The Development of Biology Practicum Guide Based on Problem Integrated Digital Learning to Improve Student Critical Thinking Skills for Class XI Even Semester

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Abstract. The aim of this study was to develop of biology practicum guide integrated digital learning in order to overcome the difficulties students in practicum activity and improve student critical thinking skills. This study was developed by ADDIE (analysis, design, development, implementation and evaluation) model which has been assessed during validation process in order to get the feasibility on material, learning design, and layout design using questionnaire. Based on Validation result showed that: (1) material expert was 97.11% (2) learning design expert was 96.83% and (3) layout design expert was 96.66%. Assessment result of individual testing from 4 students showed all of the aspect was 89.06%. From small group testing students showed that all of the aspect was 86.76% Assessment result of big group testing showed that all of the aspect was 86.20%. Validation result showed that all of assessment aspect had been very good category. It means practicum guide were suitable to be implemented during teaching and learning based on the validation result. This development research is expected to be used as an guidance for practicum activity that can improve students critical thinking skills.

Keywords: Critical thinking skills, Problem based learning, Digital learning.

1 Introduction

Currently education in Indonesia is experiencing serious problems. The results of the 2019 national examination study showed that the percentage of students who answered correctly in biology was only 50.61 percent of the total indicators tested [7]. This finding is reinforced by the end of the odd semester assessment of class XI students at MAN Tebing Tinggi, only 51 percent of students were able to answer correctly. Other facts in the field based on the results of the 2018 PISA, the ranking of Indonesian students in the science category is 71 out of 79 countries with an average of 396 which is still in the category below the international average of 500. In dealing with these questions students are required to think critically in answering PISA questions [8]. This happens due to several factors, one of which is that Indonesian students still have low critical thinking skills in solving higher order thinking questions.

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Critical thinking is a skill that can be trained, so this ability can be learned. One way to develop critical thinking skills is through learning science (biology). The students' critical thinking skills are not maximized based on the tendency of students to memorize the material. The results of the analysis show that students' critical thinking skills are still low in the evaluation category [6]. Students have difficulty identifying wrong assumptions and identifying data that is not provided when solving problems. Biology as a subject that is directly related to the environment requires students to understand the concept well. Activities that can make it easier for students to find concepts and understand and train critical thinking skills are practicum activities. Practical activities can be carried out in the laboratory or at home. During the process of these activities, students can train and improve critical thinking skills. In practicum activities usually require a guide that contains practicum objectives, tools and materials used, activity procedures, observation sheets or commonly called practicum guides.

Practical activities are carried out by involving students directly, following a process, observing an object, analyzing, proving and drawing their own conclusions about a particular object. Thus practicum activities can stimulate students to practice thinking in critical and scientific ways and gain real work experience [12]. During the pandemic, practicums that were usually carried out in school laboratories were hampered due to online learning. Practicums can be carried out virtually via zoom if the material used is possible to obtain. If the materials used are difficult for students to find, then a virtual laboratory is an alternative that can be used. Virtual laboratories can also be a solution for inadequate laboratory facilities.

Teachers as spearheads must be able to collaborate digital learning as a practicum supporting facility. Digital technology is an important requirement in learning in the 21st century. The virtual laboratory is a part of digital learning that can be utilized in learning. This virtual laboratory is sufficient to be used to assist the learning process in order to improve students' understanding of the material, and is also suitable for use to anticipate real laboratory unpreparedness [9].

One of educational websites that provide virtual laboratories is Amrita online lab. Amrita online lab is a virtual laboratory developed by Amrita Vishwa Vidyapeetham University from Mumbai India in collaboration with CDAC Mumbai India. In addition to virtual laboratories, the use of learning videos and internet-based technology also includes digital learning that can assist students' practicum activities.

In Practicum, a practicum guide is needed as a guide for activities. Practicum guides are teaching materials that contain guidelines for carrying out practicum activities in the laboratory with the aim that practicum activities take place optimally in accordance with learning objectives. The practicum guide contains practicum titles, practicum objectives, basic theory, tools and materials, work methods and observations, questions and bibliography [1]. The results of the analysis of 2 biology practicum guidebooks for class XI from Bumi Aksara and Erlangga publishers found that in general the practicum guides in circulation are not in accordance with students' needs in improving critical thinking skills and have not been adapted to digital learning applications. Practicum guides are still fixated on tools, materials and work procedures. Even though there are many things that can be revealed in a practicum guide such as how students can think critically, be creative in compiling an experiment,

collaborating on learning resources and tools and materials available for practicum needs and communicating the results of observations properly.

