

Development of E-Book Based Instructional Design PjBL Model Integrated Science Literacy To Improve Critical Thinking Ability

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Abstract: The aim of the research is to develop e-books based on PjBL model instructional design integrated with scientific literacy to improve students' critical thinking skills. To find out the feasibility validation test of e-books based on the instructional design of the PjBL model integrated with scientific literacy. To find out the E-book Effectiveness test on Critical Thinking Ability. The method to be used in this research is to use the research and development (R&D) method. The research stages are determining the material, preliminary research, analysis, design creation, material creation, initial product development, valid, feasibility test, valid, practicality test. The research data is in the form of feasibility test data by validators and the effectiveness of E-books. In critical thinking skills, the research results show that the feasibility test obtained from validation by material experts and biology teachers is reviewed based on presentation, content and language components obtained an average value of due diligence of 92.50% which is in the category very feasible to use. Meanwhile, the results of the N-gain test on the level of students' thinking abilities after using this e-book obtained a score of 0.80% in the good category in improving critical thinking abilities.

Keywords: Critical Thinking Ability; Model Project Based Learning; Science Literacy

Introduction

Data obtained through PISA on students' scientific literacy skills with an average score found in Indonesia in 2009 was ranked 57th out of 65 countries with a score of 383. In 2012 Indonesia was ranked 64th out of a total of 65 countries with a value of 382. Furthermore, in 2015 Indonesia was ranked 64 out of 72 countries with a score of 403. The low ability of scientific literacy is related to the science learning process which has not provided opportunities for students to develop reasoning and problem solving skills. The results of the 2015 PISA and TIMSS studies are proof that education in Indonesia still emphasizes aspects of lower-level thinking and rarely accustoms students to using higher-order thinking in dealing with and solving real problems in everyday life (Yanti et al., 2019).

One of the steps so that students can develop scientific literacy skills is project-based learning (PjBL). The PjBL model is useful for solving student problems with the ability to think critically and fostering environmental knowledge (Lapuz & Fulgencio, 2020). The PjBL model is also said to be student-centered learning activities and fosters the character of critical thinking, communicative, investigative, carrying out interactive and experimental learning (Farida et al., 2017). PjBL requires students to design and develop systems that can be used to investigate and solve real-world problems (Sababha et al., 2016). In line with Noviyana's research (2017) PjBL learning can require students to think creatively in solving problems received. Project based learning, which is often abbreviated as PjBL, is a model that gives teachers the

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opportunity to manage classroom learning by involving project work (Wena, 2014).

The solution offered to overcome this problem is to develop an instructional design using the PjBL model based on technology media in the form of an E-Book. Technology in education must be used appropriately to improve the quality of students' learning experiences (Aditia & Muspiroh, 2013; Husain, 2014; Yuberti, 2015). Technological developments can be utilized in learning, especially in teaching materials (Cholik, 2017; Ferdianto & Setiyani, 2018; Irwandani & Juariyah, 2016; Putra, 2012). Technology can be used to develop electronic books (e-books). These electronic books can be presented more attractively (Alifya & Rahman, 2020; Kurniawan et al., 2018; Simanjuntak et al., 2019).

Electronic books, also known as electronic books, which are often abbreviated as e-books, are digital versions of traditional printed books designed to be read on a personal computer (PC) or on a smartphone. E-books are also very helpful for the learning process outside the classroom or at home (Hadaya et al., 2018; Ozturk & Hill, 2020; Uygurer & Uzunboylu, 2017). With the existence of e-books, the learning and teaching process becomes easier. Teachers can create subject matter in e-book form and then send it to students. This e-book has advantages over printed teaching materials. First, e-books can be accessed online via laptops or smartphones (Korat et al., 2021; Rusli & Antonius, 2019).

