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A need analysis in developing virtual laboratory according to the chemistry teachers

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Abstract. Technology-based learning was always done to face up the growth of technology in the modern era. It attracted students to understand the subject matter. The development of the technology-based practicum media could facilitate students in practicum without the real tools and materials. The media could save the tools and materials that were expensive. However, need analysis were required to find out what it needed in the chemistry class according to the chemistry teachers. This research is descriptive research with quantitative and qualitative data. This need analysis used a questionnaire as an instrument that contain 6 open-ended questions and 2 yes-no questions. A virtual laboratory is one of the practicum media that can resolve the limitation of tools, materials and learning time. Respondents from this research were 37 chemistry teachers who have been teaching chemistry for at least 5 years. The data were analyzed using analysis of percentages. The results of this study obtained 91.89% of respondents stated to need an integrated virtual chemistry laboratory in hybrid learning. While practicum-based matters that were perceived to require a virtual chemistry laboratory were chemical equilibrium, electrochemistry and reaction rates. This research can be used as a criterion for developing the technology-based media.

1. Introduction

Research and development (R&D) is a step to developing the learning media. The form of this media is physical media and digital media. Physical media has a real shape, while digital media is a digital-based media that can only be opened through computers, laptops, tablets or smartphones. Currently, digital media is developed by many researchers. One example of learning media is the virtual laboratory [1-3]. A virtual laboratory is a digital-based learning media that can facilitate students in practicum [4]. This media is used in overcoming the limitations in the school laboratory. These limitations include the limited time of learning, practicum tools, and chemicals. The virtual laboratory produces a higher learning outcome, learning independence and the ability to understand concepts in their implementation [5]. Learning with virtual laboratory also improves effectiveness in learning [6-9].

Hybrid learning or blended learning consists of face-to-face learning and online meeting [10]. This learning is done in overcoming the distance of students with school. Hybrid learning has a positive effect on students [11]. In a previous study, hybrid learning could facilitate accessibility in the following learning and become an attraction in learning [12]. Therefore, hybrid learning should be developed for the utilization of existing technology. Implementation of technology in this learning can make students more interested and happy in following the lesson.

Need analysis is done to determine the problems that exist in the environment [13]. This analysis can be used in knowing the different status in the field with a status that should exist [14]. Need analysis is



the first stage of the ADDIE model [15]. Stages in the ADDIE model are Analysis, Design, Development, Implementation, and Evaluation. These five steps are used in the process of developing the media. In the research and development, the analysis phase is performed to find out the problems that exist in the learning and find solutions to overcome them [16]. A learning requires media to achieve educational goals, including practicum-based media. This media allows overcoming the limited tools, materials and learning time at school. Before the development of the media, it is necessary to do an analysis phase to find out the situation in the field. The purpose of this analysis is to determine the needs of the development of integrated practicum media in hybrid learning, specifically a virtual laboratory.

2. Methods

2.1 Research Design and Procedure

This research adopted a descriptive study with a qualitative approach through the need analysis. Need analysis is done through 2 ways, namely the analysis of previous studies and analysis of the questionnaire. Analyze previous studies by analyzing the journal concerned with virtual laboratory and hybrid learning. While the analysis of needs questionnaire begins by giving the questionnaire to the chemistry teachers forum of Bantul Regency, Yogyakarta, Indonesia.

2.2 Subjects

The research respondents amounted to 37 chemistry teachers with varying teaching and schooling. All of these teachers had experience of teaching chemistry for at least 5 years so have known the ins and outs of chemistry learning in high school. While the school of origin of teachers is divided into private schools and public schools.

2.3 Instrumentation and Data Analysis

The instruments used are journaled analysis tables and need analysis questionnaire. Journal analysis table is used to find out the results of the analysis of articles related to virtual laboratory and hybrid learning. These articles are analyzed in terms of methods, objectives and research results. The result of this articles analysis is qualitative data. The data is compared each other to find the new thing about the virtual laboratory and hybrid learning. It is synthesized to determine innovation in this development of the media. Questionnaire of need analysis is a mixed questionnaire between 2 yes-no questions and 6 open-ended questions. The instrument is explained in table 1.