Based on the results of initial observations of 4 biology subject teachers, it was shown that the practicum implementation had not fully provided practicum guides that were in accordance with the current needs of students and had not been integrated with digital learning. Amrita online lab uses English as the language of instruction. Students have difficulty understanding the simulation procedures instructed so that an integrated digital learning practicum guide is needed that has been adjusted to help students understand and improve critical thinking skills.

The practicum guide used in schools is still in the form of worksheets from the package book section that has not been tested for validity and effectiveness. The practicum guide used is also not in accordance with the requirements for content competency and competency standards from the 2013 curriculum [10]. Schools are also more concerned with the results or products obtained than the ongoing science process.

The development of practicum guides is carried out by integrating digital learning and raising a number of questions related to practicum activities to improve students' critical thinking skills. The 21st century requires students to actively develop their skills, one of which is the ability to think critically so that education is expected to equip students to discover scientific concepts such as scientists within a limited scope to be able to solve problems they face and anticipate problems that may arise in the future. The development of practicum guides is based on the problem-based learning model or problem-based learning. The goal of PBL is meaningful learning, acquisition of discipline-related heuristics and development of problem-solving skills. PBL also includes lifelong learning goals of independent learning, information gathering skills, collaborative and team learning, as well as reflective and evaluative thinking skills. Problem-based learning is characterized by a student-centered learning process with a skill-focused approach [11]. In line with this, teachers use a problem-based approach to learning biology to improve students' critical and creative thinking skills [5].

The relationship between problem-based learning models and critical thinking skills is that when students are faced with solving a given problem, students will use their critical thinking skills as initial knowledge and students can provide simple explanations. When in the data collection stage, students usually collect strategies to support their critical thinking skills. The results of the problem solving analysis are then connected to the theory that has been explained previously, then students are directed to explain further until students can find an argument. At the end of the stage, students summarize their findings for problem solving. Based on this description, it is necessary to conduct research on the development of a high school biology practicum guide integrated digital learning to improve critical thinking skills.

2 Material and Methods

This type of research is Research and Development (R&D). This research design will use the ADDIE development model (Analysis, Design, Development or Production, Implementation and Evaluation). This development model is one of the most widely used development models in a research that develops a product. Based on product development steps, this development

model is simple and can be measured in stages and systematically. This research procedure consists of analysis, design, development and implementation.

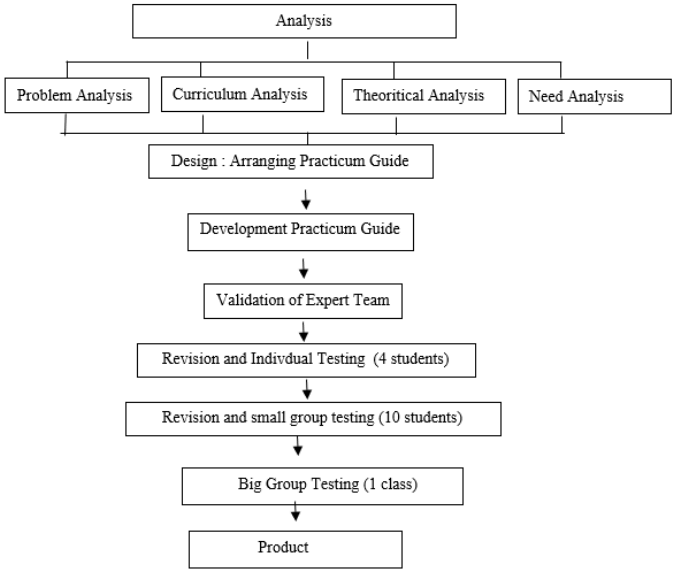

Fig.1 Stages of Biology Practicum Guide Development for class XI

In the analysis stage, A development plan has been carried out based on the findings of observations and gathering information in the form of lists and what concepts are developed in the class XI biology practicum manual product. The results of the needs analysis are designed to create an innovation in biology learning through integrated digital learning problem-based practicum activities. At the design stage, research instruments were made which consisted of needs analysis instruments, practicum guide analysis, practicum guide validation, teacher and student response questionnaires, and students' critical thinking ability instruments after using problem-based practicum guides that were integrated with digital learning. Needs analysis and problem analysis were carried out by giving questionnaires to 5 biology teachers about difficulties in practicum activities and the need for using practicum guides and giving questionnaires to 124 class XI students about difficulties, constraints and needs in learning biology. At this stage an overview of the problems and alternative solutions that can be done have been obtained.

