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Development of Interactive E-Book of Ferns Materials Through a Scientific Approach With HOTS Problems to Improve Student Learning Outcomes

Advend Sri Rizki Sianturi ✉, Amin Retnoningsih, Saiful Ridlo

Pascasarjana, Universitas Negeri Semarang, Indonesia

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Abstract

This study aims to measure the level of validity, readability, feasibility and effectiveness of interactive e-books. The research method is Research and Development (R&D) according to the syntax of Borg and Gall without a dissemination step. In the needs analysis stage, the results of research to identify ferns that grow in the lowlands, medium plains and highlands of Central Java are used. The results of plant identification were used for e-book development. The result of the initial product readability trial was 86.22%, including very good criteria. The results of the material expert validation for the first stage obtained 77.05% and the second stage results were 84.33%. The result validation of media experts obtained a result of 99.07%. The results of the legibility, validity, and feasibility tests were then tested at a large-scale level. The results of the effectiveness test obtained the pretest average value of 22, 33 and the average posttest score of 88.44. The results of the paired sample t test show a significance of 0.000 <0.05, which means that there is a significant relationship before and after using the interactive e-book. The correlation strength is 0.848, indicating a very high correlation. The average value of the activities of students in the attitude aspect of 3.36 criteria is very good. The average value of activities on the aspects of skills during discussion and practicum is 3.38, very good criteria. It is concluded that the interactive e-book of ferns can be used as a valid, practical, and effective learning resource in Senior Hight School and can then be disseminated. The correlation strength is 0.848, indicating a very high correlation. The average value of the activities of students in the attitude aspect of 3.36 criteria is very good. The average value of activities on the aspects of skills during discussion and practicum is 3.38, very good criteria. It is concluded that the interactive e-book of ferns can be used as a valid, practical, and effective learning resource in Senior Hight School and can then be disseminated. The correlation strength is 0.848, indicating a very high correlation. The average value of the activities of students in the attitude aspect of 3.36 criteria is very good. The average value of activities on the aspects of skills during discussion and practicum is 3.38, very good criteria. It is concluded that the interactive e-book of ferns can be used as a valid, practical, and effective learning resource in Senior Hight School and can then be disseminated.

✉ correspondence :
Jalan Kelud Utara III No.37, Kota Semarang, Jawa Tengah, Indonesia 50237
E-mail: advendsririzky@gmail.com

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INTRODUCTION

Currently, the plantae learning media used by students is still dominated by textbooks, sometimes complemented by the use of e-books but they are still static. This e-book has not been able to motivate students because its development is merely moving the contents of the book physically into digital form. Artifacts - artifacts that present learning activities are not found in this e-book media.

The e-book plantae learning media allows it to be developed into attractive interactive media. This media can integrate supporting components such as sound and images (graphics, photos, animation, and film) so that media content is more informative than textbooks.

The advantages of interactive e-books compared to textbooks are: 1) photos / pictures of plants are presented in original, 2) examples of plants are recognized by students because they are around them, allowing them to be used as references, 4) relatively easy and cheap because they can use smartphones or laptops, and 5) enabling students to learn independently. In general, the interaction feature can increase user motivation to use e-books in the learning process (Suyatna et al., 2019). The old opinion raised by (Latuheru, 1988: 23) about the benefits of interactive media through e-books is (1) the attention of students to the material increases the independence of students working independently and (4) memory of the material being studied is strong and long.

The material coverage of high school plantae includes groups of mosses, ferns and seed plants. The basic competence (KD) determined in this material is that students are able to apply the principle of classification to group plants into divisions based on plant metagenesis and observation and are able to present plant phenetic and phylogenic analyzes and their role in survival on earth. The development of science and technology, especially the discoveries of techniques revealing micro and molecular markers, has changed the classification of plants into the divisio category. The material coverage is broad with many divisions that need to be simplified and reviewed by plant groups in order to make it easier for students to achieve the predetermined KD. Therefore,

Achievement of affective, cognitive, and psychomotor competencies. These three competencies are measured through bloom taxonomic analysis. Affective competency assessment aims to complement cognitive and psychomotor competency attainments. The selected affective competencies are levels A2 (respond) and A3 (appreciate), students are assessed for their active role when making observations, discussions, and are able to show contributions of knowledge, opinions, and ideas(Eddy et al., 2015; Setiawan et al., 2018). The measured cognitive competencies are the level of C4 (analyzing), C5 (evaluating), and C6 (creating) through the Higher Order Thingking Skils (HOTS) level questions that will be trained to students. Measurement of psychomotor competence is carried out at the P3 level (precision), that is, students are able to show the classification of ferns based on observations (Sorrentino, 2021).

