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Enhancing Plant Diversity Learning with an Ethnobotany-Based E-Booklet: A Focus on the Pandeglang Community

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ABSTRACT

Purpose of the study: This study aims to develop an ethnobotany-based e-booklet of the Pandeglang community as a supplementary teaching material on plant diversity material for grade X high school students.

Methodology: The method used is development research with the ADDIE model, which in this stage is focused on the analysis stage. The analysis was carried out on the concept of the material through concept maps from high school and Campbell Biology books, basic competencies and indicators, and medicinal plant data obtained through interviews and literature studies.

Main Findings: The results of the analysis show that there is a match between the material between high school books and international reference books, especially on Bryophyta, Pterydophyta, and Spermatophyta. In addition, 48 types of medicinal plants were obtained that are commonly used by the Pandeglang community and are relevant to be included in the e-booklet.

Novelty/Originality of this study: The novelty of this study lies in the integration of local ethnobotanical knowledge into digital learning media based on e-booklets that are contextual and easily accessible.

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1. INTRODUCTION

The Southeast Asian region is known as one of the world's tropical biodiversity centers, including Indonesia, which has a high wealth of flora [1]-[3]. In the Pandeglang region of Indonesia, which is one of the regions with quite high flora biodiversity. This is in line with Sodhi et al. [4] in his research, stating that the Pandeglang area of Banten province has quite high diversity, one of which is marked by the quite high diversity of plants from the ginger family or zingiberaceae family.

In the context of biology learning, plant diversity is one of the important topics studied at the high school level, especially class X. This material teaches students to recognize the classification, characteristics, and benefits of various types of plants [5]-[8]. However, the approach used in delivering the material is often general and has not directly linked the local potential of a particular region [9]-[11]. In fact, the application of locally-based learning is very important to foster student awareness of the surrounding environment.

One approach that can be used to integrate local knowledge into biology learning is through ethnobotany [12]-[14]. Ethnobotany is the scientific study of the relationship between humans and plants, including local knowledge about the use of plants as medicine, food, dyes, building materials, and so on [15]-

[18]. The ethnobotanical approach not only enriches students' understanding of biology material, but also fosters appreciation for local culture and the importance of environmental conservation [19]-[21].

Unfortunately, until now there are still limited teaching materials that integrate ethnobotanical concepts into plant diversity material in secondary schools [22], [23]. Many textbooks still use examples of flora from outside the local context of students, so that learning becomes less meaningful contextually [24]-[26]. In the Pandeglang area, local community knowledge about plants is still rarely used as a source for formal biology learning, even though its potential is very large to be developed as a contextual and relevant learning medium.

Several previous studies have shown that the integration of local knowledge in learning can improve students' understanding and environmental awareness. For example, research by Pascual et al. [27] showed that the use of ethnobotany-based learning resources in Malawi can strengthen cultural preservation and improve student learning outcomes. Meanwhile, in Pandeglang also found that a local-based contextual approach encourages active student involvement in science learning [28]-[30]. However, the development of systematic and interesting learning media such as e-booklets is still very limited, especially those based on local community ethnobotanical knowledge.

This study has novelty because it develops digital e-booklet media based on local ethnobotany from Pandeglang as additional teaching materials for the topic of plant diversity. Unlike previous studies that only identified the potential of local plants, this study produces digital learning products that can be easily accessed through technological devices by students. This e-booklet not only presents scientific information about plants, but also links it to local cultural values and relevant traditional practices, thereby increasing its contextual and educational value.

The urgency of this study lies in the importance of equipping students with local knowledge that can increase their love for the environment and local culture. The purpose of this study is to develop learning media in the form of e-booklets based on ethnobotany from the Pandeglang area that can be used as additional teaching materials in biology learning on the topic of plant diversity for grade X high school students. It is hoped that this e-booklet can improve students' understanding, involvement and environmental awareness through a contextual learning approach based on local wisdom.