The development carried out in the ADDIE model is a product design realization activity. At this stage, the conceptual framework is realized into a product that is ready to be implemented. At this stage, the design of the practicum manual was developed in the form of aspects that must be in the practicum guide. The practicum guide was developed in accordance with the design analysis prepared in the previous stage in the form of a problem-based practicum guide and integrated with digital learning. After being developed, the practicum guide was validated

by material experts and learning design experts and layout design experts. After the practicum guide has been validated, it is then tried out by students.

3 Result and Discussion

Based on the needs analysis stage that has been carried out, the process of developing a problem-based integrated digital learning biology practicum guide has been carried out. Practicum guide has been validated by material experts, learning design experts, layout design experts, teacher and student responses. The validation and review results show that the average percentage is in the very good category. Input, suggestions and criticisms by validator experts are used to revise and improve the quality of the practicum guide.

Table 1. Material validity level by Material expert Validator

Aspect	Validation Percentage	Category
Content	97.36%	Very Good
Presentation	96.87%	Very Good

The data in table 1 shows that the percentage of the material expert's assessment reached 97.36% for the content aspect; 96.87% for presentation aspects; The overall average percentage of the assessment reaches 97.11%.

Table 2. Learning design validity level by learning design expert Validator

Aspect	Validation Percentage	Category
Content	95.83 %	Very Good
Learning suitability	94.64%	Very Good
Presentation eligibility	96.87%	Very Good
Presentation construction	100%	Very Good

The data in table 2 shows that the percentage of the learning design expert's assessment reached 95.83% for the content aspect; 94.64% for learning suitability; 96.87% for presentation eligibility; 100% for presentation construction; The overall average percentage of the assessment reaches 96.83%.

Table 3. Layout design validity level by layout design expert Validator

Aspect	Validation Percentage	Category
Size	100%	Very Good
Cover Design	95%	Very Good
Content Design	95%	Very Good

The data in table 3 shows that The percentage of assessment/review of layout design validator reached 100% for size aspects; 95% for cover design aspects; and 95% for the content degin aspect. For the total overall average rating reached 96.66%. Assessment result of individual testing from 4 students showed all of the aspect was 89.06%. From small group testing students showed that all of the aspect was 86.76% Assessment result of big group testing showed that all of the aspect was 86.20%. The overall validation is in a very good category and is suitable to be applied during the teaching and learning process.

In practicum activities students need a practicum guidebook, so that when doing practicum students can carry out activities even better. The practicum guide must be prepared in advance by the teacher, so that students can read and study the work steps before the practicum activities are carried out [3]. The results of this study are supported by which states that the Edmodo-based Mendel's pseudo-law deviation practicum guide to improve the critical thinking skills of biology education students with very good criteria from media validators, material validators and trials on students. The average validation of all practicum guides has very good criteria, after going through the revision stage so that a guide that is suitable for use for biology education students is obtained. The pseudo deviation practicum guide also has a significant effect on improving the critical thinking skills of biology education students[4].

In the practicum guide presented there is a stimulus that can train students' critical thinking skills in the form of questions in the form of problems in everyday life. Giving problems in learning activities will make students more interested so that they can stimulate them to be more active. This is because in learning students are required to be able to solve problems by conducting investigations and investigations. The application of problem-based learning can train students to think critically, analyze and solve complex problems, be able to work cooperatively in small teams and improve the ability to communicate effectively both verbally and in writing [2].

4 Conclusion

Based on the results of the research and data analysis that has been carried out, the conclusion of this study is that the results of the validation of material experts regarding problem-based biology practicum guides have a percentage of 97.11%; the validation results of learning design experts regarding problem-based biology practicum guides have a percentage of 96.83%; Based on the validation results of layout design experts regarding problem-based biology practicum guides, it has a percentage of 96.66%; the results of the biology teacher's response to the problem-based biology practicum guide had a percentage of 92.04%; individual test results on problem-based biology practicum guides have a percentage of 89.06; Based on the results of the small group test on problem-based biology practicum guides, it has a percentage of 86.76%. Based on the results of the limited group test regarding problem-based biology practicum guides, the percentage of 86.20% was included in the very good category. The validation results showed that all of the assessment aspects had a very good category. It means that practice guides are suitable to be implemented during teaching and learning based on validation results.

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