Virtual Biochemistry and Multiple Representation Laboratory as a Step in Revitalizing Online Practicum in the New Normal Era on Food Ingredient Testing Materials

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Abstract
Sars-Cov-19 was officially declared a pandemic by WHO. This causes the implementation of education in Indonesia to be carried out in a manner that includes universities. One of the improvements in competition in the form of food ingredient testing practicum, which is very important for hard skills, is now unable to be carried out properly or even not carried out. Providing a virtual laboratory during the pandemic has become an effective, efficient and economical solution, so the author created the Biochemistry Laboratory as an Online Practicum Game to Revitalize Online Practicum in the Pandemic Era. B-Lab was developed using the R&D method which consists of the determination, design, development and deployment stages. B-Lab uses a student-centered learning approach that presents a sequence of representations at the symbolic level in the form of reaction equations, at the macro level in the form of changes in the form or color of materials before and after the reaction using interactive animation design, and at the micro level at the depiction of the reaction process which is conveyed through visualization of molecular movement during reactions. B-Lab excels as a virtual laboratory that provides practical materials, work step modules or flow diagrams, evaluations or pre-tests and post-tests, scientific libraries in the form of general knowledge, discussions after practicums, and connects students and lecturers. B-Lab is a smart virtual laboratory solution that can be utilized by various universities in Indonesia in line with the goal of independent campuses in order to welcome the new normal era.

Keywords: Virtual Laboratory, Practicum, Multiple Representatives

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Introduction

Sars-Cov-19 was officially declared a pandemic by the World Health Organization on March 11 2020, based on information sourced from CNBN Indonesia (2020). The positive number for Covid is predicted to continue to rise until 2021, so this will have a negative impact on various main sectors such as the economy and education. Welcoming the new normal era, economic activities began to creep up with the elimination of PSBB (large-scale social restrictions). Likewise, the education implementation policy by the Minister of Education and Culture explains that schools in the green zone are allowed to operate but still subject to several conditions. Unfortunately, 94% of Indonesian students are in the yellow, orange and red zones, so this ensures that education in Indonesia is carried out online, including at the tertiary level.

Increasing academic competence in higher education institutions, which requires students to take practical courses to hone hard skills, has encountered obstacles due to limited space and facilities. Meanwhile, according to (Sadjati & Pertiwi, 2013) practicum is a very important activity to implement because it is able to provide experience and the process of developing scientific skills and attitudes to achieve competence in assembling tools, using laboratory equipment, conducting experiments/research, managing substances, representing experimental results, and educator assessment of practicum reports. Covid-19 is a correction that shows the main weakness of the campus digitalization system because it has not been able to cover the implementation of online practicums (Karim, 2020). This is proven by the author's survey using Google Form on July 26 2020 of 150 student respondents from several universities in Indonesia in science and technology study programs who explained the ineffectiveness of practicums in the midst of the pandemic. The results of the interviews revealed that several lecturers were trying to facilitate practicums using WhatsApp groups or Google Class. Students are asked to carry out practicums independently, collect practicum videos, only be given correct practicum results, look for references to make reports even though they are not carrying out practicums, there are even delays or elimination of practicums. The final conclusion from 81.3% of respondents stated that the practicum did not run optimally due to difficulties or not being able to imagine the practicum process, not being able to understand the practicum instructions, nor understanding the changes in several reactions, one of which occurred in the food content testing practicum.

