

## Development of E-Module Based on E-Pub Plant Structure and Development Courses as Teaching Material to Improve Student Science Literacy

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### ABSTRACT

This research and development aim to produce e-modules based on epub plant structure and development that are valid, practical and effective. The development of teaching materials follows the ADDIE instructional design model. The instruments used were epub-based e-module validation sheets by expert lecturers as well as student response questionnaires and science literacy pretest-posttest scores which were analyzed using the One-Way Ancova test. The results of research and development show the acquisition of a validation score by teaching material experts of 100%, Material experts by 100%, education practitioners by 99%, student response results by 87.05% and efficiency results of  $0.013 < 0.05$  so that the use of Epub-based e-modules is effective in the learning process, it can be concluded that EPUB-based e-modules are classified as very valid, very practical and effective as teaching materials that can be used by students.

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## 1. INTRODUCTION

The development of science and technology today dominates human life. Science is the basis of technological progress that offers a form of knowledge that is accessible to all. Science education contributes to the development of understanding abilities on the most effective ways to use science in everyday life and social responsibility. Science education has a beneficial role in the knowledge of the surrounding world, therefore one of the most important goals of science education is the development of science literacy (Drago & Mihb, 2015). Science literacy is a person's ability to understand and use scientific knowledge to solve problems based on scientific investigation and evidence and be able to communicate them (OECD, 2019). Science literacy is important for individuals in understanding socio-ecological problems, engaging in environmental decision making, solving science problems in everyday life and helping individuals to ask, find and determine answers to questions derived from curiosity about everyday experiences as well as useful in political, social, cultural and economic activities (Duke & Hinzen, 2011; El Islami & Nuangchalerm, 2020; Turgut & Yakar, 2020; Zangori & Koontz, 2017). Sasikala & Dhanraju (2010), In general, science literacy is a combination of skills, values, attitudes, understanding and knowledge of science that individuals need to develop problem-solving skills. Given the importance of science literacy to be developed in learning, it is necessary to improve the learning process.

An important stage of learning is to provide learning experiences in the learning process. Education in Indonesia after experiencing the Covid-19 outbreak, has many changes. This causes a learning system that can be done face-to-face and distance learning, one of which is online. Online learning must still be carried out as well as possible so that students are able to master knowledge and skills well (Sadikin & Hamidah, 2020). The occurrence of these events also supports the implementation of the industrial revolution era 4.0 in the world of education. The application of technology and communication science in the online learning process has a very important role, because technology can be used as a medium of interaction between students and lecturers (Salsabila et al., 2021). This requires students to adapt to the technology developed to improve the quality and potential of students in the learning process (Fitri & Rahayu, 2022). The use of e-module teaching material

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development becomes more effective because it can contain all material in certain competencies, has high adaptability and is close to its users in this case fulfilled by the characteristics of the e-module. The development of e-modules is expected to be a solution for students in learning in the Plant Structure and Development course. The Plant Structure and Development course is one of the compulsory courses that must be taken by students majoring in Biology, State University of Malang. Plant Structure and Development is a course that has complex material, because it is a combination of several courses including, plant morphology, plant anatomy, plant embryology and plant palinology, so that students often have difficulty in understanding the material. The results of interviews with lecturers and student questionnaires were obtained that the teaching materials for the Plant Structure and Development course available today are books, power points and journals. In addition, the teaching materials used so far still have many shortcomings, while to learn Plant Structure and Development, especially the structure and development of stem and leaf organs requires a lot of visualization of the material, so efforts are made to develop teaching materials that are in accordance with technological developments. So that lecturers and students need teaching materials that can help in the learning process and can motivate students to learn such as e-modules (Dewi et al., 2023; Hayuana et al., 2023; Putri et al., 2023; Rais et al., 2021; Raviqah et al., 2023; Wati et al., 2023).

