: } \frac{\sum \text{Total Readability Score}}{\sum \text{Maximum Readability Score}} \times 100\%$$

Table 2. Readability Test Criteria for Students

Percentage	Criteria
80%-100%	Interesting, can be used without changes
60%-79%	Quite interesting, can be used with small changes
50%-59%	Not very interesting, should not be used because it needs big changes
< 49%	Not interesting, should not be used

(Source: Sari & Suryanti, 2022)

**RESULT AND DISCUSSION**

This research started with identifying the medicinal plants used by the Balinese community in Tawang Rejo village. Based on the interview results with the Balinese community in Tawang Rejo, it was found that the Balinese community in Tawang Rejo still often uses medicinal plants to treat certain diseases. The results of the interview with 20 people from the Balinese community in Tawang Rejo and the village head, as well as the identification of Balinese medicinal plants in Tawang Rejo, provided valuable information about the types of medicinal plants and the different types of medicinal plants and the different types of medicinal plants used by the community. The results of identifying different types of medicinal plants can be seen in Figure 1.

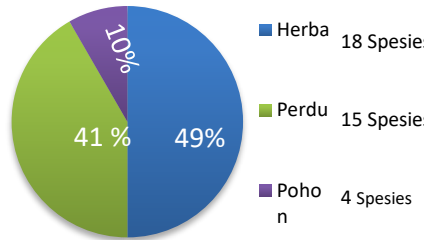


Figure 3. Number of Medicinal Plant Species by Habit

Figure 3 reveals the results of identifying medicinal plants revealed that 37 medicinal plant species were found to have relationships. These species were classified into 22 families. The most prominent families used for medicinal purposes were *Zingiberaceae*, *Piperaceae*, *Solanaceae*, and *Achantaceae*. The results of the classification of the use of medicinal plants by the Balinese tribe in Tawan Rejo village can be seen in the table 3.

Table 3. The results of the classification of the use of medicinal

No	Familli	Nama Spesies	Habitus	Bagian dimanfaatkan	Jenis Penyakit	
1.	Astareceae	1) Kenikir/ <i>Cosmos caudanus Kunth</i>	Perdu	Daun	Diabetes, Darah tinggi	
		2) Daun Insulin/ <i>Smalanthus sonchifolius</i>	Perdu	Daun	Darah tinggi	
		3) Beluntas/ <i>Pluchea Indica Less</i>	Perdu	Daun	Rematik dan Kolestrol	
2.	Achantaceae	4) Pecah Beling/ <i>Storbilanthes crisa</i>	Herba	Daun	Demam, Batu ginjal	
		5) Sambiloto/ <i>Andrographis paniculata</i>	Herba	Daun	Flu	
		6) <i>Paniculata</i>				
		7) Kencana Ungu/ <i>Ruellia tuberosa L</i>	Herba	Bunga dan Daun	Gatal dan Peradangan	