One of the departments that felt the impact was the science and technology department such as biology, chemistry, medicine, etc. Some of these majors have to do practicum as one of the skill requirements for their future work. An important practicum that forms the basis for learning is biochemistry. This practicum can only be done in a laboratory because it uses various reagents, tools and personal protection that cannot be found at home. As a result, while online, practical work cannot be carried out. An example of biochemistry practicum is food content testing, which is part of biochemistry which provides information about chemical composition and processing (Reedijk, 2014). The practical function of food content testing is to obtain general information regarding regulations, labeling, sampling, determining chemical characteristics, physical properties, and completely discussing basic principles and application methods (Nielsen, 2003). Food content testing, including testing for carbohydrates, glucose, protein and fat, is quite complicated because it involves reactions and various stages of sequential implementation. Based on a survey, a number of departments such as biology, chemistry, science education, pharmacy, nutrition and medicine are carrying out this test, but the food content test is threatened with not being able to take place properly due to the corona virus pandemic. If they don't find a solution, quite a few students who

receive food content testing practicum experience misconceptions and don't even gain knowledge because there are no facilities and effective solutions for carrying it out independently. In fact, in the world of work, practical skills are really needed for pure and education majors who will later become teachers (Subiantoro, 2010).

The problem of online learning which limits practicum because it cannot be carried out in the laboratory must find a bright spot so that it remains effective, efficient, and the material can be received properly and correctly. Several previous studies stated that the provision of virtual laboratories has various advantages including (1) Reducing geographical barriers, (2) Saving time, (3) Economical, does not require expensive laboratory buildings, tools and materials like conventional laboratories which are sometimes expensive and easy to use. damaged, (4) Increase understanding of the experiment, because it allows it to be repeated to clarify the experiment, (5) Increase the effectiveness of learning (Kusumaningsih, Iswahyudi and Susanti, 2014). Another supporter is the statement by Sudaryana and Doharma (2019) which states that using simulation games will increase students' understanding and motivation to learn, because games are used interactively so that students will understand the concept of the material better. Games also increase enthusiasm in students. Students do not feel burdened when receiving the material because it feels like playing a fun game (Haswan & Al-Hafiz, 2017). Based on existing problems and technological advances and in line with the learning agenda in the Independent Campus based on the Ministry of Education and Culture (2020) where the government provides challenges and opportunities to develop students' creativity, personality, capacity and needs, as well as developing independence, the author created a biochemistry virtual laboratory as a practical game online as a revitalization of online practicum in the pandemic era.

The research objective is to create a Virtual and Multiple Representative Biochemistry Laboratory. Testing the effectiveness and ease of use of the Virtual and Multiple Representative Biochemistry Laboratory. Testing the validity of the Virtual and Multiple Representative Biochemistry Laboratory media. The purpose of this research is to produce effective and valid virtual laboratory learning media, provide learning media references that can replace online practicums, and apply for product patents.

Method

This type of research is development research using the R&D method which consists of the define, design, development and disseminate stages (Thiagarajan, et al., 1974) but the stage targeted by researchers is development. This study focuses on developing a virtual laboratory game that can facilitate online practicum by providing a virtual practicum space, materials, and a place to collect reports. Material taken from RPS Biology Department, FMIPA UM. Data collection techniques were obtained through media practicality test questionnaires, observations and interviews.

Definition Stage (Define), the first stage that must be carried out is front-end analysis which aims to analyze the problems faced in practicum learning in the Department of Biology, State University of Malang. Next is leaner analysis by identifying students to find out problems, knowledge, desires and characteristics of target users. The next step is ask analysis with the aim of identifying the skills and abilities that target users (students) must have in the material. The final step is specifying instructional objectives to determine specific media output.

The media design stage is developed in several activities, namely constructing criterion-referenced tests, media selection, format selection, and initial design. The first stage of preparing the criteria test is used to determine the user's initial abilities. The second stage of media selection is adjusted to the results of the evaluation and analysis of concepts and characteristics of students carried out in the previous stage. Media design starts with compose a prototype using Adobe Illustrator to form 2Dmedia assets. A further application is Adobe XD to see a full preview of the workflow on the UI to better present the prototype. The design of the practical process in the virtual laboratory room was developed using the Construct 2 application, which produces the final display in the form of a 2D game in HTML 5 format which can be exported to Android. The third stage is selecting the format, designing a virtual laboratory learning media that will contain learning material. The design is displayed in the form of a story board containing the virtual laboratory display design. The final stage is the close beta version design in the form of an overall design of the components of the B-Lab media before being validated and ready to be tested. The final result of this media is a virtual laboratory in the form of an .apk file that can be installed on an Android device with at least Android 4.1 Jellybean.

