Development of Virtual Laboratory Based on Interactive Multimedia on Planting and Painting Bacteria

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Abstract. The aim of this research is to produce Virtual Laboratory based on interactive multimedia on sub material of planting and painting bacteria. Knowing eligibility of the media and knowing the student’s respond that has been taught of using Virtual Laboratory. The method of this research is development research. This research consists of two stages are preliminary (preparation and design) and formative evaluation (self evaluation, expert reviews, small group and fields test). Data collection techniques used in this research are questionnaires and tests. The subject of this research is 37 students. Based on validation result from validator, Virtual Laboratory is categorized valid. This value is obtained because Virtual Laboratory can be installed in various hardware and software, easy to use, the program works well, and Virtual lab has a unique shape, interactive and good animation. Meanwhile, students give the positive respond, it means student can operate and simulate the experiment of planting and painting bacteria with Virtual Laboratory and helps students to understand the material of planting and painting bacteria easily. So it can be concluded that Virtual Laboratory has legibility to be used as learning media.

1. Introduction

Virtual Laboratory (VL/Virtual lab) is a set of laboratory tools in the form of interactive multimedia based computer software that operates with computer hardware and can simulate activity in the laboratory as if the user is in the actual laboratory (1,2). Interactive multimedia means a device equipped with user-operated controller tools, so users can choose what they want for the next process. Interactive multimedia combines and synergizes all media consisting of text, graphics, audio, and interactivity (3).

On the previous research Virtual lab is able to provide an overview of the International Retrofit Energy Trial at Cork Institute of Technology, Ireland. As well as providing an example of this type of analysis can be done by using this platform (4). Another benefit like a web-based Virtual lab on a frequency modulation experiment helped students to be able to carry out experimental work and gain hands-on experience of using an expensive spectrum analyzer according to their own schedule and pace on an individual basis (5). The Virtual lab also has interactive screen experiments and be innovative media for distance learners (6). However, Virtual lab for planting and painting bacteria experiment is not exist yet.

The aims of this paper is to development of Virtual lab, knowing eligibility of the media and knowing the student’s respond that has been taught of using Virtual lab. Virtual lab development starts from the preliminary stage including content preparation and Virtual lab design. Then proceed to the
formative evaluation stage including self-evaluation, expert reviews, small groups, and field tests (7). The result of this research is Virtual lab can be developed and utilized by students to do planting and painting of bacteria experiment. The advantages when using a Virtual lab is so effective because it does not need much time to do the simulation lab and can be repeated if students do not understand. So it helps students more easily understand the planting and painting bacteria material.

2. Experimental Method
The method of this research uses development research with type formative research. Figure 1 give illustration for the formative research design:

![Figure 1. Flowchart of Formative Research Design](image)

The development research focus on two stages are preliminary consists of preparation and design. Preparation stage works for analyzing of content, while the design for a device of learning material and media. Furthermore formative evaluation, first Self Evaluation: On this stage all learning devices that have been made will be checked again before validation. Then, Virtual lab must be measures by the researcher to know how does the condition and function of the program. The second Expert Review: All learning devices are validated by the validator. Validator consists of two are material and media. Virtual lab that is validated on this stage is prototype 1. Comment and suggestion from the validator uses for revision and fixed learning devices. The repair of Virtual lab of this research calls prototype 2. Third, Small Group Evaluation: On this stage the Virtual lab measurement prototype 2 on small group of student (6 students). Fourth, The real field test uses all learning devices that has been revised and validated.

The subject of this research is students of class X for 37 students at Senior High School (SMAN 1 Pontianak). The technique of collecting data on this research is questionnaires of eligibility Virtual lab and student’s respond. The eligibility of Virtual lab media is valid by the experts 3 from media and 3 from material expert. The research instrument is questionnaires that have been validated by 2 lecturers Biology education and 1 biology teacher with the result validation is valid.

The questionnaire eligibility of Virtual lab uses formula as follows: 
\[ RTV_{TK} = \frac{\sum_{i=1}^{n} A_i}{n} \]  
with notes RTV_{TK} (total mean) validity, A_i (mean aspect i), i(aspect) and n (more aspects). The questionnaire eligibility of Virtual lab that is validated by the media expert consists of 10 questions which divided into two aspects are engineering software and audio visual communication. The student’s respond analysis using likert scale consists of 4 options answer, such as very agree, agree, disagree and very disagree. There are 30 questions are 15 positive questions and 15 negative questions.
3. Result and Discussion

3.1. Development and Eligibility of Virtual lab Based on Interactive Multimedia on Sub Material of Planting and Painting Bacteria.

