Development of the PDEODE-WEB Model in Blended Learning to Improve the Students Critical Thinking Skills

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Abstract. The purpose of the study was to determine (1) the quality of the predict-discuss-explain-observe-discuss-explain-website (PDEODE-WEB) development in the blended learning of digestive system covered in valid aspects, (2) the impact of the PDEODE-WEB in blended learning on digestive system toward the critical thinking skill of high school students. Type of this research is a 4D that include Define, Design, Development, and Disseminate. Data analysis techniques that used are descriptive and inferential statistics using ANAVA tests. Research shows that (1) the results obtained from the PDEODE-WEB model in Blended Learning with tools, are empirically valid and reliable in learning, (2) the PDEODE-WEB model in Blended Learning has a significant influence on improving the thinking skills of SMA XI students at SMAN 4 Pekanbaru. This result is proven by the ANAVA test results with a Sig < 0.05. Then it can be concluded that there are improved thinking skills of students who learn to use PDEODE-WEB in Blended Learning. Therefore, the PDEODE-WEB model in Blended Learning can effectively improve the students' critical thinking skills on the digestive system material and found an average value of N-Gain of 0.6 with a moderate category.

1. Introduction

The 21st century is era of globalization where Information and Communication Technology (ICT) is developing, the development of the globalization era requires the education sector to be able to create critical and adaptive human resources for any changes and developments [1]. Education is one of the areas that are experiencing phenomenal changes as a result of the advancement and use of information technology. Mobile and e-learning are already facilitating the teaching and learning experience with the use of latest channels and technologies [2].

This 21st century learning has entered the digital era, in which educational practitioners have developed and designed digital-based learning such as online learning. However, online learning still requires another learning, namely face to face learning. This combination of online and face-to-face learning is known as Blended Learning [3].

The teaching and learning environment is embracing a number of innovations and some of these involve the use of technology through blended learning. This innovative pedagogical approach has been embraced rapidly though it goes through a process. The introduction of blended learning (combination of face-to-face and online teaching and learning) initiatives is part of these innovations but its uptake, especially in the developing world faces challenges for it to be an effective innovation in teaching and learning [4]. Blended learning could be further defined as the learning mode integrated with various hybrid factors, such as learning environments, brain acquisition mechanism, learning affective factors, learners and teachers [5]. Blending learning varied based on different goals.
such as pedagogical richness, access to knowledge, social interaction, personal agency, cost effectiveness, and ease of revision [6].

The National Education Association has identified 21st century skills as "The 4Cs (Critical Thinking, Creativity, Communication, Collaborative) skills" including critical, creative, communication and collaboration thinking. Critical thinking skills are skills to carry out various analyzes, assessments, evaluations, reconstructions, rational and logical decision making [7].

The problem that has been present in education is in terms of applying the model in the learning process. Most teachers still apply conventional learning that does not refer to students' critical thinking skills. The teacher's lack of creativity in using the learning model in class causes the implementation of learning to be monotonous [8].

Based on interviews and observations at SMAN 4 Pekanbaru in class XI, problems were found: Learning methods that were only applied were lectures, discussions and demonstrations. Such learning cannot involve and activate students in learning, and there are still many students who have not been able to cultivate their reasoning, questioning, and analysis skills so that they do not support students' critical thinking skills. Learning still leads to teacher centered which makes students only receive information from a teacher, thus causing learning activities in class to look bored, and less enthusiastic. Biology learning has difficulty due to abstract physiological concepts, one of which is the digestive system material in humans, and the limited learning media that are interesting and able to motivate students in teaching and learning. In addition, the advantage in this school is that almost all students already have smartphones and also have laptops, the availability of supporting learning processes is provided by the presence of computer laboratories, science laboratories, wifi, LCDs in classrooms but teachers have not optimally implemented ICTs in the learning process.

Based on these problems researchers can apply the learning model by providing problems that involve students' thinking skills and involve the process of analyzing based on the actual problems. One learning model is PDEODE (predict-discuss-explain-observe-discuss-explain). PDEODE is able to train students to develop scientific concept [9], PDEODE learning model to create a conducive learning climate and in accordance with science process skills [10]. PDEODE helps students to understand science in life [11].