2. RESEARCH METHOD

2.1. Types of Research

The type of research used in this study is development research. Development research is a type of research that produces new products or improves existing products and has the effectiveness of a product [31], [32]. So that development research is suitable for use in this study, namely conducting development so that it produces a product in the form of an ethnobotany e-booklet of medicinal plants as a supporting media for learning plant biodiversity material in class X of high school. The model used in this development research is the ADDIE development model [33]. Researchers chose the ADDIE model because this model is simple and can be carried out in stages or systematically to produce efficient and effective products. The stages of the ADDIE model consist of Analysis (analyzing), Design, Development, Implementation, and Evaluation [34].

2.2. Research Location

This research was conducted at Madrasah Aliyah Mathla'ul Anwar Pusat Menes located on Jl. Cimanying-Menes, Pandeglang district, Banten.

2.3. Research Development Procedures

The ADDIE model development research procedure consists of 5 stages, which can be seen in Figure 1 below:

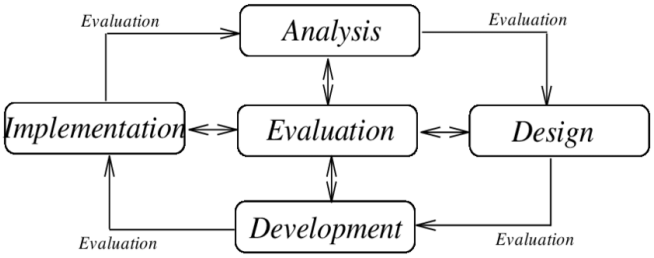

Figure 1. Stages of the ADDIE model

2.3.1 Analysis Stage

The analysis stage is carried out by searching for literature reviews from relevant sources, both from books and from research journals that have been conducted to strengthen the basis for development research [35]. At this stage, researchers analyze the needs of students in terms of developing learning media and the

concept of its contents by conducting literature studies from journals or research that has been conducted and exploring information about knowledge of medicinal plants from residents and conducting observations in the surrounding environment to document medicinal plants [36]. It is known that the learning media used does not yet contain the local potential of the region itself, for example in the material on plant biodiversity. Based on these problems, there needs to be learning media that contains knowledge of local potential to support learning, so that students gain contextual knowledge.

Analysis of medicinal plant data was carried out by collecting medicinal plant data from community interviews and previous research as well as from plant books. Interviews were conducted with 12 informants. The community who became informants had the criteria of being 45 years old and having knowledge of medicinal plants used in everyday life. The contents of the e-booklet are adjusted to the results of the analysis of the concept of the material being studied and basic competencies.

2.3.2. Design Phase

The design stage begins with the researcher designing a learning design or a media that is in accordance with what is being researched. At the design stage, the researcher designs appropriate learning media [37]. The design stage of this e-booklet consists of the stage of compiling materials obtained from the results of interviews and literature studies, collecting photos of medicinal plants, and media design. . The stage of compiling materials is based on the results of interviews and literature studies on medicinal plants used by the community. The material on medicinal plants includes local names, regional names which in this case are taken from the name of the Sunda region, taxonomy, plant morphology, parts used as medicine, benefits, and how to use plants as medicine.

2.3.3. Development Phase

In the development stage, researchers developed previously designed media in the form of an ethnobotany e-booklet of medicinal plants [38]. The learning media that has been produced in the form of an e-booklet will be validated by experts or validators consisting of media experts, material experts, and biology teachers. The e-booklet that has been validated and received input will be revised according to input from the validators to produce a better e-booklet. After the revision, the next stage is the implementation stage. The validation instrument contains several aspects that need to be assessed. This instrument is in the form of a Likert scale from 1-5 for media validation, material validation, and biology teachers. This validation is to assess the feasibility of the e-booklet media from several aspects. The following is a table of the media expert validation instrument grid.

Table 1. Media Expert Validation Instrument Grid

No	Assessed Aspects
1	Media appearance
2	Media content and purpose
3	Media language

Validation of material experts is carried out to assess the suitability of the material, so that it is suitable for use. The aspects assessed are as follows.