Development of Virtual lab presents the simulation of planting and painting bacterial eksperiment. The validation result can be seen on Table 1:

| Aspect                         | Criteria                                                                 | Validator score on- | (Ki) | (Ai) |
|--------------------------------|--------------------------------------------------------------------------|---------------------|------|------|
| Software Engineering           | Compatibility (it can be installed/run by hardware and software).       | 3 3 4               | 3.33 | 3.42 |
|                                | Reliability (the program can have good function).                       | 4 3 4               | 3.67 |
|                                | Usability (it is easy and simple to be used and operated).              | 3 3 4               | 3.33 |
|                                | Maintainability (it can be protected/managed easily).                  | 3 3 4               | 3.33 |
| Communication Audio Visual     | Creative on idea and concept.                                           | 3 4 4               | 3.67 | 3.44 |
|                                | Visual (layout, design and color).                                      | 3 4 4               | 3.67 |
|                                | Audio (narrative, sound effect, back sound and music).                  | 4 3 4               | 3.67 |
|                                | Animation.                                                              | 3 3 3               | 3    |
|                                | Interactive Layout (navigation pad).                                    | 3 3 4               | 3.33 |
|                                | Interactivity.                                                         | 3 3 4               | 3.33 |
| ∑Ai                           |                                                                         | 6.86                |      |
| RTV_{TK}                      |                                                                         | 3.43                |      |

**Conclusion**: Valid

Information:

\[ \text{Ki} = \text{Average Criteria } i \]

\[ \text{Ai} = \text{Average Aspect } i \]

\[ \text{RTV}_{\text{TK}} = \text{Average total of validation both two aspects} \]

According to Table 1 it can be known that Virtual lab is valid and eligible to be used as learning media with the score 3.43. If the average scores up to 3, so the learning media can be claimed valid [8]. Engineering Software Aspect, this aspect can be valid with average score 3.42. Virtual lab can be installed or run in the existing variety of hardware and software, the Virtual lab program is able to run good function, easy and simple. Audio Visual Communication Aspect, communication aspect of audio visual gets average score of 3.44 and valid. A creative Virtual lab on making ideas, visual (layout design and colour), audio (narrative, sound effect, back sound and music), animation, interactive layout (navigation knob) and interactivity of Virtual lab has fulfilled the eligibility standard on learning media.

Based on the explanation above, Virtual lab has eligibility as learning media. Nonetheless, there are suggestions from validator to be good prototype 1, so it needs revision (Tabel 2).
Table 2. The Change Media Before and After Revision (Prototype 1)

| Before Revision                                           | After Revision                                           |
|------------------------------------------------------------|----------------------------------------------------------|
| The application is still on fla format.                   | App has been gathered on one compilable exe.             |
| Instrumentation is not appropriate with user command.     | The instrument move based on user command.               |
| The sound on evaluation question is still crowded.         | The sound on evaluation question is neat and clear.      |
| The object media target is small so it is hard to drag and drop. | The target object media has been large to be dragged and dropped. |
| The icon knob is small and it is hard to be clicked.      | The size icon has been large and it is easy to be clicked. |

This is the recapitulation result from media expert through Virtual lab based on interactive multimedia can be seen on Table 3.

Table 3. The Recapitulation Result from Material Expert through Virtual lab Based on Interactive Multimedia on Sub Material of Planting and Painting Bacteria

| Aspect       | Criteria                                                                 | Validator Score | (Ki) | (Ai) |
|--------------|--------------------------------------------------------------------------|------------------|------|------|
| Format       | Accord with sound, animation and color.                                  | 2                | 3    | 3    | 2.67 | 3.33 |
|              | Use size, shape, font color that is easy to be read.                    | 2                | 3    | 3    | 2.67 |
|              | Appropriate as learning media in the class/laboratory.                  | 4                | 4    | 4    | 4    |
|              | Be an alternative for doing practicum of planting and painting bacteria. | 4                | 4    | 4    | 4    |
| Content      | The material formulas based on the basic competition, indicator and the aim of learning syllabus. | 4                | 4    | 4    | 4    | 3.67 |
|              | The using appropriate for sub material of planting and painting bacteria. | 4                | 4    | 4    | 4    |
|              | The clear concept of sub material for planting and painting bacteria on Virtual lab. | 3                | 3    | 3    | 3    |
| Language     | The language easy to understanding.                                      | 4                | 4    | 4    | 4    |
|              | The satement was right based on EYD                                      | 4                | 4    | 4    | 4    |

∑Ai = 11

RTV = 3.67

Conclusion: Valid

The validation material expert shows that Virtual lab based on interactive multimedia on sub material of planting and painting bacteria is valid and eligible to be used as learning media with 3.67.

