Implementation of e-module flip PDF professional to improve students' critical thinking skills through problem based learning

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Abstract. Critical thinking is one of the skills that must be possessed in the 21st century. These skills can be improved by using the right media in learning. This study aims to examine the effectiveness of lipid metabolism’s Flip PDF Professional’s electronic module (e-module) in problem-based learning to improve students' critical thinking skills. The e-module used in this study was previously made by researchers and published. The research data process used non-parametric Wilcoxon match pair test with research instruments test critical thinking skills in the form of pre-test and post-test. Instrument tests are made based on the achievement of subject learning and critical thinking indicators that have been tested for content validation by expert. The subjects in this study were third-level students in Chemistry Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Jakarta. After the Wilcoxon match pair test with SPPS was obtained value Asymp. Sig. (2-tailed) is worth 0.000 < 0.05. This means that there is an increase in students' critical thinking skills in pre-test to post-test after learning with method Problem Based Learning with the lipid metabolism e-module media.

1. Introduction

Industrial Revolution 4.0 is an era of integrated technological innovation with knowledge [1]. Learning activities in this era should be done anytime and anywhere [2]. Technology has an important role in these learning activities. Learning media that support technology-based learning include e-book, flipchart, games, multimedia interaction (MMI), electronic modules (e-modules), power-point (ppt), video, and web-based learning (WBL) [3]. Appropriate learning media can support the achievement of learning objectives, motivating and engaging for students [4]. Electronic modules or so-called e-module is a self-learning media are arranged systematically, displayed in an electronic format, in which there is audio, animation, and navigation [5]. E-module in the form of a flipbook has a page edit function and can create interactive book pages by inserting images, videos from YouTube, MP4, audio videos, hyperlinks, quizzes, flash, etc. This learning media is appropriate to use as an innovation in industrial revolution 4.0 and 21st-century learning.

21st-century learning integrates knowledge, skills, attitudes, and mastery of technology [6]. The main skills needed in 21st-century learning are known as 4Cs - communication, creativity, collaboration, and critical thinking [7]. Most universities make critical thinking skill to be the main goal of higher education [8]. In the chemistry education literature, attempts to teach critical thinking are common [9]. Critical thinking actively conceptualizes, analyses, synthesizes, and evaluates information through observation,
experience, reflection, reasoning, or communication, as a guide [10]. Providing learning material related to its application in daily life can improve students’ critical thinking skills [11].

The use of electronic modules as learning media can present authentic problems in the form of objects that are not directly observed [12] so it easier to solve problems given by lecturers. Appropriate learning models to improve critical thinking skills is the Problem Based Learning (PBL) [13]. Problem Based Learning provides various problem situations for students [14]. The student is the learning centre while the teacher facilitating students as a facilitator that to actively solve problems and build their knowledge in groups [15]. The use of e-modules in the PBL learning model can provide students with independent learning [16] and provide concrete experiences to solve the problem [17].

Applications that can be used to create e-modules, consist of Kvisoft Flipbook Maker 3D Page Flip Professional [18]; and Flip PDF Professional. The Flip PDF Professional application is easier to use because it can be operated for beginners. Flip PDF Professional is a flipbook maker application that has a page edit function and can create interactive book pages by inserting images, videos from YouTube, MP4, audio video, hyperlinks, quizzes, flash, etc [19]. Previous research has developed e-modules using applications such as 3D Page Flip Professional and Kvisoft Flipbook, there is also research that develops e-modules to improve critical thinking skills. There is not yet e-module created using the Flip PDF Professional application to improve critical thinking skills. We have made e-module lipid metabolism with the Flip PDF Professional application whose article is waiting to be published. In this article, we examine the effectiveness of the e-module to improve students’ critical thinking skills through Problem Based Learning.

2. Methods

The method used is Wilcoxon Match Pair Test to see the effectiveness of e-module lipid metabolism in improving students' critical thinking skills through Problem Based Learning. The study was conducted at the Faculty of Mathematics and Natural Sciences; State Universitas Negeri Jakarta in May 2019 with research subjects is chemistry education students in the sixth semester consist of 36 students. Improvement of students' critical thinking skills obtained from the results of the pre-test and post-test.