Table 2. Material Expert Validation Grid

No	Aspects assessed
1	Plant morphology
2	Scientific name and taxonomy of plants
3	Benefits of plants
4	Parts of plants used as medicine

Next, validation by biology teachers is carried out to assess the feasibility of the material listed in the e-booklet. The aspects assessed are listed in the following table.

Table 3. Biology Teacher Validation Grid

No	Assessed Aspects
1	Coverage of material
2	Completeness of material
3	Updatedness of material
4	Presentation of material
5	Media display
6	Use of media

2.3.4. Implementation stage

In the implementation stage, the resulting product, namely the ethnobotany e-booklet, was tested on grade X and XI MIPA students. This trial activity aims to determine the extent of the feasibility of the e-booklet media. This trial stage was carried out by small group trials and large group trials using tests. At this stage, students were also given a questionnaire for assessment responses, criticisms and suggestions for the e-booklet.

2.3.5. Evaluation Stage

Evaluation is the final stage of the ADDIE model. At this evaluation stage, the product analysis process is carried out at the implementation stage to see whether there are any deficiencies or not [39]. This is done to assess the feasibility of the product in the form of an e-booklet, whether it is suitable for use or not.

2.4. Research Instruments

Research instruments are tools that researchers use to collect data, measure phenomena, and analyze data that are in accordance with the problems faced by the research subjects or samples. The form of the instrument used depends on the type of research. This research uses instruments, namely questionnaire sheets, interviews, and observations.

2.5. Data Analysis Techniques

Data collection techniques in this research are literature studies, observation, interviews and documentation. Qualitative data were obtained from literature studies, interviews, observations, and documentation. This data contains ethnobotany in the area where the research took place. In this case, the researcher filtered the qualitative data obtained so that only important data would be taken. Meanwhile, unimportant data will be discarded. Important data in this study are medicinal plant data which include plant names, morphology, properties or uses, parts used, and how to use them as well as photos of plants.

The feasibility analysis of this e-booklet product was obtained from the results of a questionnaire given to biology teachers and students. This questionnaire was given to test the feasibility of the medicinal plant ethnobotany e-booklet. The following is the formula and percentage table used to determine the feasibility value of the product produced, in this study, namely the medicinal plant ethnobotany e-booklet.

$$\text{Mark} = \frac{\text{otal score obtained}}{\text{maximum score}} \text{ X } 100\% \quad \ldots(1)$$

Table 4. Media eligibility criteria

No	Score in percent (%)	Eligibility Category
1	81 - 100 %	Very Eligible
2	61 - 80 %	Eligible
3	41 – 60 %	Quite Eligible
4	21 - 40 %	Not Eligible
5	0 – 20%	Very Uneligible

Student learning outcome data was obtained from the results of tests conducted before (pretest) and after (posttest) learning. Analysis of learning outcome data in this study was calculated using the N-gain factor formula, which is as follows:

$$\text{N-gain} = \frac{\text{Spost}-\text{Spre}}{\text{Smakx}-\text{Spre}} \quad \ldots(2)$$

Description:
N-gain = increase in understanding
Spost = Final test score
Spre = Initial test score
Smaks = Maximum score

Table. 5 Interpretation of N-Gain scores

Score N-gain	Category
$0,7 < g < 1$	High
$0,3 \leq g \leq 0,7$	Medium
$0 < g < 0,3$	Low

Based on the table above, if the N-gain score obtained is greater than 0.7 or less than 1, then the student's learning outcomes are high and the use of e-booklets is effective for use. The N-Gain score is greater than 0.3 or less than 0.7, then the student's learning outcomes are categorized as moderate, while if the N-Gain

score is greater than 0 or less than 0.3, then the student's learning outcomes are categorized as low and the use of e-booklets is less effective.