Based on the explanation above, what will be studied in the research is the development of an e-book based on the PjBL model of instructional design integrated with scientific literacy to improve critical thinking skills implemented in the target school. Research is very useful for use in learning activities, because the e-book developed has the advantage of presenting interesting features, presenting project activities that can help students practice critical thinking skills. Apart from that, the e-book developed can facilitate online learning because it is packaged using the latest features that connect directly to sources on the internet, such as YouTube for uploading project documentation and accessing material in the form of videos, Google Drive for accessing questions, email for sending assignments and journal portals to broaden students' insight.

This will have a positive impact on the learning process activities that will be implemented by teachers and students at school. The objectives of this research are as follows: For the needs of developing e-books based on instructional design based on the PjBL model integrated with scientific literacy to improve students' critical thinking skills. To find out the validation test for the feasibility of e-books based on the PjBL model of integrated scientific literacy instructional design. To find

out the Effectiveness of E-books on Critical Thinking Ability.

Method

Types of Methods

This type of research is carried out using the development method or Research and Development (R&D). The process of implementing this activity is in the form of an e-book product based on the instructional design of the PjBL model integrated with scientific literacy to improve students' critical thinking skills for the perfection of the product that has been made (Borg & Gall, 1983). The stages of the research are formulating potentials and problems, collecting data, conducting research product designs, validating products, carrying out product revisions, conducting product trials and continuing product revisions. Product improvement can use the development method by testing the effectiveness of the product which contains the following flowchart (Figure 1).



Figure 1. The ADDIE Model Development Stage

Research Stages

The implementation of the stages of this procedure adopts development research (Borg & Gall, 2007). The research stages are determine the material, preliminary research, analysis, design making, manufacture of materials, initial product development, valid, due diligence, valid, effectiveness test, final product

Research Data Collection Techniques

To expedite the process of research activities carried out by using research data collection techniques which include: observation, non-test in the form of a questionnaire consisting of a material expert questionnaire as a validation test and product effectiveness test, interview process and documentation.

Data Analysis Techniques

The process of the activities carried out by the data analyzer which produces the product consists of several phases, namely the design phase of the design in analyzing information about science process skills in aspects of the realm of knowledge, characteristics and skills of students. In the realization phase, carry out a clear action in product design in solving problems that have a real action being analyzed, realized by construction or production activities of an assessment tool from the resulting initial draft (Prototype 1, this is done by validating research products. The phase of making learning tools in the form of tests that will be carried out content validation on experts

Result and Discussion

This research succeeded in developing teaching materials, namely e-books based on the PjBL Model which integrates scientific literacy to train critical thinking skills in Coordination System material that is theoretically and empirically valid and practical. The e-book has sub-materials namely: Nervous System, Hormones and Sensory Organs. E-book development research obtained results which will be discussed as follows:

Definition Stage (define)

This stage contains the collection of information used to prepare the draft (initial product). First of all do a needs analysis by interviewing the needs of SMA Muhammadiyah students in Langsa City with a total of 20 students. Based on the results of the interviews, it is known that there is no e-book that uses the PjBL model based on scientific literacy. The references used for teaching temporarily are school books coupled with material sought from the internet. However, these references are still lacking, so it is necessary to develop e-books to help the learning process. This is in line with research (Widyastuti, 2019) which states that learning tools that really support the learning process are the availability of e-books.

The next step is to analyze the material to be developed in the e-book. Based on the distribution of the needs questionnaire which stated that 16 out of 20 students thought that the coordination system material was difficult to understand. So thus this development research developed a biology e-book on coordination system material. Then an analysis of the syllabus and material concepts is carried out as well as formulating the goals to be achieved in each lesson

Design Stage (design)

The second stage is the design of e-books based on scientific literacy. At this stage what needs to be considered is the way the material is presented in the e-

book. The presentation of the material in this scientific literacy biology e-book connects the biological sciences with the context in the lives of students. The description of the material begins with phenomena that are often encountered by students, then there are questions or problems with the aim of directing students to be able to see an overview of the material they will learn. After being stimulated with questions, it is followed by the presentation of the material, where each material contains examples of questions and their application in everyday life. The results at this stage are then used as a guideline for carrying out the next stage, namely the development stage.