3.	Apiaceae	8)	Seledri/ <i>Apium graveolens L</i>	Herba	Daun	Kolestrol
4.	Caricaceae	9)	Pepaya/ <i>Carica papaya</i>	Herba	Daun	Demam berdarah
5.	Campanulaceae	10)	Bunga Bintang/ <i>Hippobroma longiflora</i>	Herba	Bunga dan Daun	Sakit gigi dan Luka
6.	Crassulaceae	11)	Sedingin/ <i>Kalanchoe Pinnata</i>	Herba	Daun	Demam
7.	Euphorbiaceae	12)	Jarak Pagar/ <i>Jatropha curcas L</i>	Perdu	Daun	Rematik dan Sariawan
8.	Fabaceae	13)	Lamtoro/ <i>Leucaena leucocephala</i>	Pohon	Buah dan Daun	Luka dan Diabetes
		14)	Dadap/ <i>Erythrina variegata</i>	Pohon	Daun	Darah tinggi dan Demam
9.	Iridaceae	15)	Bawang Dayak/ 16) <i>Eleutherine palmifolia</i>	Herba	Umbi	Darah tinggi
10.	Melastomataceae	17)	Senggani/ <i>melastoma candidum</i>	Perdu	Bunga	Nyeri
11.	Moringaceae	18)	Kelor/ <i>Moringa Oleifera</i>	Perdu	Daun	Asam Urat dan Kolesrol
12.	Myrtaceae	19)	Jambu Biji/ <i>Psidium guajava</i>	Perdu	Daun	Diare, DBD dan Diabetes
		20)	Daun Salam/ <i>Syzygium polyanthum</i>	Perdu	Daun	Darah tinggi
13.	Lauraceae	21)	Alpukat/ <i>Persea americana</i>	Pohon	Daun	Darah tinggi
14.	Lamiaceae	22)	Kumis Kucing/ <i>Orthosipon aristatus</i>	Herba	Bunga dan Daun	Asma
15.	Pandanceae	23)	Pandan/ <i>pandanus amaryllifolius</i>	Perdu	Daun	Darah tinggi, dan Nyeri
16	Piperaceae	24)	Sirih/ <i>Piper Betle</i>	Herba	Daun	Diabetes
		25)	Sirih Cina/ <i>Piperomia pellucida</i>	Herba	Daun	Diabetes
		26)	Merica/ <i>Piper Nigrum</i>	Pohon	Buah	Flu
17.	Poaceae	27)	Serai/ <i>Cymbopogon citratus</i>	Herba	Umbi	Anemia, Kolestrol
18	Rubiaceae	28)	Mengkudu/ <i>Morinda citrifolia</i>	Perdu	Buah dan Daun	Anemia, kolestrol
19.	Rutaceae	29)	Jeruk Nipis/ <i>Citrus X aurantifolia</i>	Perdu	Buah	Batuk
20.	Solanaceae	30)	Cepokak/ <i>Solanum torvum</i>	Perdu	Buah	Anemia
		31)	Ciplukan/ <i>Physalis angulate L</i>	Perdu	Daun dan Akar	Demam dan Kolestrol
		32)	Kecubung/ <i>Datura metel L</i>	Perdu	Daun	Asma
21.	Thymelaceae	33)	Mahkota Dewa/ <i>phaleria macrocarpa</i>	Perdu	Buah	Kolestrol
22	Zingiberaceae	34)	Lengkuas/ <i>Alpine galanga</i>	Herba	Umbi	Anemia
		35)	Kunir Putih/ <i>Curcuma zedoaria</i>	Herba	Umbi	Magh
		36)	Temulawak/ <i>Curcuma zantorriza</i>	Herba	Umbi	Penambah nafsu makan
		37)	Jahe/ <i>Zingiber officinale Roscoe</i>	Herba	Umbi	Imun tubuh
		38)	Kencur/ <i>Kaempferia galanga L</i>	Herba	Umbi	Darah tinggi
		39)	Kunyit/ <i>Curcuma domestica</i>	Herba	Umbi	Magh



Table 3 reveals the findings of the medicinal plant's analysis laid the foundation for developing an e-module for biodiversity materials in this research. Because of that, the e-module was created based on the utilization of Balinese medicinal plants found in Tawang Rejo village using the 4D development model by Thiagarajan. The developed e-module was then subjected to expert validation tests by media experts, material experts, and education practitioners. The expert validation test provided an assessment of the feasibility of the developed product. The results of the e-module validation test, based on the scores obtained from the validators, are summarized in Table 4.

Table 4. E-Module Validation Results by Validators

No	Validator	Assessment Aspect	Score Obtained	Maximum Score	Percentage (%)	Category
1	Media Expert	Size	8	8	100	Very Suitable
		Cover Design	16	16	100	
		Content Design	23	24	95.8	
		Total	47	48	<b>97.9%</b>	
		Content Feasibility Component Presentation	26	28	92.5	
2	Material Expert	Feasibility Component Language Aspect	24	28	85.7	Very Suitable
		Total	31	32	93	
		Total	81	88	<b>92%</b>	
		Content Feasibility Component Presentation	26	28	92.5	
3	Practitioner	Feasibility Component Language Aspect	27	28	96.4	Very Suitable
		Total	30	32	93.7	
		Total	83	88	<b>94.3%</b>	

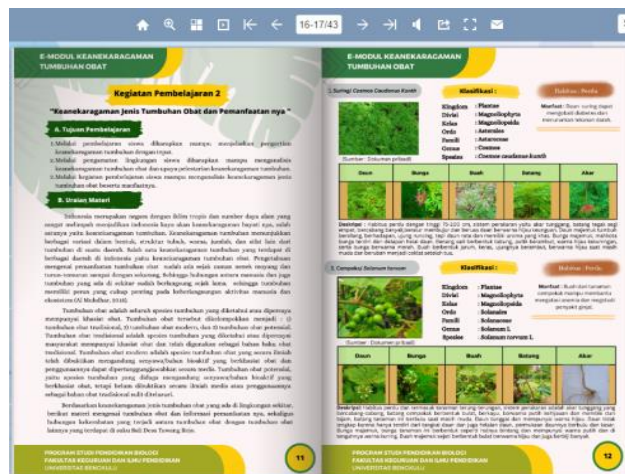
Table 4 reveals the validation results shown in Table 4 indicate that the developed e-module is suitable for use based on the percentage scores given by the media expert, material expert, and education practitioner with an average score of 94.7%. After being declared suitable, the e-module was subjected to a readability test by students. readability test conducted on 20 students of class X IPA SMAN 6 Seluma. The readability test was conducted to see and find out to what extent the developed e-module can be understood