E-module is a module in digital form, consisting of text, images or both that contain material suitable for use in learning (Herawati & Muhtadi, 2018). E-module has several characteristics, namely self instructional, self contained, stand alone, adaptive and user friendly (SMA, 2017). The advantages of e-modules over print modules are that they are interactive, make navigation easier, allow displaying or loading images, audio, video and animations and are equipped with formative tests or quizzes that allow for immediate automatic feedback. In addition, another advantage is that e-modules in the learning process lie in the stages of problem-based learning, namely student orientation to problems, organizing students to learn, guiding individual and group investigations, developing and presenting work and analyzing and evaluating the problem-solving process (Sugihartini & Jayanta, 2017). E-module is developed based on electronic publication (epub) application program. Epub is a digital book format composed of multimedia, html5, css, xhtml, and xml files packaged in one file. Epub contains images, audio, animation, video, web links so that it is more efficient to use in learning (Harahap, 2020). The reason for choosing the epub format is the ease of access because it can be used on computers and smartphones (Amalia & Kustijono, 2017) and adapts to the size of the screen reader device (Hidayat et al., 2017).

The development of epub-based e-modules will be effective if integrated with the learning model. The learning model used is the PBL (Problem Based Learning) learning model. The problem-based learning model includes activities such as formulating problems, organizing, investigating problems, developing and presenting the results of solutions to problems and analyzing and evaluating the problem-solving process (Arends, 2015). The problem-based learning model was chosen because it has proven effective in improving students' 21st century skills (Juleha et al., 2019; Simamora et al., 2017). Based on the description that has been described, the purpose of this research is the development of e-modules based on e-pub Plant Structure and Development courses as teaching materials to improve valid, practical and effective student science literacy.

## 2. RESEARCH METHOD

This development research aims to produce a product in the form of an epub-based e-module for plant structure and development courses. The development of epub-based e-modules refers to the ADDIE instructional model. The ADDIE model consists of five stages, namely analysis, design, development, implementation and evaluation (Rayanto Yudi Hari & Sugianti, 2020). The subject of research and development is an S1 student majoring in Biology, State University of Malang which consists of two offerings. The type of research used is a quasy experiment with a pretest-posttest non-equivalent control group design (Leedy & Ormrod, 2015). Data collection instruments and data analysis techniques collected in epub-based e-module research and development are qualitative data (criticism and suggestions from validators and respondents) and quantitative data (assessment score results from validators and respondents and pretest-posttest results). Quantitative data analysis is described as follows.

Validity test of teaching material experts, material experts and education practitioners. The validation quantitative data is analyzed by the following formula.

$$V = \frac{Tse}{Tsh} \times 100\%$$

Information:

V : Percentage of validity

Tse : Total score of filling out the validation questionnaire

Tsh : Total maximum score for filling out the validation questionnaire

The score obtained based on the formula that has been described is then made based on the criteria in Table 1.

Table 1. Product Development Validity Criteria

Range of Values (%)	Validity Criteria
$85,00 \leq X$	Very valid
$70,00 \leq X < 85,00$	Valid
$55,00 \leq X < 70,00$	Quite valid
$40,00 \leq X < 55,00$	Less valid
$X < 40,00$	Invalid

Source: (Sulisetijono, 2018)

Student response questionnaire practicality test. The calculation formula used is as follows.

$$\text{Percentage of response} = \frac{\text{Number of scores that appear}}{\text{Ideal score amount}} \times 100\%$$

The score obtained based on the formula that has been described is then made based on the criteria in Table 2.

Table 2. Assessment Criteria for Practicality Test Results

Percentage (%)	Practicality Criteria
$85,00 \leq X$	Very practical
$70,00 \leq X < 85,00$	Practical
$55,00 \leq X < 70,00$	Quite practical
$40,00 \leq X < 55,00$	Less practical
$X < 40,00$	Impractical

Source: (Sulisetijono, 2018)

#### Effectiveness Test

Test the effectiveness of e-modules to improve student problem science literacy using pretest and posttest scores. Values in the normality test use the Shapiro-Wilk test and the homogeneity test using Levene's Test of Equality of Error Variance. To see the effect of using e-modules in learning using the Ancova One Way test. The Ancova One Way test is used to determine the effectiveness of e-modules in learning to improve students' science literacy, in order to obtain results whether or not the e-module has an effect in improving science literacy. E-module is said to be effective or influential if the p-value < 0.05.