School learning problems and the results of the analysis of relevant literature studies show the need for an interactive and more dynamic fern e-book, easy to understand and attractive to students. Therefore, the development of teaching materials in the form of interactive e-books on ferns needs to be done through a scientific approach with HOTS questions so that student learning outcomes increase and KD is achieved. The phenomenon of "walking library" or students bringing various kinds of books to school is expected to be minimized.

METHODS

This development research adopted the stages of research by Borg and Gall (1983). The research subjects were 1) material experts and media experts; 2) students of class x and 3) biology teacher 11 semarang high school.

Research design

At the implementation used a Quasi experimental design method, which is a research carried out without a comparison or control class (Arikunto, 2002). The experimental design used was one group pre test - post test.

The population in this study were students of class X SMA Negeri 11 Semarang. Sampling was done by random sampling technique. The method of data collection was done by using the test method and the method of documentation. The test method takes the form of a multiple choice testwhich has been tested for the validity, validity, reliability of the data with a total 25 items.

Data analysis

The results of the exploration of ferns were observed and then identified with the help of a microscope and reference books and asked questions to experts. The e-book feasibility analysis was assessed by the criteria for the percentage of the BSNP assessment score. The results of the feasibility were tested on small-scale students and student analysis was carried out based on the criteria used Sudjana (2006). E-book teaching materials that have been improved based on the results of small-scale trials were tested on a large scale. The test of the effectiveness of teaching materials on learning was carried out through pre-test and post-test as well as the results of the final response analysis of students.

The student completeness value in this study was 75. Individual learning completeness was calculated from the combined average of the assignment value and the post-test score using the formula:

$$Nilai = \frac{T\ (1) + P\ (2)}{3}$$

Information

Task (T) : Weight 1

Written test / post - test (P) : Weight 2

The average score of the students' written test is calculated using the formula (Arikunto, 2006):

Information :

X: Average written test score

∑X: Total value obtained

N: Number of students

Student learning outcomes were then tested with the t test and the Gain test which were carried out as follows:

1. T test

Student learning outcomes in the aspect of student knowledge or concept mastery were tested using the t test using the paired sample t test with the SPSS 23 program, to find out significant differences in learning outcomes before and after using the developed chemistry learning module.

2. Gain Test

Gain test is conducted to determine the extent to which learning outcomes increase *pre-test* and post - test which was conducted before and after using the e-book of biology learning material developed by ferns.

3. Effect size test

The effect size is used to determine how much influence the interactive e-book has on learning outcomes for a single group / one group.

RESULTS AND DISCUSSION

Results of Exploration of Ferns Plant

Exploration of ferns was carried out in lowland areas (Darupono Nature Reserve, Kendal and Mount Pati, Semarang), medium plains (Penggaron Forest and Baturraden Botanical Garden), and highlands (Mount Lawu and Mount Ungaran). The results of the identification of ferns are presented in Table 1.

Table 1. Exploration results for ferns

Family	Number of species
Denstaedtiaceae	10
Schizaeaceae	5
Thelypteridaseae	1
Adiantaceae	6
Grammitidaceae	1
Polypodiaceae	21
Equisetetaceae	1
Selaginellaceae	4
Gleiheniaceae	3
Woodsiaceae	3
Vittariaceae	1
Pteridiaceae	2
Nepheolepidaceae	1
Cyatheaceae	1
Davalliaceae	2
Aspleniaceae	2
Marattiaceae	1
Lycopodiaceae	1
Dipteridaceae	1
Blechnaceae	2

The exploratory ferns were used as a source of material for the development of e-book teaching materials which were presented in the form of narration, video, contextual images and questions with HOTS vision.

Interactive E-book Development

The development of e-book teaching materials refers to the analysis of the students' needs analysis of interactive learning resources that are easy to understand and interesting. In general, students have difficulty recognizing and distinguishing ferns. The term scientific name is difficult to memorize, the

morphology of ferns, especially the spore part, is difficult to observe with the naked eye so that students find it difficult to understand the metagenesis of ferns where when studying ferns, students find it difficult to learn. Bariah (2019) states that needs analysis is an important step to obtain initial information that will be used as a reference for development.