3. RESULTS AND DISCUSSION

The results of this study produced a supplementary material product in the form of an ethnobotany-based e-booklet in the Thailand region on plant biodiversity material. This e-booklet was developed by referring to the ADDIE development model which consists of four stages, namely Analysis, Design, Development, Implementation, and Evaluation. The research results obtained from this study are as follows:

3.1. Analysis

The analysis stage in the development of the e-booklet was carried out through three main focuses, namely analysis of material concepts, basic competencies and indicators, and collection of medicinal plant data through interviews and literature studies. The analysis of the material concept was carried out by compiling and comparing concept maps from high school Biology books and Campbell's books. The results of the comparison showed similarities in the material, especially on the topics of Bryophyta, Pterydophyta, and Spermatophyta and their roles in life. Based on these similarities, the material in the e-booklet is focused on the role and benefits of plants as medicine in the context of ethnobotany.

Furthermore, the analysis of basic competencies and indicators was carried out by referring to basic competencies 3.8 and 4.8 in the senior high school Biology curriculum, which includes grouping plants based on general characteristics and compiling observation reports. From the indicators contained in the senior high school Biology book by Irnaningtyas, new, more contextual indicators were derived, such as identifying medicinal plants based on morphological characteristics, explaining the habitat and uses of medicinal plants, and compiling field observation reports on these plants.

The final analysis relates to the collection of medicinal plant data through direct interviews with the Pandeglang community who have knowledge of medicinal plants. This interview revealed that local people generally plant medicinal plants around their homes for personal use. In addition to interviews, a literature study was conducted from journals and books to complete information on the morphology and utilization of these plants. From the combined results of interviews and literature, data on 48 types of medicinal plants were obtained which were then included in the e-booklet as the main content.

3.2. Design

The design of this e-booklet uses green nuances, which aims to make the e-booklet characterize plants that are identical to the color green. The designed e-booklet consists of 71 pages, starting with the cover, booklet identity page, foreword, table of contents, photo gallery, definition of ethnobotany, brief explanation of medicinal plants, types of medicinal plants, quizzes, bibliography, and finally the author's profile page. The e-booklet that has been compiled using the Canva application is then made in flip form using the Flip PDF professional application, so that the appearance of the e-booklet becomes more attractive and lively because the page display in flip form can be flipped like reading a physical book. As explained by Hoiroh and Isnawati (2020) that Flip PDF professional is software that can change the form of a booklet into an electronic form, so that each page of the booklet opens like a book.

3.3. Development

This development stage is carried out after the media in the form of an e-booklet has been designed. At this stage, the media is validated by experts, namely media experts, material experts, and biology teachers. The following are the results of the validation stage:

Media validation is conducted to assess aspects of media appearance, media content and purpose, and media language. The results of this media validation determine the suitability of the media that has been created for further use in the trial stage. The results of the media validation that have been conducted are as follows.

Table 6. Results of media expert validation

Aspects assessed	Result value (%)	Description
Show media	86,6	Very worthy
Content and purpose of media	76,6	Worthy
Language of media	80	Worthy
Average	81	Very worthy

Based on the media validation results table above, it can be seen that the results of the assessment of the media display aspect obtained a value of 86.6% with a very feasible category, the content and purpose aspects of the media obtained a value of 76.6% with a feasible category, and the language aspect of the media obtained a value of 80% with a feasible category. The assessment results of the three aspects were averaged and obtained a

value of 81% with a very feasible category. This means that the media that has been created is very feasible to be used at the trial stage for students.

Validation of material experts assesses the content of the material contained in the e-booklet. This validation determines the suitability of the material that has been prepared so that there is no misconception and it is suitable for use. The validated material includes local names or regional names, plant taxonomy, plant morphology, parts used as medicine, benefits or properties, and how to use medicinal plants. The value of the material validation results is 90% with a very suitable category. The following are the results of the material validation calculation:

Table 7. Material validation results

No	Validated aspects	Number of plants	No revision needed	Need revision	Mark %
1	Plant morphology	48	48	0	100%
2	Scientific name and taxonomy of plants	48	29	19	60%
3	Benefits of plants	48	48r4sdh	0	100%
4	Parts of plants used for medicine	48	48	0	100%
Average validity level					90%

Validation from biology teachers who are field experts was conducted to assess aspects of material coverage, completeness of material, accuracy of material, timeliness of material, presentation of material, media display, and use of language. The results of the biology teacher validation are shown in the following table.

