Bio-VLab: Virtual Laboratory Based on Android Educational Game

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ABSTRACT

Virtual reality has a lot of potentials to be applied in the field of education and learning, known as virtual learning. For some learning activities there is quite a lot of interest in research about virtual learning. However, at present there is little virtual learning in the packaging of a virtual laboratory based on an Android educational game that presents a series of practical activities as a form of verification or confirmation of concepts learned by students. For this reason, this research aims to develop Bio-VLab, a game-based android mobile application, by adopting some of the ADDIE development procedures covering the analysis and design stages. Technical analysis was carried out descriptively qualitatively based on prototypes generated from the design of the development including initial appearance, class choices, list of materials, learning objectives, display of teaching aids, and practical content.

INTRODUCTION

The era of technological disruption is increasingly evolving to facilitate every human activity in adopting digital devices for learning and education purposes (Zawacki-Richter & Latchem, 2018). So that the potential for the exploitation of technology such as the use of virtual concepts has become a trend in delivering computer-generated virtual reality simulations (Boulton, Kent, & Williams, 2018; Radianti, Majchrzak, Fromm, & Wohlgemann, 2020) and cellular devices (Wang et al., 2012). The virtual concept has been described as a 21st century learning tool or media (Rogers, 2019), so it is commonly known as virtual learning (Jensen & Konradsen, 2018).

Virtual learning is widely used for several learning activities, such as the use of e-learning with a variety of different applications and platforms (Carruth, 2017). Concepts offered in various applications can replace offline learning. However, for practicum-based learning, it is considered that only a few presents in the concept of virtual laboratories (Podolefsky, 2012; Chinarro et al., 2017; Ma & Nickerson, 2006). Preliminary analysis results with conditions that require virtual learning, as many as 65% of biology teachers have never done practicum...
virtually. While practicum is important as a form of verification or confirmation of concepts learned by students (Supriatno, 2013). Especially for learning biology that requires active and constructive processes in which students function as active information builders to build subjective representations for meaningful learning achievement (Aiello, D’Elia, Di Tore, & Sibilio, 2012; Barko & Sadler, 2013; Sharma, Agada, & Ruffin, 2013).

A Virtual laboratory is an interactive media that can simulate activities in the laboratory as if the user were in an actual laboratory (Xu et al., 2014). Virtual laboratories offer the possibility of simulation experiences, experienced in real laboratories (Tatli & Ayas, 2013). A review of several studies using virtual laboratory-based learning in science classes shows varied results but shows a high correlation with student learning satisfaction. In this case the motivation and attitudes of students become a supporting factor as students attempt to achieve learning experiences ((Mayer, Warmelink, & Bekebrede, 2013). Other studies show that virtual laboratory-based learning stores more information and increases students' readiness for practicum (Krokos, Plaisant, & Varshney, 2019; Other results explain effective in improving learning outcomes based on knowledge, abilities, and skills (Dalgarno, Bishop, Adlong, & Bedgood, 2009; Winkelmann, Keeney-Kennicutt, Fowler, & Macik, 2017). Especially when the packaging presented in the virtual laboratory integrates the assessment in the practical activities. This assessment will be more attractive to high school students if it is presented in the form of a game. Games can provide different colors in measuring the achievement of a learning. Even games can function as valid models for the wider community (Szell & Thurner, 2010). A game-based virtual laboratory is fun, challenging, provides experience and also entertainment (Muhamad et al., 2012).

Based on the principle of importance to anticipate distance learning, it is important to introduce Bio-Vlab in the form of a virtual laboratory based on android mobile applications as one of the media learning solutions that can be given to secondary school students. So the purpose of this research is to develop a virtual laboratory based on Android educational games for practicum activities in secondary schools. It is hoped that this virtual laboratory simulation is as good as direct practicum so that it can replace traditional laboratory practice experience.

**METHODOLOGY**

This research used to research and development methods by adopting some of the development procedures from ADDIE including the analysis and design stages. The ADDIE concept was simple and provides many instructions in the process of developing a learning product. The ADDIE development model facilitates or provides a framework for responded to the complexity of the learning environment by responding to various situations and contexts (Branch, 2010). The development model used has not yet fully reached the stage of development, implementation, and evaluation.

The analysis phase was carried out to explore the needs needed including material characteristics, student characteristics, and other learning support capabilities. The entire analysis is devoted to biology material in high school, which includes all material contained in practical activities. A needs analysis was obtained through interviews with teachers and students.

The design phase was an advanced stage for designing virtual laboratories based on Android educational games. Specifically, this stage included designing the setting of practicum objectives, practicum procedures/scenarios, practicum material and evaluation/assessment tools.
The results of this study were analyzed descriptively qualitatively based on the resulting prototype.