At the development stage, validation tests are carried out by media and material experts and development trials are carried out. The validation stage is carried out on practical instructions and materials to validate and assess the suitability of the media. The expert team involved in the validation process is media experts (media experts) and experts in the field of Biochemistry (material experts). Meanwhile, development trials were carried out using assessment questionnaires on real target subjects. Researchers carry out research up to the development stage.

Results and Discussion

Results

Results of virtual laboratory game development. The branding name of the biochemistry laboratory application as an online practicum game as a revitalization of online practicum in the pandemic era. Biochemistry laboratory is a game that contains a biochemical laboratory simulation on food test materials. Not only is the Biochemistry laboratory educational, it also makes learning fun. B-lab presents a complete representative visualization of biochemistry practicum starting from material, interactive practicum, as well as quizzes. The universal biochemistry laboratory is able to provide the opportunity for the sensation of learning in the laboratory. B-lab is very suitable for use in the online learning era, and also equalizes the practical abilities of all students in Indonesia. The genre of this game is an edugame simulation. The experience offered is that players will be able to experience biochemical practicum testing food content in an interactive virtual laboratory room. The preparation of the virtual laboratory simulation game follows the flow of the visual game flowchart with text and 3D modeling of the chemical molecules used.

Practical material menu concept, in this menu users will be presented with written practical material and there is an icon connected to the video which is integrated with YouTube. This menu is used to make it easier for students to understand the material before doing practicum. Science library menu concept, containing unique information on biochemistry. In the form of a piece of scientific factual information in written form that is not widely known by the public. A flowchart is a path that players go through in exploring the content provided in the game.