Table 8. Results of Biology Teacher Validation

Aspects assessed	Result value	Description
Coverage of material	100	Very worthy
Completeness of material	100	
Updatedness of material	100	
Presentation of material	100	
Appearance of material	100	
Use of media	100	

Based on the table above, the assessment results by the biology teacher obtained a value of 100% with a very feasible category, so it can be said that the material that has been designed in the form of an e-booklet is suitable for use as a material supplement. Based on the validation results, there is a suggestion from the biology teacher that this e-booklet should be made into a book and published.

3.4. Implementation

3.4.1. Small group trials

A small group trial was conducted on 18 students to determine the students' responses to the e-booklet that had been developed and then revised again if the results were not suitable. In this trial, students were given a response questionnaire containing 14 assessment aspects to be filled in and a comment column. Based on the results of the students' responses, it was found that the e-booklet that was developed was interesting to read, the design was good and aesthetic, the language was easy to understand, and it could increase motivation to learn about medicinal plants because it was equipped with clear plant images and easy-to-understand explanations and a display like a physical book also had animated sounds of open book pages. This made students enthusiastic about reading the e-booklet.

From the results of the response, it was obtained that the value of each aspect had very good value criteria with an average value of 90. Based on the results of these values, the e-booklet was not revised and was very suitable for use. The results of the student response assessment aspects can be seen in the following table.

Table 9. Results of student assessment aspects

Assessment aspects	Value	Criteria
New knowledge		Good
The material in the E-Booklet increases motivation to learn about medicinal plants	87	Very good
The material in the E-Booklet provides knowledge about morphology, taxonomy, and benefits of plants	93	Very good
The material about medicinal plants in the E-Booklet is easy to understand	88	Very good
I am happy that the potential of my local/regional environment is used as a supplement to the material on plant diversity (medicinal plants)	88	Very good
I am interested in learning about medicinal plants in my environment/region	83	Very good

This E-Booklet makes me love plants and the surrounding environment	82	Very good
This E-Booklet provides knowledge about medicinal plants in my area	93	Very good
This E-Booklet can help me understand the material well	95	Very good
The appearance of this E-Booklet is interesting to me	94	Very good
The pictures/photos of medicinal plants in this E-Booklet are clear so that I can recognize the appearance of the plant	92	Very good
After studying this E-Booklet, I became interested in seeing medicinal plants directly in the surrounding environment	82	Very good
After studying this E-Booklet, I learned the regional name (Sundanese) and scientific name of medicinal plants in the surrounding environment	93	Very good
The language used is communicative and easy to understand	92	Very good
Average	90	Very good

3.4.2. Field Trial

Field trials were conducted on 36 students by giving them pretests and posttests to determine their learning outcomes after using the e-booklet media. In addition to being given tests, students were also given a response questionnaire to determine their responses after using the e-booklet media. Students filled out the response questionnaire given directly after completing the posttest. This response questionnaire contained 14 assessment aspects. Based on the results of the students' responses, each aspect had very good value criteria with an average value of 91. This shows that the e-booklet is very feasible to use and is able to attract students' interest in medicinal plants. The following is a table of the results of the student response questionnaire assessment.