Development Stage (develop)

The biology e-book that has been designed is then used as an e-book product to be developed so that it becomes a better product. Some of the things done in this stage are:

Making E-books

In this activity, e-books are made starting from searching and collecting various sources and relevant information to enrich the material, making the required illustrations, charts and graphs, typing, editing and setting the layout. The following are PjBL aspects based on scientific literacy contained in the developed e-book:

Content Aspect

Content is a scientific knowledge refers to both scientific knowledge (knowledge about the natural world) and knowledge about science itself as well as the activities of human life. Techniques in the form of steps that will be used in completing the project from biology subjects in the form of coordination system materials used in making the project. The results of the project preparation can be seen in Figure 2.



Figure 2. Presentation of Content Aspects

Process Aspect



Figure 3. Presentation of Process Aspects

Implementation Process science refers to a process for answering questions or solving problems, such as identifying and interpreting natural phenomena and explaining the conclusions of the phenomena that occur.

In this case the cognitive processes involved in the scientific process include inductive/deductive reasoning, critical thinking, constructing explanations based on data. Ability to solve problems, identify and interpret and explain conclusions. This includes knowing the types of questions science can and cannot answer, what evidence is needed in a scientific investigation, and conclusions based on the available evidence. The phenomena presented are contextual phenomena or those that can be encountered in everyday life. An example of a process aspect is presented in Figure 3

Context Aspect

The modern definition of scientific literacy emphasizes the importance of knowing and understanding the context of science applications, as well as being able to apply science in solving real problems it faces, both related to science applications including the application of science in personal, social and global settings such as: health; natural resources; environmental quality; danger; the latest developments in science and technology. The results of the compilation on the context aspect can be seen in Figure 4.



Figure 4. Presentation of Context Aspects

E-book Feasibility Test

The results of the e-book feasibility test have been validated by three validators, namely education expert lecturers, subject matter expert lecturers and biology teachers who are reviewed based on presentation, content and language components. The following is a recapitulation of the PjBL-based e-book validation results (Table 1).

Based on the validation results by the three validators, the e-book developed as a whole obtained a

validation score percentage of 93.00% in a very valid category. These results indicate that e-books are suitable for use in learning. E-books are developed according to the development stage starting from curriculum analysis, student analysis, task analysis, and concept analysis to the e-book design stage and several revisions that produce draft I, II, and II. Fatmawati (2016) argues that to produce learning tools must go through the design of content, structure and appearance according to needs, according to predetermined competency

standards and basic competencies. The e-book drafts 1 and II were revised by the supervisor then draft II was validated by expert lecturers and biology teachers to produce draft III. The following are suggestions and results of revisions from the validator for PjBL-based e-books.

Table 1. Recapitulation of E-Book Validation Results

Rated aspect	Score			Average
	V1	V2	V3	
Presentation Aspects				
Serving technique	4	3	4	3.67
Supporting the presentation of the material	3	4	4	3.67
Completeness of the presentation of the material	4	4	3	3.67
Presentation of learning	4	4	4	4.00
Display quality	4	3	3	3.33
Layout quality	3	4	4	3.67
Video quality	4	3	4	3.67
Image quality	4	4	4	4.00
Validity Score (%)				92.75
Content Aspect				
Conformance of the material with the concept	4	3	4	3.67
The suitability of the concept with the 2013 curriculum	4	4	3	3.67
Up to date concept	3	4	4	3.67
Compatibility with PjBL syntax	4	4	3	3.67
Compatibility with scientific literacy	4	4	4	4.00
Compatibility with critical thinking indicators	3	4	4	3.67
Validity Score (%)				93.00
Language Aspect				
Language use	3	4	4	3.67
Use of terms	4	4	4	4.00
Identity and Information Sources	3	3	3	3.33
Validity Score (%)				91.75

Description: V1: Lecturer of education expert; V2 : Lecturer material expert; and V3 : High School Biology Teacher.