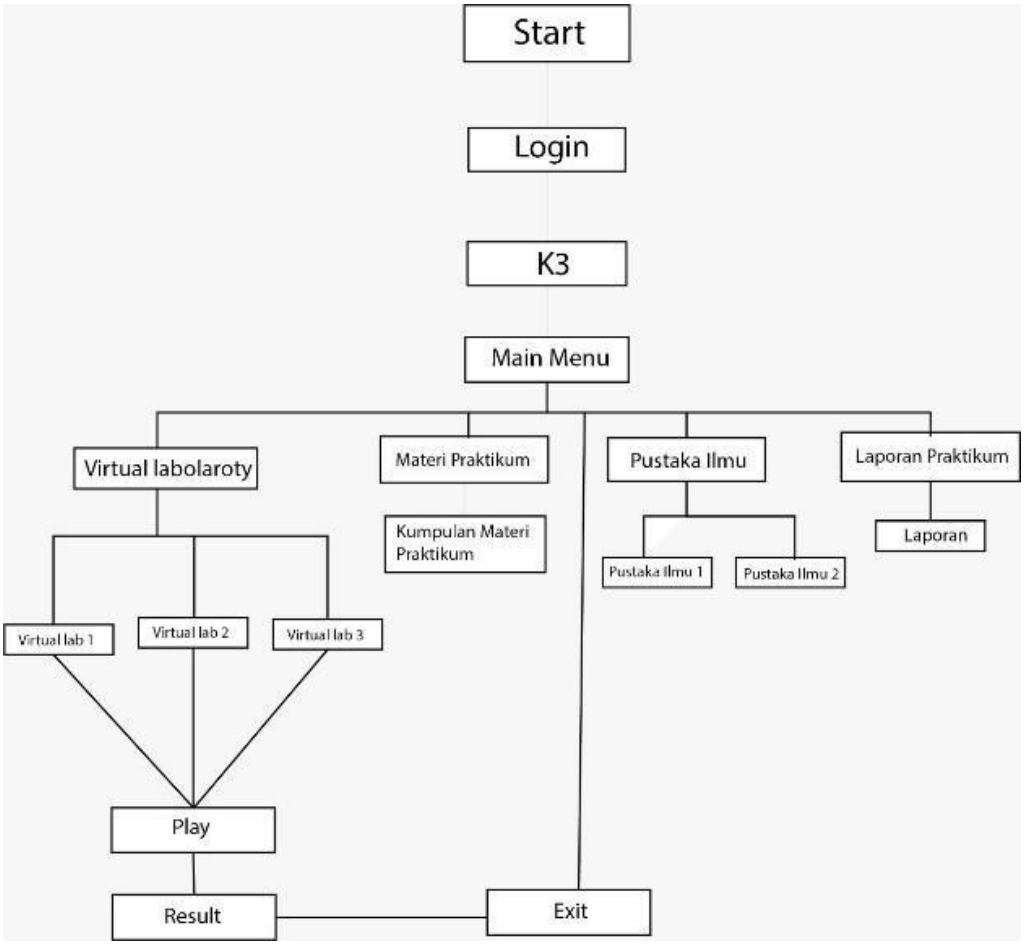

Figure 1. Game Flowchart

Flowcharts function to make it easier to organize games and are the basis for the framework of the game flow that will be created. The flowchart in this game consists of start followed by player login, going to the K3 mini game, main menu, and ending at the game exit section. Virtual laboratory menu concept, in this menu the user will enter a virtual practicum room where the user will play a practicum simulation game. Users can drag and drop all items in the practicum room so that the practicum can run interactively. In this menu there are also evaluations and discussions that display. The concept of the practicum report menu is a menu where students can send their practicum reports to the lecturer via an icon connected to the lecturer's Google Form.

Visual Design

a. Main Menu Design

Figure 2. Main Menu Design

The main menu display design is adjusted to the laboratory and bio character:

b. Laboratory Virtual Design

Figure 3. Virtual Lab Design

The design of the virtual laboratory display is designed according to the theme, namely biology practicum, and adapted to the user, namely students.

c. Practical Material Design

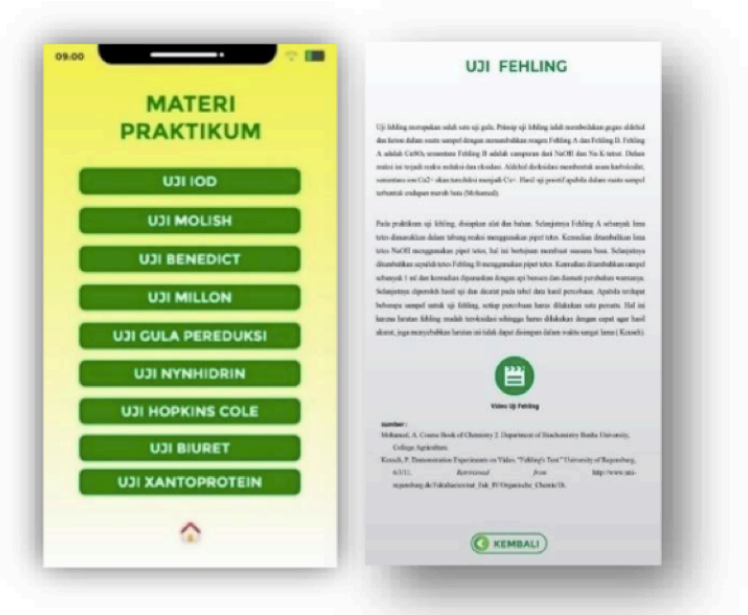

Figure 4. Practicum Metrial Design

The practicum material design is displayed in text displays and video icons that are integrated with videos on YouTube.

d. Science Library Design

Figure 5. Science Library Design

The science library design contains unique quotes about facts in biochemistry.