Table. 10 aspects of student response assessment

Assessment aspects	Mark	Criteria
The material in the E-Booklet provides new knowledge	97	Very good
The material in the E-Booklet increases motivation to learn about the need for medicine	89	Very good
The material in the E-Booklet provides knowledge about the morphology, taxonomy, and benefits of plants	92	Very good
The material about medicinal plants in the E-Booklet is easy to understand	91	Very good
I am happy that the potential of my local/regional environment is used as a supplement to the material on plant diversity (medicinal plants)	88	Very good
I am interested in learning about medicinal plants in my environment/region	86	Very good
This E-Booklet makes me love plants and the surrounding environment	93	Very good
This E-Booklet provides knowledge about medicinal plants in my area	90	Very good
This E-Booklet can help me understand the material well	95	Very good
The appearance of this E-Booklet is interesting to me	96	Very good
The pictures/photos of medicinal plants in this E-Booklet are clear so that I can recognize the appearance of the plant		Very good
After studying this E-Booklet, I became interested in seeing medicinal plants directly in the surrounding environment	86	Very good
After studying this E-Booklet, I learned the regional name (Sundanese) and scientific name of medicinal plants in the surrounding environment	92	Very good
The language used is communicative and easy to understand	93	Criteria
Average	91	Very good

Students worked on the pretest and posttest which were shared via a google form link. The pretest and posttest contained questions about medicinal plants discussed in the e-booklet. There were twenty questions with a working time of 40 minutes each before and after using the e-booklet. Data on the results of the pretest, posttest, and N-Gain scores can be seen in the table below.

Table.11 Results of Students' Pretest, Posttest, and N-Gain Scores

Value	Pretest	Postest
Low value	25	25
Highest value	80	80
Standard deviation	14.80	14.80
Mean	54.44	54.44
Median	55	55
Mode	65	65
N-Gain	0.75 (high)	

Based on the table above, it is known that in the pretest results the lowest value is 25 and the highest value is 80, the standard deviation calculation on the pretest value is 14.80, and the average value is 54.44. The median value is 55 and the mode value or the value that is often obtained is 65. While the posttest results obtained the lowest value is 65, the highest value is 100, and the standard deviation calculation is 10.12. The average of the posttest value is 88.47, the median value is 87.5, and the value that is often obtained (mode) is 100. Furthermore, the N-Gain test was also carried out to determine the effectiveness of the e-booklet. The N-Gain test value obtained is 0.75 with high criteria. The calculation of the N-Gain test can be seen on the attachment page. Based on the results of the pretest, posttest, and N-Gain test values, it shows that there is an increase in the test results of students before and after using the e-booklet and the e-booklet is effective and feasible to be used as a supplement to the material.

3.5. Evaluation

The evaluation stage is carried out based on the results of the implementation stage whether there are any deficiencies or not. The results of the implementation stage obtained student responses in the small group trial obtained a score of 90 with very good criteria and student responses in the field trial obtained a score of 91 with very good criteria as well. This shows that students are very interested in the media that has been developed because this e-booklet media has an attractive and aesthetic design, is easily accessible to students, and the display of plant images is clearly visible with easy-to-understand explanations. In addition, the media developed has a flip display so that it looks like a physical book that can be moved each page and is equipped with open paper sound animation. Such a display makes students very enthusiastic and interested in using e-booklets.

The learning outcomes of students during the trial showed an improvement, as indicated by the increase in pretest and posttest scores. Additionally, the results of the N-Gain test showed a value of 0.75, which falls under the high criteria. In terms of the achievement of the Minimum Mastery Criteria, out of 36 students, 35 students met the Minimum Mastery Criteria, while only 1 student did not. This indicates that the developed media can effectively improve student learning outcomes and is highly suitable for use as a supplementary material on plant topics. These findings are consistent with previous research, which showed that the development of e-booklet teaching media on plant material to enhance students' biology learning outcomes resulted in an N-Gain value of 0.55 with moderate criteria, demonstrating its potential to improve learning outcomes and its suitability as a teaching medium [40].

This e-booklet has several advantages that can attract students' interest, including that this e-booklet is designed attractively and aesthetically, it is equipped with pictures of plants from the researcher's personal documentation with easy-to-understand explanations and interactive quizzes that can be accessed via the linked link. This quiz is in the form of a crossword puzzle game, so students don't get bored answering questions. In addition, this e-booklet has a flip-shaped appearance so that it looks like a physical book that can be flipped and is equipped with sound animation when students move the page to the next page and is easy to use or operate. Several advantages of this e-booklet are very interesting for students to e-booklets and make it easier for students to understand the material. In line with Carda and Reeby [41] who stated that e-booklets used in learning are easy to use or use, easy to understand, attractive color presentation and clear images will encourage students to be more enthusiastic and active in participating in learning.