The ferns that have been identified are a source for developing e-book teaching materials with a professional pdf flip software application. The software is used to create charts and key features, including interface links, video, audio, music and interactive quizzes. The use of professional Flip pdf can be applied to all subjects in an effort to improve student learning outcomes (Amanullah., 2020).

*E-book*interactive professional development results based on Flip pdf consisting of several main menus, namely: (1) Instructions for use, (2) KD and learning objectives, (3) learning materials with pictures of ferns from exploration and development videos, (3) interactive HOTS quizzes, (4) Evaluation, (5) Glossary, (6) Profile.

The developed e-book was said to be interactive because there was link that make it easier to acces material, animated videos, and user interaction with e-books through quizzes. The order of the development of interactive e-book compiled with scientific studies to lead students' thinking and emotion.

Product Eligibility

The validity of e-book teaching materials was assessed by a validator in the first and second stages of designing an interactive e-book on nail plant material through a scientific approach with HOTS questions. The results of the e-book validation are presented in table 2.shown in the following table:

Table 2. The results of the e-book validation

Component	Percentage	Criteria
Material: Phase I		
• Contents	77	Revision
• Presentation	70	Revision
• Language	69.4	Revision
• Scientific	75	Revision
Phase II		
• Contents	83.3	Feasible
• Presentation	77.5	Feasible
• Language	75	Feasible
• Scientific	82.14	Feasible
Media	99.07	Very feasible

Small-Scale Readability Test

*E-book*interactive which has been deemed appropriate for the material and very feasible for the media was tested on small-scale students with 20 students. Student responses to the use of e-books are in Table 3.

Table 3. Student responses to small-scale trials

Aspect	Percentage (%)	Criteria
Interest	88.67	Positive
Theory	86.67	Positive
Language	83.33	positive
Total	86.22	positive

Product feasibility and positive student responses on all criteria indicate that the e-book is valid after being revised according to expert input the e-book is applied on a large scale to obtain the effectiveness of this teaching material on affective, cognitive, and psychomotor competencies.

Effectiveness Test Cognitive competence

The results of pre-test and post-test on the aspects of students' knowledge or conceptual mastery showed an increase in learning outcomes after students used interactive e-books. The improvement of student outcomes is presented in the following diagrams:

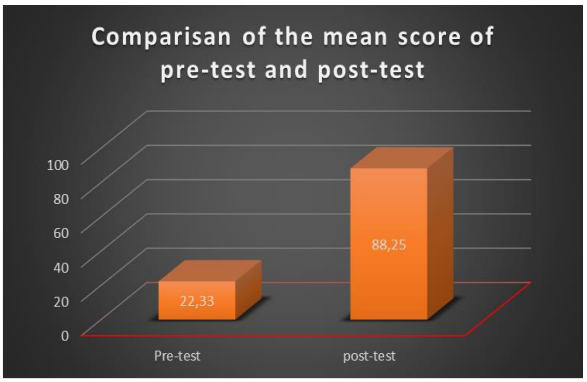

Figure 1. The average value of the results of the pre-test and post-test aspects of students' knowledge or concept mastery.

The result of the calculation of N-Gain on the average learning result or the test of students' concept mastery ability of 0.84 is in the high category. This shows that the use of e-books contributes to the achievement of cognitive competencies.

The results of the paired sample t test with SPSS 23 indicate that the significance is 0.000 <0.05. The test results show that there is a significant difference in learning outcomes between before and after using the interactive e-book. This difference occurs because the material in the interactive e-book is easy to understand on the aspects of presentation, content aspects, and language aspects complemented by interactive images and videos containing ferns found in the students' environment.

The increase in learning outcomes is also evidenced by (Zahara et al., 2017) because students get learning first through e-book learning media before getting learning from the teacher so that the learning obtained is more optimal.

The calculation of the Effect Size data shows that the effect size value is 8.85> 1.00, so it can be concluded that the use of interactive e-books of ferns on learning outcomes has a high effect (strong effect).