e. Practical Report Design

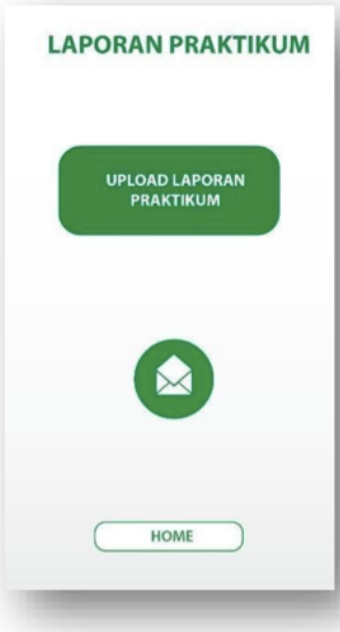

Figure 6. Practical Report Collection Design

The practicum report design contains an icon which, if clicked, will be integrated with the respective lecturer's Google Form.

f. Discussion Design

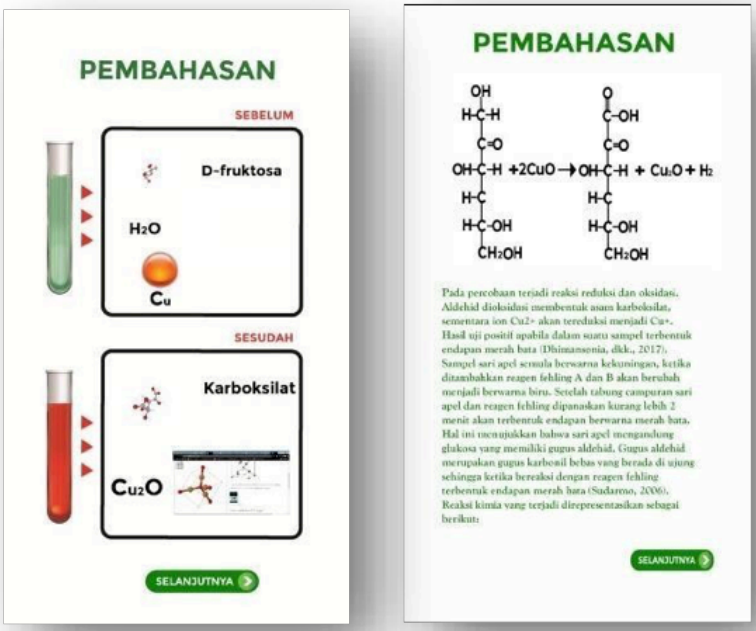

Figure 7. Discussion Design

The discussion design contains 3D modeling of each chemical element used during the practicum. Apart from that, it also displays reading texts and chemical structures to make it easier for students to receive the material. This game has been validated by media experts, namely lecturers in the department of information engineering, Malang State University, getting a result of 90.9%. Meanwhile, the validity of the material has been validated by a lecturer in the biology department at Malang State University, getting a result of 95%, so the data says that this game can be used without revision.