**RESULT AND DISCUSSION**

Bio-VLab is designed as a media in biology learning, which helps in practicum learning. This Bio-VLab can also be used as supporting media if practical activities are difficult to carry out. Bio-VLab is created by integrating learning material, practicum, and assessment content into an interesting and challenging game application for students. The Bio-VLab is made very easy for users to operate it. Following is the appearance of the design presented by the Bio-VLab application on each component.

![Figure 1. Initial View Applications Bio-V Lab](image)

Figure 1 is the initial appearance of the Bio-VLab to start the Bio-VLab application. The menu on the start screen has a settings button that will direct users to google and facebook icons as the user's choice to connect and link accounts. This menu will make it easier for users to save the history of practical work, so that when the user re-enters the application, the previous practical history is still stored. Another menu is a column to fill in the name to make it easier for teachers to recognize the application user account. Then followed by the play button that will direct the user into the next display.
Figure 2. Class Level Selection Menu
Figure 2 presents a class selection menu which is continued when the user has entered a name and started the application. The class levels presented are class X, class XI and class XII.

Figure 3. Material Selection Menu
Figure 3 presents the display menu in the form of a list of materials that can be selected by the user. In the top column there is a percentage display which shows the percentage of practicum that has been done out of the total of all available practicums, so that users can find out some practicums that have not been completed, as well as there is a display of total scores that are accumulated from each practicum that has been done.
Figure 4. Learning Objectives Menu

Figure 4 is a serving menu of learning objectives. This menu will appear when the user chooses the material and the user can see the learning objectives of the material. The existence of this learning goal can facilitate students in understanding the learning outcomes to be achieved. After that the user can click on the 'start' button and a display will appear with the props and practicum menu. For example, the material chosen is the structure and function of the digestive system.

The teaching aid contains a torso and an explanation of each material. The existence of material content aims to facilitate students in finding sources of knowledge/theory about the selected material. The material is presented in written form accompanied by pictures from relevant sources so students can learn easily and the theory can be confirmed valid. Description of the material will appear when we squeeze the part of the target organ, then the feature can be zoomed in/out, shifted, rotated, so it is clear to learn. The props display menu is shown in Figure 5.

Figure 5. Display Props Menu

Practicum content contains animations and simulations of some tools and materials that can be used in virtual practicum, the existence of practicum content aims to facilitate students in carrying out virtual practicum (simulations) according to the demands of learning objectives.
An example, the practicum chosen was the food ingredients test practicum in Figure 6a. In the food lab test display menu the user can choose several practicums, for example the chosen practicum is the Benedict Test. The Benedict Test display, as shown in Figure 6b, presents 3 choices: Guide, Play Games, and Back. When choosing a guide on the menu, you will be given instructions on how to do the practical work (Figure.6c). When the user chooses to play games, the Practicum display will appear as in Figure 6d. On this menu the user will do a practical simulation as well as a practicum directly, with a drag and drop system. During the simulation, the user performs without any special commands from the system.

Some things that are used as an evaluation in this virtual laboratory include the appraisal of accuracy that is adjusted to the user's work while doing the simulation, if the user is wrong in performing the procedure then the percentage of accuracy is reduced and affects the score points.
to be obtained; the maximum score given is 100 points per practice; and the user's working time is considered with the ideal time of each practicum, if it exceeds the predetermined time it will affect the score points that will be obtained.

This design illustrates that the virtual laboratory in the Bio-Vlab package can produce better learning motivation for students, promote problem solving skills, practice creativity, and can be used as a useful and productive tool to support students in effective learning while increasing learning atmosphere (Yang, 2012). The same explanation is also from Mueller Daniel that there are other advantages of virtual use that is efficiency, anywhere, timeliness and orientation of learning assignments.

Therefore if the virtual laboratory is used correctly there will be many benefits. To identify the strengths and weaknesses of virtual laboratories, the development stage of ADDIE must proceed to the develop, implement and evaluate stages. Further research needs to be done to determine the effectiveness of virtual laboratories as a substitute for more traditional laboratory practice experience (Hawkins & Phelps, 2013) and the virtual world can be said to be effective for teaching experiments (Winkelmann et al., 2017).

CONCLUSION

Bio-Vlab is a virtual laboratory application based on Android educational games that are used as a supporting media for practicum activities. This Bio-Vlab application is a solution to the lack of facilities and infrastructure in practicum activities, and can be used as distance learning. The content contained in this application that contains learning material and practicum of each basic competency. Also, in this application there is an assessment program so that it gives a different color in measuring the achievement of a learning. The Bio-Vlab application provides illustrates that virtual laboratories can produce better learning motivation for students because the application is designed like Android games that are fun in general, thus creating meaningful and effective learning for students. Further research needs to be done to determine the effectiveness of the Virtual Laboratory application based on Android educational games.

REFERENCES


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