### 3. RESULT AND DISCUSSION

#### Stages of Analysis

At this stage, an analysis was carried out related to the need for the development of teaching materials in the form of epub-based e-modules in the structure and development of plants course. Based on the results of interviews and observations, it was found that students still have difficulty in distinguishing each tissue in plants. This difficulty is because learning has not been equipped with more contextual teaching materials. The learning resources used still refer to many learning tools in the form of student worksheets, power points, and scientific articles. In addition, the teaching materials used so far still have many shortcomings.

#### Design Stages

This stage will be carried out in February 2023. The purpose of this stage is to design learning models and learning tools for Biology students of State University of Malang in plant structure and development courses. In addition, the design stage is also carried out to design teaching materials in the form of e-modules starting from the beginning to the end of the e-module to improve student science literacy.

#### Development Stages

At this stage, the design of teaching materials that have previously been prepared will be developed. This stage of development is also carried out product validation which aims to produce teaching material products that are valid, practical and feasible to use. The validation carried out by several experts including teaching material experts, material experts and education practitioners.

The results of epub-based e-module validation by teaching material experts can be seen in Table 3. Validity criteria by teaching material experts are very valid with a percentage of 100%.

Table 3. Results of Epub-Based E-Module Validation by Teaching Material Experts

No.	Indicators	Average	Percentage (%)	Category
1.	Eligibility of contents	5	100	Very valid
2.	Presentation and display quality	5	100	Very valid
3.	User practicality and Language	5	100	Very valid
4.	Compatibility with e-module characteristics	5	100	Very valid
5.	Integration of e-modules with bound variables	5	100	Very valid
Average percentage of validation results (%)			100	Very valid

A module is one of the specially prepared and systematically designed learning materials that learners can use independently (Kebudayaan, 2017). The preparation of the e-module is based on the results of the needs analysis so that the e-module is expected to be in accordance with the needs of students in learning. Before the e-module is implemented in the classroom, it is first validated by expert validators of teaching materials, material experts and biology education practitioners. E-module validation is important to determine the level of e-module feasibility to be applied in learning (Setambah et al., 2017). In addition, the validation test aims to produce good and relevant teaching materials (Akbar, 2013). Feedback and suggestions obtained during validation can be used to conduct formative evaluations before the implementation phase is carried out (Rayanto Yudi Hari & Sugianti, 2020).

The validity test by teaching material experts obtained an average percentage of validation results of 100% which is classified as very valid (Akbar, 2013). Aspects assessed for e-module validation by teaching material validators are the feasibility of content, presentation and display quality, user practicality and language, suitability with the characteristics of the e-module and integration of e-modules with bound variables. E-module is classified as very valid because it meets all aspects of the criteria.

The e-module developed has fulfilled the module writing structure which aims to facilitate users in learning certain materials and competencies (Kemendikbud, 2017). The structure of writing epub-based e-modules integrated with problem-based learning models aims to study the material of morphological and anatomical structures of leaf organs and specifically to improve students' science literacy in the learning process. Based on the characteristics of the e-module, namely self instructional, self contained, stand alone, adaptive and user friendly (Kemendikbud, 2017), The e-module has met these characteristics and can be used in the learning process.

The results of epub-based e-module validation by material experts can be seen in Table 4. Validity criteria by teaching material experts are very valid with a percentage of 100%.