Some of the previous explanations, the researcher is interested in developing the PDEODE-WEB model in high school because PDEODE is not enough to carry out learning that supports 21st century skills, so that the PDEODE model developed is integrated in the web at the Predict and Discuss 1 stage conducted online while the Explain, observe, discuss 2 and explain 2 stages are carried out in online so as to produce blended learning. WEB (Word Elektric Browser) is a learning media that uses a computer or smartphone device that is easy to use and can be accessed anywhere and anytime, in the WEB there are text, images, videos, and communication that is done directly [12].

Therefore, the researcher took the title "Development of the PDEODE-WEB Model in Blended Learning to Improve the Students Critical Thinking Skills".

The formulation of the problem in this study are as follows (1) How is the quality of the development of the PDEODE-WEB model in Blended Learning on the digestive system material produced in terms of validity, practicality and effectiveness? (2) What is the effect of the PDEODE-WEB model in Blended Learning on the digestive system material on the critical thinking skills of high school students?

The explanation above, the objectives to be achieved in this development research are (1) to find out the quality of the development of the PDEODE-WEB model in blended learning on the digestive system material produced in terms of validity, practicality and effectiveness. (2) To determine the effect of the PDEODE-WEB model in blended learning on the digestive system material on the critical thinking skills of high school students.

2. Research Methods
This type of research is a research and development that refers to the 4D model. This research is aimed at developing a product in the form of a PDEODE-WEB learning model, the learning tools used include a syllabus, Learning Implementation Plan (LIP), Student Worksheet, and critical thinking
skills test. Before being tested, the product is validated internally and externally, both through qualitative and quantitative analysis.

The product trials that were developed consisted of three stages, namely (1) the validity test of experts, practitioners (teachers), and colleagues; (2) limited trials (one-on-one trials and small group trials) at FKIP Riau University, and (3) expanded trials (at SMAN 4 Pekanbaru). The trials were expanded using the pretest and posttest control group design experimental methods [13].

Data analysis techniques as a whole include (1) analysis of the validity and reliability of products/instruments, using qualitative and quantitative descriptive analysis (empirical tests). (2) analysis of product valuation data developed, using qualitative and quantitative descriptive analysis (criteria techniques such as in Table 1); and (3) analysis of the effect of the PDEODE-WEB model in blended learning on improving students' critical thinking skills, using the ANAVA test with the help of the SPSS 25.0 program with a significance level of 5%.

Table 1. Contents Validity Criterias

| No  | Average Interval | Category Validity |
|-----|-----------------|-------------------|
| 1   | 3.25 ≤ x ≤ 4    | Very Compatible   |
| 2   | 2.5 ≤ x < 3.25  | Compatible        |
| 3   | 1.75 ≤ x < 2.5  | Not appropriate   |
| 4   | 1 ≤ x < 1.75    | Not compatible    |

3. Results And Discussion

The data obtained in this study are: (1) the validity of the PDEODE-WEB learning model in Blended Learning; (2) limited trial results; and (3) the results of the trial are expanded.

The validity / feasibility value of the PDEODE-WEB learning model in Blended Learning is obtained from expert lecturers, teachers, and peers. Expert lecturers gave an assessment in the "very appropriate" category (Table 2). This shows that the PDEODE-WEB learning model in Blended Learning that was developed received an appreciation that was "very appropriate".

Table 2. Content Validation Scores of KD 3.7 Digestive System

| Aspect | Criterias Validation | Score Evaluation For Each | Validation Score and Category |
|--------|----------------------|---------------------------|------------------------------|
| Theory | 1. Suitability of material with Core Competencies and Basic Competencies | 3.5 | 3.42 Very Compatible |
|        | 2. Truth of the Concept | 3.7 |                     |
|        | 3. Update theory | 3 |                     |
|        | 4. The order of presentation theory | 3.2 |                     |
|        | 5. Appropriate examples | 3.7 |                     |

Furthermore, the limited trial data is grouped into two types, namely the one-on-one trial data and the small group trial data. In the one-on-one trial, there was also an assessment of the PDEODE-WEB model with an average score of 95.0 in the "very good" category.