The learning activity begins with an explanation from the lecturer regarding the material of lipid metabolism using power-point slides for one meeting. Next meeting, students were given lipid metabolism pre-test questions to see the initial critical thinking skills. After that, the lecturer divides students into 6 groups according to the number of problems that must solve. Each group had a different problem related to lipid metabolism. Students are given e-modules as learning media to help students solve the problems they get.

The last meeting, students presented solutions to the problems they had discussed with their respective groups. Other students can give an argument to their friends who present in front of the class. The lecturer gives confirmation if there is a statement that is not conveyed by the students. The learning activity ended with a post-test of lipid metabolism.

Improvement of students' critical thinking skills seen from the results of pre-test and post-test in the form of essay questions that are in accordance with course learning outcome and indicators of critical thinking skill. Indicators of critical thinking skill consist of 1) analyzing questions, 2) focusing questions, 3) identifying assumptions, 4) determining solutions to problems, 5) writing answers or solutions to problems, 6) determining conclusions from solutions to problems, and 7) determining another alternative to solve the problem [20]. Critical thinking criteria there is in table 1.
3. Result and Discussion
The implementation of e-modules through Problem Based Learning show an increase in results from pre-test to post-test. This can be seen from the way students answer questions given essays. In the pre-test results, students answer questions without identifying all information in the problem, cannot show procedures in getting answers, and do not determine alternatives to complete answers. Post-test results showed an increase in the answers given by students. Students can determine the concept in solving the problem given, identify all information in the problem, show the procedure in getting answers, and determine alternatives to complete the answer. Comparison of the percentage of students’ critical thinking skills can be seen in table 2.

Table 2. Comparison of the percentage of students’ critical thinking skill in pre-test and post-test

| Percentage | Criteria | Percentage | Criteria |
|------------|----------|------------|----------|
| 90% ≤ X ≤ 100% | Very Good | 19.4% | Very Good |
| 75% ≤ X < 90% | Good | 27.8% | Good |
| 55% ≤ X < 75% | Enough | 52.8% | Enough |
| 40% ≤ X < 55% | Less | - | Less |
| 0% ≤ X < 40% | Very Less | 8.3% | - |
| 91.7% | Very Less | - | Very Less |

In the pre-test results, many students had very poor critical thinking categories (91.7%), only a few had less critical thinking skills (8.3%). The majority of students do not meet the criteria of critical thinking that focuses on the question, approve, determine the solution of the problem to the question. The results of the post-test showed the increase in the category of critical thinking students became quite good to very good. The majority of students have met the indicators of critical thinking in focusing questions, identifying assumptions, determining solutions to problems in the problem, there are even some students who have been able to determine alternatives to other ways to solve the problems that exist in the problem. Students can already provide answers with scientific explanations according to the concept of lipids.

During the learning activities, students are more active in expressing opinions, critically making ideas and constructing their own knowledge with an explanation of the material contained in the e-module. Students independently in finding solutions to the problems given and analysing the solutions obtained. They give each other an analysis of the arguments presented between group members. This learning process can train students to construct knowledge appropriately and improve critical thinking skills. Through e-module on Problem-Based Learning, teachers can also develop interesting, effective learning.

Effect of using e-modules seen from hypothesis testing. Pre-test and post-test results were given scores using indicators of critical thinking skills. After the pre-test and post-test results are obtained, the data is tested for normality and homogeneity using SPSS. The normality test is carried out with the Liliefors test using SPSS and obtained sig. value for pre-test of 0.028 <0.05 then H₀ is rejected, pre-test data are not normally distributed. Whereas in the post-test the value of sig. of 0.115> 0.05 then H₀ is
rejected, post-test data are normally distributed. Homogeneity test was carried out with SPSS and obtained sig. the results of calculations with SPPS obtained 0.022 <0.05 then $H_0$ is rejected, the variance of the data is not the same or not homogeneous.

Data for pre-test is not normal and overall data is not homogeneous so non-parametric Wilcoxon match pair test is performed to measure the significance of the difference in pre-test and post-test values. After the Wilcoxon match pair test with SPPS was obtained value Asymp. Sig. (2-tailed) is worth 0.00. This value is smaller than 0.05, it can be concluded that $H_0$ is rejected and $H_1$ is accepted. This means that there is an increase in students’ critical thinking skills in pre-test to post-test after learning with method Problem Based Learning with the lipid metabolism e-module media.

4. Conclusion
The results of the study show that the use of e-modules lipid metabolism through problem-based learning effective improves the critical thinking skills of chemistry education students.

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