Table 4. Results of Epub-Based E-Module Validation by Material Experts

No.	Indicators	Average	Percentage (%)	Category
1.	Relevance	5	100	Very valid
2.	Accuracy and quality of contents	5	100	Very valid
3.	Completeness of the dish	5	100	Very valid
4.	Language feasibility	5	100	Very valid
Average percentage of validation results (%)			100	Very valid

The validity test by material experts obtained an average percentage of validation results of 100% which is classified as very valid (Akbar, 2013). Aspects assessed for e-module validation by material validators are relevance, accuracy and quality of content, completeness of presentation and language feasibility. E-module is classified as very valid because it meets all aspects of the criteria. Revision of the e-module by providing a liaison between the material contained in the concept map, to be able to guide students to arrange the concepts learned so that they can see the relationship between the material and each other. The relationship between concepts can be seen from propositions, because the concept itself has a wider scope than other concepts so there needs to be a proposition that shows which concept is higher or lower in the hierarchy (Yuniati, 2013).

The addition of learning videos in accordance with the material presented makes the e-module harmonious so that it can facilitate students' understanding of the concepts and messages of the material delivered (Nadarrini & Susanti, 2016). Epub-based e-module visualization can be seen in various kinds of pictures of plant species from the surrounding environment, but in the selection of images must be considered so that plant organs can be seen as a whole. One of the main subjects in the e-module is about single leaves and compound leaves. Single leaves and compound leaves can be seen from the pictures of plant species, but the images presented do not show the whole from the stalk to the leaf blade, so it is necessary to replace the image of plant species that can display the whole part from the stalk to the leaf blade. Renat et al (2017) states that the images on the e-module are expected to increase interest and understanding of the material and the material presented must be proven true in order to avoid misconceptions.

The results of epub-based e-module validation by education practitioners can be seen in Table 5. The Validity Criteria by teaching material experts is very valid with a percentage of 99%.

Table 5 Results of Epub-Based E-Module Validation by Education Practitioners

No.	Indicators	Average	Percentage (%)	Category
1.	Completeness of contents	4,8	96	Very valid
2.	Accuracy of the material	5	100	Very valid
3.	Serving	5	100	Very valid
4.	Language	5	100	Very valid
Average percentage of validation results (%)			99	Very valid

The validity test by biology education practitioners obtained an average percentage of validation results of 99% which is classified as very valid (Akbar, 2013). Aspects assessed for e-module validation by validators of biology education practitioners are completeness of content, accuracy of material, language and presentation. E-module is classified as very valid because it meets all aspects of the criteria. Revision of the e-module with the selection of pictures of plant species that are able to represent images on each material such as pictures of banana leaf plant species that can represent parts of each leaf, selection of corn leaves that have ligulanya, but if there are pictures that still do not have arrows that show parts of the leaves, arrows are given on the parts and the selection of good and interesting images in order to increase student understanding of the material (Renat et al., 2017). In addition, the usefulness of e-modules can attract students' interest in learning in class (Syahmani et al., 2022) and attract attention and excite students (Islahiyah et al., 2019).

#### Stages of Implementation

At this stage, the validated e-module is then applied to students. The most important thing at this stage is to prepare teachers and students. Student preparation includes class identification and observation, arranging implementation schedules, and technical preparations needed by students. This application stage is carried out directly by researchers as model lecturers using e-modules. The learning implementation process is assisted by students and lecturers who act as observers. This research will be carried out in March-April 2023 at State University of Malang.

The implementation stage is carried out in two offerings, namely offering A and offering I with a total of 50 students. The e-module that has been developed is implemented in offering A as an experimental class to determine the effect of using e-modules in learning. In addition, at this stage, a practicality test was also carried out by students offering A. The results of the practicality test were obtained from the student response questionnaire during implementation, in this case the S1 students of the Department of Biology who were included in the experimental class consisting of 25 students. The results of the practicality test can be seen in Table 6. The practicality criteria by the results of the student response questionnaire are very practical with a percentage of 87.05%.