In addition, the images in the e-booklet make it easier for students to understand the material so that the material studied will be more meaningful in students' cognition. This is based on the results of student responses who got a score of 90 in the limited test and 91 in the field trial with very good criteria, and the N-Gain value obtained was high. These very good results were obtained because the material listed in the e-booklet is contextual material, namely about medicinal plants that are used daily by the community and are often found by students in the surrounding environment, so that students can easily understand and apply it well. Explains, contextual material that is linked to the surrounding environment helps students to relate the knowledge gained and apply it in everyday life.

Previous research has shown that digital media such as e-books, learning videos, and interactive applications can improve student motivation and learning outcomes. A study by Tazhitova et al. [42] demonstrated that the use of local culture-based media can increase student engagement and enhance the relevance of the material. Furthermore, integrating local knowledge into science learning can strengthen students' scientific literacy [43]. Therefore, this e-booklet reinforces these findings by highlighting local ethnobotanical knowledge as the main content.

The novelty of this research is the integration of local communities community ethnobotanical knowledge into an interactive e-booklet that is easily accessible to students through digital devices. Few studies have developed learning media that combine local aspects with a concrete technological approach, particularly in the form of an e-booklet that resembles a physical book and is equipped with animation features. This research makes a new contribution to biology education by offering an alternative media that not only supports understanding of the learning material but also preserves local wisdom through digital documentation. This is a strategic step in supporting contextual learning that is relevant to students' daily lives.

The implementation of this e-booklet has shown positive results through expert validation tests and excellent student responses, as well as improved student learning outcomes with high N-Gain values. This media has the potential to be widely implemented as supplementary teaching materials in schools, particularly on biodiversity and plant utilization. However, this study still has several limitations. One of them is the limited coverage of ethnobotanical content, which only represents one local community, so generalization to other regions requires further study. Furthermore, the implementation of this media is highly dependent on the availability of digital devices and adequate internet access, which may be a challenge in some areas. Therefore, further development can consider cross-cultural content adaptations and offline versions of this e-booklet.

4. CONCLUSION

Based on the results of the research on the development of E-Booklets as supplementary teaching material, it can be concluded that community ethnobotanical knowledge—particularly the use of 48 identified medicinal plants—is still actively practiced and can be passed on to the younger generation through documentation in the form of an e-booklet. Developed using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), the resulting flip-top e-booklet features an attractive, animated design resembling a physical book, complete with sound effects of page-turning, and is accessible via internet-connected laptops or mobile devices. Validation results indicate that the e-booklet is highly suitable as supplementary material, with scores of 81% from media experts, 90% from material experts, and 100% from biology teachers. Student responses were also very positive, scoring 90 in a limited trial and 91 in field testing, both categorized as very good. Furthermore, the N-Gain score of 0.75 with high criteria demonstrates that the e-booklet significantly improves student learning outcomes. Therefore, it is highly suitable for use in biodiversity learning. For future development, it is recommended that the content be expanded to include ethnobotanical knowledge from diverse regions to reflect broader cultural diversity, and further studies should explore its effectiveness across different learning modes (online and offline) and educational levels..

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AUTHOR CONTRIBUTIONS

Conceptualization, E.N. and R.P.L.; Methodology, E.N.; Software, E.N.; Validation, E.N. and R.P.L.; Formal Analysis, E.N.; Investigation, E.N.; Resources, R.P.L.; Data Curation, E.N.; Writing – Original Draft Preparation, E.N.; Writing – Review & Editing, E.N. and R.P.L.; Visualization, E.N.; Supervision, R.P.L.; Project Administration, R.P.L.; Funding Acquisition, R.P.L.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

Not applicable.

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