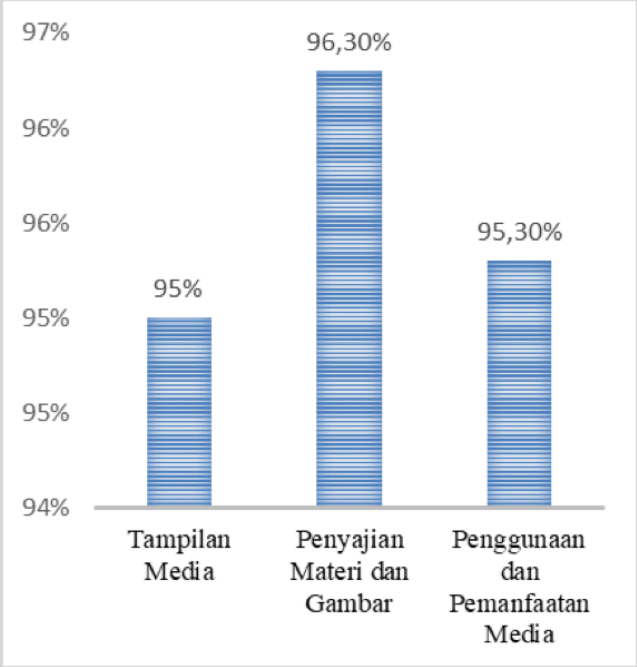

Figure 8. Media Readability Test Results in Small Classes

Based on a media readability test in a small class of 25 students majoring in biology offering A 2018, respondents stated that the appearance of the biochemistry virtual laboratory was good with an average score of 95%. This media readability test includes color components, font type and color, as well as packaging content and appearance. Meanwhile, the presentation of material and images received 96.3%, including suitability and clarity of images, clear and easy to understand material, and ease of language. The use and utilization of media got 95.3%, which includes the use of quizzes and evaluations, ease and explanation of action button functions, ease in operating the media, and ease in providing understanding.

Discussion

This virtual laboratory simulation game product has advantages, including that it can be installed on an Android smartphone of at least version 5.1 and above, has a virtual practicum room that can be used interactively, has practicum materials and instructions to make it easier for users to operate, there are simulations, 3D animations from compound molecules used in practice, there is an evaluation in the form of questions. In line with the statement (Subiantoro, 2010) which states that practicum must have a complete package of observation, analysis of results, discussion and evaluation to strengthen students' understanding.

Apart from that, what is selected in the virtual laboratory simulation game is tailored to the user, namely students, and is designed to be attractive in order to increase the user's interest

in learning. The importance of adapting the design to the user is supported by the statement (Puspitorini et al., 2014) which researched the development of digital comic learning media to increase student learning motivation. The result was that students were more interested in learning media that had a design that suited their psychology compared to text-based learning media. Virtual laboratory simulation games also facilitate students to submit reports to lecturers in the form of draft reports so that lecturers can assess the extent of students' understanding. This is very helpful for practicums in this online era and can be a substitute solution for online practicums in online conditions.

The advantage of the virtual laboratory simulation game is that it functions to support online practicum learning in the new normal era, so that students can still follow the practicum material. This also supports student independence in independent learning. Apart from that, virtual laboratory simulation games can also facilitate students' different learning speeds or types, because they can be done alone and can be repeated many times which will increase students' understanding (Bire, Geradus and Bire, 2014).

As a result or benefit of using virtual laboratory simulation games, it will facilitate students' practical activities (Hmelo-Silver, Duncan and Chinn, 2007). In practical learning, virtual laboratories can represent visualizations/representations of material concepts, this is included in the multiple representation section and prepares students for practical work more readily (Kollöffel and de Jong, 2013). The advantage of this virtual laboratory simulation game is that it is able to display visualization models that cover concepts with representation from the sub-microscopic to the macroscopic level which is expected to support and increase students' understanding through this online practicum activity, especially the food biochemical testing material.

Based on the results of media validation getting 90.9% and material validation getting 95%, it is hoped that this virtual practicum simulation game can be used to facilitate students in replacing practicum during online learning. Proven by the results of a small class test of 25 students majoring in biology, the media display results were 95% valid, the material and image presentation was 96.3% and the use and use of media was 95.3%. It is hoped that the revitalization of learning can be realized for a more equitable learning process.

Conclusion

Based on the research, a close beta version of the virtual laboratory simulation game was produced with a virtual lab menu, materials, science library and practical collection lockers. The media validation test results were 90.9% and the material validation test results were 95%. Meanwhile, in a small class media readability test on 25 biology students, the results of the media display were 95% valid, the presentation of material and images was 96.3% and the use and use of media was 95.3%. It can be concluded that the virtual laboratory biochemistry game is valid for use without revision.

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