Affective Aspects

Affective competency assessment refers to the results of observations of student activities during the learning process using interactive e-books including during practicum. The competencies assessed include 1) working together in groups; 2) tolerant; 3) attention to the discussion material; 4) discipline in discussion; 5) responsibility. The result of the average value of affective competence for each indicator at each meeting was 3.36, including the very good criteria (Figure 2)

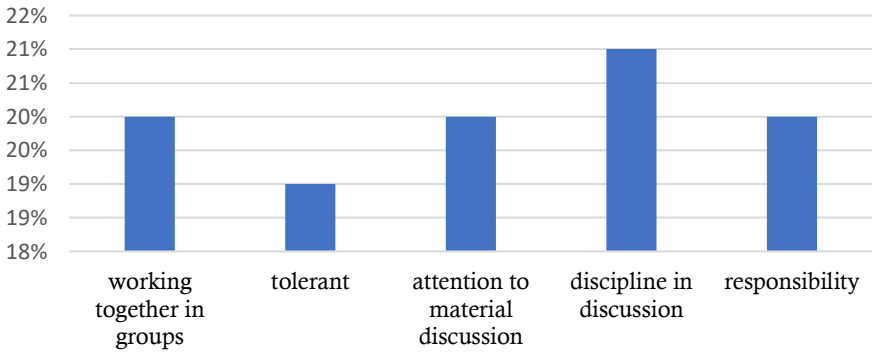

Figure 2. Percentage of Average Affective Competencies

The scientific approach to interactive e-books is proven to lead to student-centered learning on the effectiveness of its involvement. Affective competences and students' positive responses show that the e-book is ineteractive on affective material. The results of this study strengthen Sriwahyuni et al. (2019) that the use of professional Flip pdf can improve learning outcomes and student attitudes. In addition, the use of digital learning resources is effectively used in strengthening character values (Rina et al., 2020; Lestari et al., 2021).

Psychomotor Competence

Psychomotor competency assessment is carried out when students are having discussions and practicum using an interactive e-book. Measured competence 1) cooperate in groups; 2) skills in understanding practicum; 3) reporting of practicum results; 4) timeliness of carrying out practicum; 5) responsibility; 6) ability to observe (Figure 3)

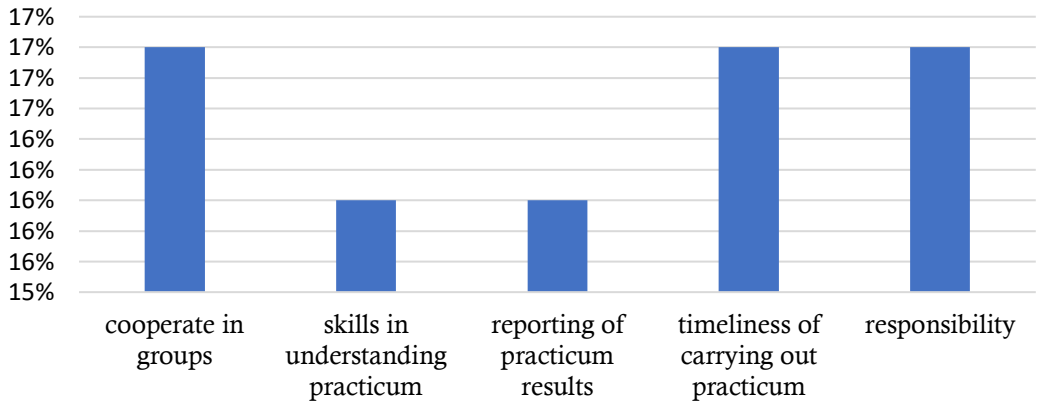

Figure 3. Percentage of Average Skills Aspects

E-book application is effective with excellent psychomotor competency achievement. Students have high curiosity and are motivated to do it seriously. Amin et al. (2017) in their research concluded that interactive media as teaching material can improve students' science process skills, including grouping (classification), planning experiments, making observations.

This supports the results of the study by observing the aspects of working with groups, the timeliness of carrying out practicum, responsibility, and the ability to observe to obtain a higher average score than other aspects. The availability of clear learning resources fosters the curiosity of students and encourages active discussion.

Nurdin (2015) states that there are significant differences in competence from the application of conventional e-books inetarchical. Qibtiya & Kustijono (2018) confirm that using interactive e-books trains students to formulate problems, give arguments, make induction, evaluate and decide and implement a problem.

CONCLUSION

The results of the interactive e-book validation by material experts were declared feasible and media experts declared very feasible. Small-scale trials involving 20 students on interactive e-book readability also included positive criteria. Finally, the application of interactive e-book on nail plant material on a large scale has also proven effective as a teaching material so that it can be used as an alternative learning resource. This inactive e-book will make it easier for students to understand the concept of ferns because of the completeness of the picture and its suitability with the ferns in the students' environment.

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