Based on data from small group trial results obtained an assessment of the PDEODE-WEB model with an average score of 97.5 in the "very good" category. The average score of students' critical thinking skills for the experimental class was 90.13 included in the "very critical" category, while the control class was 83.75 with the "very critical" category. The value of the critical thinking skills gain of students is 0, 6 included in the category of "medium". Standard gain rating categories are in accordance with Table 3.
Tabl e 3. Categories of N-Gain values

| Control N-Gain | Categories |
|----------------|------------|
| g > 0,7        | Height     |
| 0,3 < g > 0,7  | Medium     |
| g < 0,3        | Low        |

[14].

The standard gain value shows an increase between the pretest and posttest results. The experimental class gain value is the same as the control class, showing that the PDEODE-WEB learning model in blended learning that is applied in the experimental class can improve students' critical thinking skills.

This is with previous research that the results reported here indicate that blending maintains or increases access for most student cohorts and produces improved success rates for minority and non-minority students alike. In addition, when students express their beliefs about the effectiveness of their learning environments, blended learning enjoys the number one rank [15]. Students were satisfied with the blended learning model as it was a change in the traditional learning system which allowed students to study interesting and attractive lessons on computers before class, followed by in-class teacher delivered lesson summaries afterwards. Students were encouraged to obtain more understanding of content in order to execute classroom activities and exercises. The outcome was that the students understood the content much better and enjoyed self-directed learning and individuated information research [16]. Blended Learning can promotes personalization. Students’ motivation is augmented when they are exposed to tools that reinforce their strength while improving their shortcomings [17] and BL facilitates the identification of students’ strengths and weakness. Such an intervention is critical because it provides teachers with information needed to streamline the productivity of each student in learning institutions [18].

Hypothesis testing is carried out to determine whether there is an influence of the PDEODE-WEB learning model in blended learning on students' critical thinking skills at SMAN 4 Pekanbaru. Before testing using hypotheses, prerequisite tests are first performed which include tests of normality and homogeneity of data. From the prerequisite tests that have been carried out, the data in this study are normally distributed and homogeneous, the hypothesis test conducted is a parametric statistical test that is by ANAVA analysis.

Table 4. ANAVA Test of Experiment and Control Class

| Paired Differences | T     | dF  | Sig 2 (tailed) |
|--------------------|-------|-----|----------------|
| Critical Thinking  | Pretest-Post Control | -6,578 | 35 | 0,000 |
| Skill              | Pretest-Post Experiment | -6,644 | 35 | 0,000 |

Based on Table 4, it can be seen the significance value of the statistical test shows a value of 0,000 or less than 0.05, so that H0 is rejected at the 5% significance level. This means that there is a difference between the critical thinking skills of students whose learning uses the PDEODE-WEB model in blended learning, compared to the critical thinking skills of students whose learning applies only the PDEODE model at the school. It can also be interpreted that the PDEODE-WEB learning model in blended learning has a positive influence on improving students' critical thinking skills on the subject matter of class XI SMAN 4 Pekanbaru.

4. Conclusions

Based on the results of data analysis and discussion, the following conclusions can be drawn. The PDEODE-WEB learning model in blended learning along with the tools developed is valid with the "Very Appropriate" category, so that this learning model is worthy of being used as an alternative
model of relevant learning. The PDEODE-WEB learning model in blended learning has a significant effect on improving the critical thinking skills of students of class XI of SMAN 4 Pekanbaru, this is evidenced by the ANAVA test which shows the significance value (Sig.) = 0.000 with a 95% confidence level. The PDEODE-WEB learning model in blended learning has a significant effect on improving the critical thinking skills of class XI students of SMAN 4 Pekanbaru. This is evidenced by the ANAVA test which shows the significance value (Sig.) = 0.000 with a 95% confidence level.

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