Table 6. Practicality Test Results by Student Responses

No.	Student	Average (%)	Category
1	1st Student	99.23	Very practical
2	2nd Student	87.69	Very practical
3	3rd Student	99.23	Very practical
4	4th Student	78.46	Practical
5	5th Student	80.77	Practical
6	6th Student	90.00	Very practical
7	7th Student	96.15	Very practical
8	8th Student	91.54	Very practical
9	9th Student	86.92	Very practical
10	10th Student	96.92	Practical
11	11th student	70.77	Practical
12	12th Student	100.00	Very practical
13	13th Student	87.69	Very practical
14	14th Student	83.85	Practical
15	15th Student	97.69	Very practical
16	16th Student	72.31	Practical
17	17th Student	76.15	Practical
18	18th Student	81.54	Practical
19	19th Student	80.00	Practical
20	20th Student	86.15	Very Practical
21	21st Student	91.54	Very Practical

No.	Student	Average (%)	Category
22	22nd Student	86.15	Very Practical
23	23rd Student	74.62	Practical
24	24th Student	82.31	Practical
25	25th Student	98.46	Very Practical
<b>Average</b>		<b>87.05</b>	<b>Very Practical</b>

Epub-based e-module teaching materials are developed for student use in learning activities, therefore the teaching materials that have been developed need to be tested for practicality. Practicality tests are important to determine the ease of use of teaching materials by users, in this case students (Annisa et al., 2020). Suarsana & Mahayukti (2013) positing that modules are said to be practical if users in this case field practitioners and students assess that modules can and are easy to use.

The results of the student response questionnaire to the practicality of epub-based e-modules are included in the very practical category, because the use of e-modules can facilitate students in learning, motivate and improve student learning outcomes, and make learning fun with illustrations in the form of images, audio and video (Astalini et al., 2021).

#### Evaluation Stages

This stage takes place after the implementation process is carried out. At this stage, the effectiveness of the e-module was tested to improve students' science literacy. The effectiveness test of epub-based e-modules is known through pretest and posttest values. Pretest and posttest values were analyzed using the One-Way Ancova test to determine the hypothesis test, but before that, prerequisite tests were carried out, namely the normality test using the Shapiro-Wilk test and the homogeneity test using Levene's Test of Equality of Error Variance. The results of the prerequisite test can be seen in Table 7 and the results of the hypothesis test can be seen in Table 8.

Table 7. Science Literacy Prerequisite Test Results

No.	Variable	Test Type	N	P	alpha	Information	
1	Sains literacy	Normality	Pretest	50	0.051	0.05	Normal
		Normality	Posttest	50	0.063	0.05	Normal
		Homogeneity	posttest	50	0.829	0.05	Homogeneous

Table 8. Results of the Science Literacy Hypothesis Test

Source	Type III Sum of Squares	df	MS	F	p
Corrected Model	3534.101 <sup>a</sup>	2	878.432	15.396	.000
Intercept	1504.197	1	2536.182	44.451	.000
PreLitSains	3334.101	1	1151.344	20.179	.000
Offering	69.881	1	272.436	4.775	.034
Error	5427.019	47	57.056		
Total	252284.000	50			
Corrected Total	8961.120	49			

The results of the hypothesis test using the One-Way Ancova test at a significance level of 5% can be concluded that there is an influence of learning using epub-based e-modules on student science literacy. Epub-based e-modules are developed in a structured manner following the syntax of the problem-based learning model. The problem-based learning model provides opportunities for students to learn how to identify a problem, collect information that is appropriate to the problem and conduct experiments to get explanations and solutions to the problem. Therefore, students not only memorize, but can take advantage of opportunities to train and develop science literacy in themselves (Alatas & Fauziah, 2020). Science literacy consists of three indicators, namely explaining phenomena scientifically, evaluating and designing scientific questions and interpreting data and evidence scientifically (OECD, 2019).

#### 4. CONCLUSION

Based on the objectives of this research and development, it was concluded that (1) epub-based E-module meets the criteria for validity by teaching material experts, material experts and educational practitioners; (2) Epub-based e-module meets the criteria of practicality by student response; (3) The use of EPUB-based e-modules is effective in learning.

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