The results of this questionnaire are mixed data between quantitative and qualitative data. The qualitative data are produced by question number 4 and the quantitative data are produced by 7 number others. It is analyzed quantitatively with the percentage. The calculation percentage of questionnaire used formula :

$$\% = \frac{\text{number of teachers who agreed}}{\text{total respondents}} 100\%$$

However on the material is chosen, the percentage was calculated using the formula :

$$\% = \frac{\text{number of subject matters that chose by teachers}}{\text{total subject matters}} \times 100\%$$

The total subject matters that mentioned by the teachers were 156. It's because not all teachers choose 5 materials. There are only 3 or 4 materials.

Table 1. Indicators of the Questionnaire

Number of Question	Type of the Question	Indicators
1	Yes-No	Teachers state whether or not practicum-based matter is considered difficult for students
2	Open-ended	If teachers say yes (question number 1), teachers must be mentioned at least 5 practicum-based matters that considering difficult for students.
3	Yes-No	Teachers state whether or not practicum-based matters done completely
4	Open-ended	If teachers say no (question number 3), teachers must be explained the strategies to replace the practicum activities.
5	Open-ended	Teachers explained the matters always needs the practicum to master the matters.
6	Open-ended	Teachers explained what the virtual laboratory can help students to an understanding of the matters
7	Open-ended	Teachers explained what the forum out of learning time is needed.
8	Open-ended	Teachers explained the integrated virtual laboratory in hybrid learning is needed or not for the reason.

3. Results and Discussions

This study was a preliminary study for the development of a virtual chemistry laboratory integrated hybrid learning. It is an analysis step of the ADDIE model. The analysis phase of ADDIE development model can be done in various ways. Among them are by interview, questionnaire or pre-survey, class observation, teacher or student observation, article analysis, and so on. The process is to strengthen existing research. However, in this study, the analysis phase is only done with 2 processes only, that is articles analysis and giving of the questionnaire. It because this ways is easy and need a little time to know the situation of many schools.

The preliminary study process or often called need analysis began by analyzing the journals on virtual laboratory and hybrid learning. This article analysis was useful to investigate the existence of technology in education and learning. The components analyzed were researched methods, the purpose of the research, and research results.

The results of the analysis of previous studies, several studies have been carried out the development and use of virtual laboratories in the study of science, especially chemistry. The use of virtual laboratories has more effective results than conventional laboratories [2,6,8]. The study was a research on the development and implementation of media using pretest-posttest design. This virtual laboratory media can increase students' abilities and motivation in chemistry practicums with simulations [17-18].

Learning using hybrid learning mode can significantly facilitate students in accessing learning [12]. This hybrid learning is also effective in practical preparation [19]. Hybrid learning mode is one example of student-centered learning. Learning like this is highly desired by students.

The analysis of the journal stated that there has been a lot of virtual laboratory development and implementation in the classroom. But in many research, the implementation in the classroom compared just 2 classes with real laboratory and virtual laboratory. This comparison clearly showed that the use of a real laboratory will have a good effect. There makes students gain real experience. Students with a virtual laboratory only get visualization. For that, it is necessary to compare the two treatments coupled with the use of virtual laboratory as support.

The virtual laboratory that will be developed is a laboratory based on hybrid learning. Hybrid learning is used in a learning process that not only depends in the classroom but also uses online learning. In its implementation, this laboratory is used in 2 types. The first type is the use of a laboratory as a substitute

for conventional laboratories, and the second type is the use of the laboratory as a supporter of the conventional laboratory. Both types of virtual laboratory use will be compared with conventional laboratory usage as usual. The three treatments used have the same learning time and the same teacher. Different learning times and teacher will make a difference in the outcomes later on. The use of a virtual laboratory as a supporter is used in online learning.

The result of an open-ended questionnaire given to chemistry teachers stated that 94.6% of respondents stated practicum-based matters were difficult to understand by students. These matters should be understood through practicum, whereas according to them the limitations of tools, chemicals, and time make practicum activities minimized. Each respondent mentions a maximum of 5 materials, the percentage of the materials were stated in figure 1.