The result of validation data by the material expert shows that Virtual lab is valid with 3.67. It is displayed that Virtual lab can be used as learning media. Based on the aspect below: Format Aspect, format aspect gets the average score 3.33 and it belongs to valid. Virtual lab has accord with sound, animation and good color. Using of size, shape and color shape that has been read. The Virtual lab becomes an alternative to be practiced on practicum on planting and painting bacteria. Content Aspect, the content aspect gets score 3.67 and is valid. Virtual lab arranges with material formulas based on
basic competition, indicator and the aim of learning syllabus. Virtual lab based on sub material. Language Aspect, the language aspect gets the average score 4 and it belongs to valid. Virtual lab uses easily language to be understood. But, validator gives suggestion to fix the content of Virtual lab.

Table 4. The Change Material Before and After Revision (Prototype 1)

| Before Revision | After Revision |
|-----------------|---------------|
| Wrong pronunciation on words “Virtual lab” dan inconsistent intonation. | Record again the words and sentences on Virtual lab with good pronunciation and intonation. |
| Kind, color and font are hard to be read. | Observe clearly about color, font which are easy to be read. |
| Wrong sterilization. There is no explanation about source of bacteria on streak plate stage. | The right sterilization concept. The additional explanation about source of bacteria on streak plate stage. |

3.2 Student Respond through Learning on Planting and Painting Bacteria using Virtual lab

The result of student respond through Virtual lab based on interactive multimedia on sub material of planting and painting bacteria can be seen on Table 5.

Table 5. Questionnaire Analysis Result of Student’s Respond on Field Test Stage

| Criteria | Indikator | Interval (%) | Respon |
|----------|-----------|--------------|--------|
| Respond | Respond Virtual lab that is used on learning activities. | 89,19 | Very Positive |
| | Respond through learning material. | 83,78 | Positive |
| | Respond through language. | 84,12 | Positive |
| | Respond through presentation (visual). | 87,84 | Positive |
| | Respond through relevance uses Virtual lab | 81,59 | Positive |
| Reaction | Attention through Virtual lab on learning. | 83,61 | Positive |
| | Confidence uses Virtual lab on learning. | 78,89 | Positive |
| | Satisfaction through Virtual lab on learning | 83,11 | Positive |

The student’s respond on this research are their respond and reaction through Virtual lab. According to analysis data, student’s respond through Virtual lab amounted 84.15 % with positive respond. There are student’s respond that consists of 2 criteria’s are respond and reaction. Respond, respond through Virtual lab that is used on learning is very good because the operation of Virtual lab is easy. One of good learning media is the easy on usage, operation and it is not hard to be operated [9]. Most of students are happy and interest because they able to operate practicum simulation for planting and painting bacteria with Virtual lab. Students give positive respond through learning material of Virtual lab. This is important because media must appropriate with characteristic of fact, concept, principle and procedural to help the effective learning process [9]. The student respond seems from their comment that states through Virtual lab is very easy to understand for direct simulation practicum.”

Virtual lab uses language, so student can understand the meaning of the words. Using picture and animation on Virtual lab is good. The good media must be clearly and neatly on layout, format, sound, written, and picture illustration or animation [9]. Virtual lab based on interactive multimedia made due to the student’s need on sub material of planting and painting bacteria, the simple media on layout is focused as basic material to be learnt by the student. Reaction, Virtual lab able to make students interested. It can be seen from student’s comments that like the visual (picture and animation), the
animation of Virtual lab is good and interesting, and the display of laboratory animation and the tools seems like the real and the simulation practicum on Virtual lab like the real practicum”.

Visual is able to develop the interest in a learning subject. In addition, the interest can improve student’s motivation with taking, creating and involving students on learning process [10]. The messages through simulation will more interesting, because with attention students will be encouraged on their self motivation to learn.

Student’s reaction on self confidence criteria use Virtual lab on learning is categorized positive. But, the presentation is less positive on confidence than other indicator. It is because some of students still disbelieve on their own selves to do simulation practicum of planting and painting bacteria with using Virtual lab based on interactive multimedia.

Regarding to this research, it has been known that students feel satisfied and get benefit after learning to use Virtual lab based on interactive multimedia on sub material of planting and painting bacteria (positive reaction). Some of students suggests that learning with Virtual lab based on interactive multimedia is interesting experience because use picture, animation and simulation.

4. Conclusion
Based on the result of the research, it can be concluded that Virtual lab based on interactive multimedia on sub material of planting and painting bacteria is valid and eligible to be used as learning media with RTV TK 3.55. Furthermore, student’s respond through Virtual lab based on interactive multimedia on sub material and painting bacteria belongs to positive with average presentation of 84.15%.

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