The results of the expert validation show that the instructional design with integrated PjBL KPS is classified as valid based on the results of the validator's assessment as indicated by the score of the validation sheet scoring each of 80.0; 79.9 and 80.8 and fulfill the valid category (Nuraini & Waluyo, 2021). Flip book type e-book based on scientific literacy on theoretically and

empirically feasible ecological material. Theoretical feasibility based on expert lecturer studies shows an average percentage of 97.9% with a very valid category (Muhlas, 2019).

The results obtained were that the e-module Practicum Based Learning Model (PjBL) products integrated with science process skills and scientific literacy analyzed consisted of three categories with a percentage value of very valid aspects with a value of 87.5% on the quality element of the e-module, then the practicum module is declared feasible to be used as a practicum guide. The implementation of students' worksheet product development to carry out ethnosience based on science literacy is carried out to find out the feasibility test of students' worksheets consisting of material experts, media experts, and practicalization experts is In the validation process by obtaining material experts overall average of 95.0% is categorized as very valid, In the validation process by material experts obtaining an overall average of 93.0% were categorized as very valid and In the validation process by practicalization experts obtained an overall average of 96.3% categorized as very valid (Siska et al., 2022).

Effectiveness of E-book on Critical Thinking Ability

The effectiveness of the developed e-book can be seen through the average N-gain score. The N-gain score is a score taken from a comparison between pretest scores and posttest scores based on the stages of students' critical thinking tests. Students' critical thinking test answers show the level of students' critical thinking skills. The results of achieving students' critical thinking skills in the pretest and posttest can be seen in the following figure.

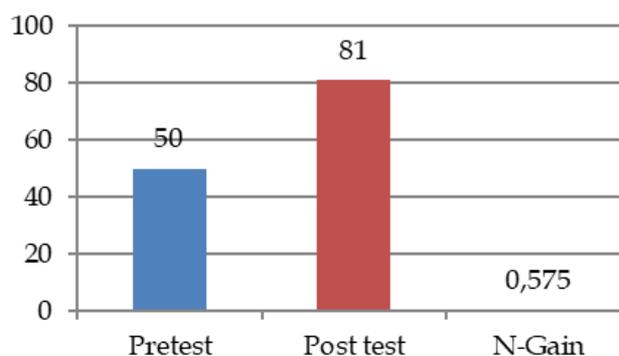


Figure 5. Results of Student Critical Thinking Analysis

Based on the picture above, the students' posttest scores at the level of critical thinking skills are higher than the pretest scores. This shows that the developed e-book succeeded in increasing students' critical thinking skills. This is reinforced by the results of the N-gain test shown in the figure. Based on the results of the N-gain

test above, it shows that the acquisition of the N-gain value is in the medium category. In other words, the developed e-book is effective. Effective textbooks are characterized by increased student learning outcomes. This is in line with the research of Rohana & Wahyudin (2017) that learning with PjBL can improve students' literacy skills. Wijanarko (2017) that the PjBL model empowers students' scientific literacy through scientific work to solve a problem and produce products so that learning outcomes are maximized. This is consistent with research conducted by Gunawan et al., (2017) that textbooks with the PjBL model can enrich students' mastery of physics concepts. The results of the research, data analysis and discussion, it can be concluded that the project based learning (PjBL) learning model influences the scientific literacy of students at SMA Negeri 1 Kopang (Kamariah et al., 2023).

Conclusion

Based on the results of research and analysis of data on the development of an e-book based on the instructional design of the PjBL model integrated with scientific literacy to improve the critical thinking skills of Muhammadiyah high school students, it is in the very feasible category to be used in the learning process. The average result of expert validation from the e-book feasibility test is 92.50% which has a very feasible category, while the average result of e-book development based on instructional design model PjBL integrates scientific literacy to improve students' critical thinking skills. This is based on the results of the N-Gain analysis of 20 students. The average N-Gain test results get a value of 0.575 and are in the currently category in increasing critical thinking skills

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Author Contributions

Siska Rita Mahyuni: create an e-book application, Nursamsu: Create validation instruments and conduct school observations, Rizky Nafaida: Creating critical thinking instruments, Salwa Rezeqi: Help validation E-book

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Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this paper

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