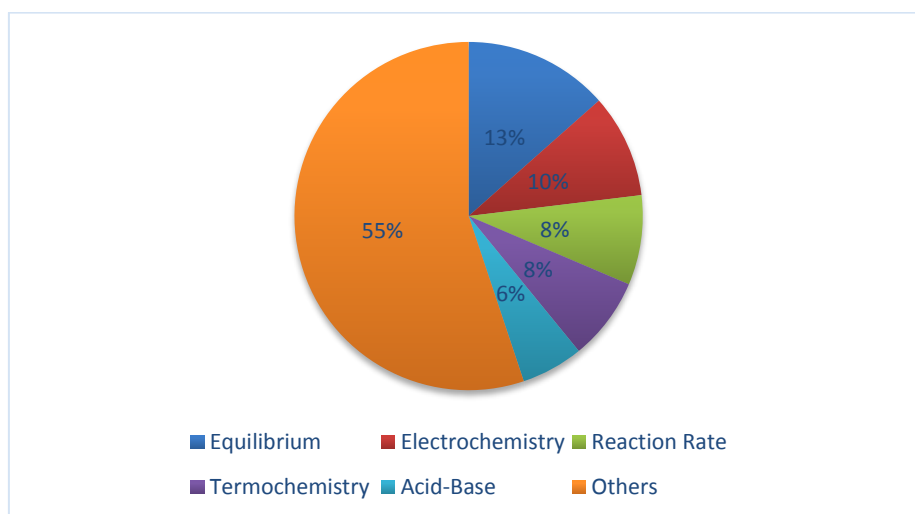


Figure 1. Percentage of Practicum-based Matters that were Considered Difficult

The five materials become the matters that required a practicum in learning. Limitation of the time is the main reason for eliminating practicum activities. From the open-ended question about strategies to replace the practicum, real practicum takes a lot of time. They often only provide a finished video or practicum data for analysis. This activity did not give a practical experience to students. Students just receive data without experiment. As much as 97% of respondents stated the matters not always needs the practicum to master it. Another result, 89.19% of respondents stated that virtual laboratory can help in the process of learning-based practice. A virtual laboratory may allow students to gain experience in the practicum of such materials [3].

For forums outside the school time, 64.86% of respondents stated that the forum was needed to increase knowledge. Activities in this lesson make students more relaxed but serious in following the lesson. This activity is still given the presence to know the students who follow this lesson. Learning involving technology make students more interested in following the learning. This is because today's students have relied on technology, especially smartphones. This dependency makes students comfortable in learning with technology rather than learning as usual. Learning using multimedia is effective in improving the quality of learning for the better [20]. Media that will be developed later is expected to improve the quality of chemistry learning.

In the development of virtual laboratory integrated hybrid learning, as many as 91.89% of respondents said they need this media. Learning by using a virtual laboratory as much as possible can resolve the limitations of time, tools and practicum materials. This learning can streamline the time so that the aims of learning can be achieved completely. Hybrid learning is an efficient mode in chemistry learning [21]. This learning is expected to face up the technological developments.

The virtual laboratory becomes a learning media that can facilitate students in practicum. Practicum can virtually stimulate students with visualization of the tools, materials, and practicum. Practicum with this laboratory does not require a long time, because we do not need to prepare tools and materials manually. The tools and materials used already exist in this laboratory. While conventional laboratory requires considerable preparation time. In addition, the laboratory process will also take time. The results achieved in conventional laboratories are uncertain according to existing theory. We need to match the results of that practicum theory.

In previous research, the stage of analysis is the stage of finding the problems that exist in an environment [22]. The research is to determine the indicators in the design of e-learning in Vocational School. The difference with this research is that the research is only determining the indicators to be developed in a learning design. Another study suggests that this phase of need analysis is to find out the needs of students and teachers in the learning process, especially in the needs of instructional media [16]. In the study, the analysis phase by pre-survey at school. The result of this stage is to know the need for developing learning media in the form of mind-mapping. The difference with this research is the process undertaken. In this study, the analysis phase was done by giving an open-ended questionnaire to the chemistry teachers, whereas in the previous research, the analysis phase was done by observation to the school. Giving an open-ended questionnaire to the chemistry teacher will be more meaningful than observation to school. The chemistry teachers involved came from more than 20 schools so the problems that exist in these schools can be known.

4. Conclusion

The results of this study are needed to develop a virtual chemistry laboratory. The developed laboratory is an integrated hybrid learning. The selected material is electrochemical. It is a material of grade 12th. This analysis can help the researchers to find out the needs of developing the media, especially integrated virtual laboratory in hybrid learning. Then they can develop the media in other matters to resolve the problems in the chemistry class. So that, students can understand the matters with simulation in the virtual laboratory. Furthermore, implementation of hybrid learning can be developed to resolve the limitation of the learning time.

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