by students such as language structure, material, appearance, and the entire e-module as well as student responses in studying the e-module. The results of the readability test can be seen in Table 5.

**Table 5. Readability Test Results by Students**

No	Assessed Aspect	Percentage	Category
1	Interest Aspect	96.2%	Very valid
2	Material Aspect	96.2%	Very valid
3	Language Aspect	99%	Very valid
	Average	97%	Very valid

Table 5 reveals the based on the readability test results shown in Table 4, all aspects of the readability test received a percentage above 90%, with a category of "very valid." From both analysis results, including the feasibility test and the readability test, the e-module developed received positive feedback. This finding demonstrates that the e-module, which showcases various medicinal plants used by the Balinese community in Tawang Rejo Village as material content, is suitable for use and very valid for students as teaching material for biodiversity topics and can increase student motivation in studying biodiversity material. The e-module was created using the Canva design application and Microsoft Word 2010. The developed e-module was then made in electronic form using the Flipbook application. Students access the e-module through the link: <https://online.fliphtml5.com/latxg/bksh/>. The appearance of the e-module using the Flipbook application can be seen in Figure 4.



**Figure 4. E-Module Display in Flipbook Format**

Figure 4 reveals the developed e-module also features an interactive quiz based on Wordwall, which can be played online to enhance students' engagement with the

study material and make the learning process more enjoyable. The quiz consists of 10 questions aligned with the core competencies (KD) developed. Students can answer the quiz by accessing the link: <https://wordwall.net/id/resource/53237177>. Using the e-module online or digitally is easy—students simply need to access the provided link, and the e-module will appear in a digital flipbook format. This allows students to read it like a digital book with available display options. Khamidah et al. (2019) explained that the application and use of interactive digital teaching materials strongly support learning and improve student performance by presenting content clearly through images, videos, and animations, all designed to be visually appealing.

Based on expert validation of the e-module, there were suggestions and comments from media and material experts for improving the e-module. Media experts noted that the digital format of the e-module could be more detailed and recommended adding a QR code to the cover for easier online access. Additionally, the e-module cover should be designed with contrasting colors and as attractive as possible to capture students' interest in studying or reading the e-module. The choice of colors and images in the e-module can be adjusted according to the needs. According to Asri & Dwiningsih (2022), a well-designed e-module should feature an engaging and aesthetically pleasing interface with a suitable combination of text color, font, and background, considering both aesthetic and functional aspects to make it easier for students to use as a learning resource. The e-module cover is shown in Figure 5.



Figure 5. Cover Before and After Revision

Figure 5 reveals the suggestions were obtained from content experts, including revising the e-module title, improving the glossary section, and refining the descriptions of medicinal plants. According to Angraini (2018), a comprehensive glossary should

include a wide range of vocabulary, which helps readers comprehend scientific terms encountered in a book and serves as a valuable knowledge resource. The revised glossary, based on expert feedback, is shown in Figure 6.

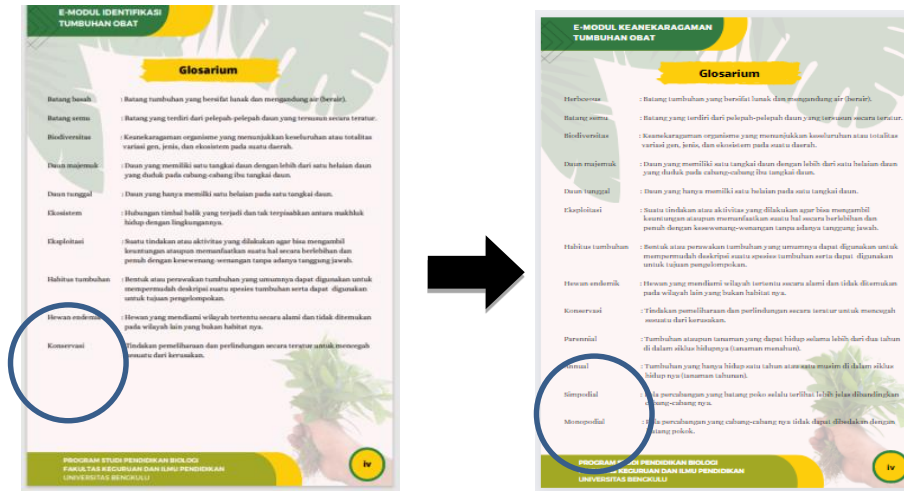


Figure 6. Glossary Before and After Revision

Figure 6 reveals the e-module developed as a supplementary learning tool for biodiversity was found to be highly engaging by students, according to the results of a readability test. This suggests that the e-module makes studying biology enjoyable for students and was able to increase students' learning motivation and also helps them feel more enthusiastic about learning biology without getting bored. The readability test was also conducted using electronic devices such as smartphones, which the students already use. It was done to evaluate the practicality of using the e-module and its online presentation. The trial demonstrated that students could easily access the e-module online using their mobile phones. The use of online quizzes, learning video links and all the elements in the e-module make students more interested and motivated in learning, especially studying the material independently.

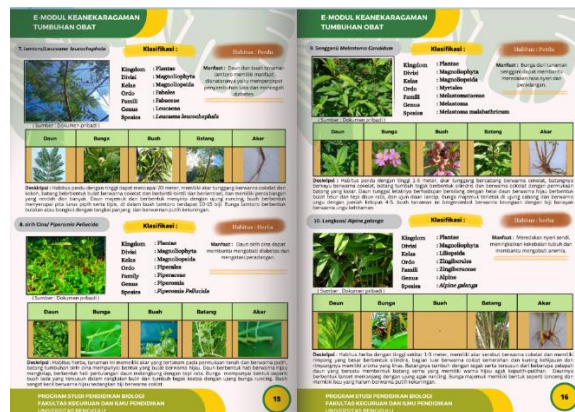


Figure 7. Content of medicinal plant diversity material

Figure 7 reveals the cultural wealth of the Balinese people regarding traditional medicine (indigenous medicinal knowledge) contained in the Balinese Lontar Usada. The Balinese Lontar Usada is a manuscript containing the treatment system, medicinal ingredients and traditional treatment methods that have important meaning and position in the traditional Balinese medicine treasury (Sutomo & Iryadi, 2019). Especially in Tawang Rejo village, people still quite often use traditional medicines that come from the environment so that it is very relevant to be studied in the material on biodiversity, through learning using this e-module students can get to know the types of plants and their kinship, besides that what is interesting is that through learning using this e-module students can also see the parts of medicinal plants in full, learn the benefits of medicinal plants and how to utilize medicinal plants, so that through learning using this e-module it can attract interest and also increase students' learning motivation through a learning process that is relevant to the surrounding environment. However, based on the results of research on the use of plants as medicine by the Balinese tribe in Tawang Rejo Village, there are also differences in results with the use of plants as medicine by other tribes. Differences in the use of plants as medicine by certain tribes are caused by natural conditions, especially the availability of plants used for traditional medicine in each region, as well as differences in customs, habits, and underlying cultural philosophies (Jumiarni & Komalasari, 2017).

A study by Diki & Auliya (2024) imilarly found that the e-module developed using Flip PDF was not only deemed feasible and ready to use but also well-received by students. The e-module is easily accessible through a link that students can open on their mobile phones, making it convenient for them to use. This new learning resource on biodiversity is expected to enhance student engagement, spark their interest in the subject, and provide a new learning experience for students. Martin et al. (2021) also reported that student interest and motivation in learning increased after using e-modules, suggesting that these materials can be a valuable alternative for teachers seeking to implement more varied and innovative learning techniques.

## **CONCLUSION**

This study utilized a Research and Development (R&D) approach, specifically following the 4D model to create a biodiversity e-module that integrates the cultural practices of the Bali Tribe in Tawang Rejo village, particularly the various types of

medicinal plants. The e-module provides detailed information on the morphology of medicinal plants traditionally used by the Bali Tribe, based on the researcher's findings. The e-module was created using a flipbook application and can be accessed through a link or by scanning a QR code, making it easy for students to open it freely. The results of expert validation and readability tests confirmed that the e-module is effective and well-received by students. Therefore, it can be concluded that the biodiversity e-module, which highlights local traditions on the use of medicinal plants, serves as a valuable and engaging educational resource for students.

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