






# Student's Perception of Virtual Breadboard Simulator and TeamViewer in Digital Electronics

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**Keywords:** Virtual Breadboard Simulator, Teamviewer, Digital Electronics.

**Abstract:** This research aims to describe the quality of digital electronics practicum with Virtual Breadboard Simulator and TeamViewer. This quality can be seen in the effectiveness and perceptions of students. The research uses descriptive quantitative research methods. The research subjects were 21 students majoring in Electronic Engineering at D3 Padang State University who took the Digital Electronics Practicum course. Data on student perceptions of product display aspects (Simulator and TeamViewer) were obtained from student response questionnaire sheets with indicators of clarity of usage instructions, legibility, image display quality, color composition, communication facilities, and ease of operation. The data were analyzed using the percentage of responses from students according to their respective indicators. The results showed that students had a positive reaction to practicum activities. Therefore, it is concluded that the digital electronics practicum with the Virtual Breadboard application has good quality if the implementation is assisted by TeamViewer, which is carried out in groups and works together in real-time in building a circuit.

## 1 INTRODUCTION


Vocational education as education-for-work is based on the philosophy of essentialism, pragmatism, and existentialism (Sudira, 2012). Education that has the combined characteristics of education and training functions (Vokasi, 2020), Balanced theory and practice-oriented towards specific skills and job readiness of graduates (Haris et al., 2020), (Utami et al., 2018). Vocational education based on its characteristics has very important practical/practice learning (Sasongko & Widiastuti, 2019).


The purpose of the practicum is to test and apply the theory and scientific evidence learned in a course or portion of a course (Haryoko & Jaya, 2018). Practicum is also defined as a learning strategy that allows students to empirically practice cognitive, affective, and psychomotor abilities using laboratory


facilities (Utami, 2017).


Practicum is usually carried out in a real (hands-on) laboratory, besides having advantages, it also has several limitations, including (1) unable to meet distance learning needs (Altalbe, 2018); (2) requires longer instruction time; (3) unable to provide for students' special needs (Burkett & Smith, 2016); (4) expensive equipment and operations (Crandall et al., 2015); and (5) unable to accommodate all the material and limited time, resulting in failure to meet the expected learning objectives (Brinson, 2015).


Laboratory practicum in vocational education is very important to make students active in the learning process (Belmawa, 2020), (Jaya, 2010). Moreover, the knowledge gained through direct experience in the laboratory is proven to be more profound and has a long-term effect (Kastelan et al., 2015). Direct experience in the laboratory can also be constrained

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if a situation changes suddenly, such as the current pandemic phenomenon.

In addition to the problems above, the education system in Indonesia has undergone changes due to the COVID-19 pandemic. The distance education system is one method for overcoming social distance-related obstacles to direct learning. one of the applications of a distance learning system such as online lectures will facilitate the learning process without the need for face-to-face meetings(Dewantara et al., 2020). This impact also has implications for digital electronics practicum learning.

Digital Electronics Practicum is one of the subjects that must be taken by students (UNP, 2018). This course examines and exercises various digital circuit types. Digital circuits are the foundation of all digital systems currently in use(Luković et al., 2016). Circuit logic is a central concept in understanding how computers and electronics work. Currently, several software has been produced that can visualize and simulate it, such as Virtual Breadboard Simulator.

### 1.1 Virtual Breadboard Simulator

A simulator is software that simulates physical instruments such as measuring instruments or other real systems. A simulator is a form of an interactive multimedia object consisting of heterogeneous formats consisting of sound, graphics, hypertext, text, animation, images, videos, which contain both implicit and explicit learning objectives and are digital. The purpose of the simulator is to provide simulative facilities that allow students to conduct experiments conducted like a real (hands-on) laboratory.

A breadboard is a circuit board whose function is to arrange electronic components and place them without soldering them to electronic circuits. A breadboard is used to connect one component with other electronic components via cables. Virtual Breadboard Simulator is one of the simulators that can be used to support the Digital Electronics practicum.

The Virtual Breadboard Simulator provides virtual tools and materials in the form of Breadboard with its power supply, various types of TTL logic transistors, switch components, LED and 7-segment displays, cables, and logic probes, and much more. This simulator is developed by James Caska which is open source. The Virtual Breadboard Simulator display is shown in Figure 1.

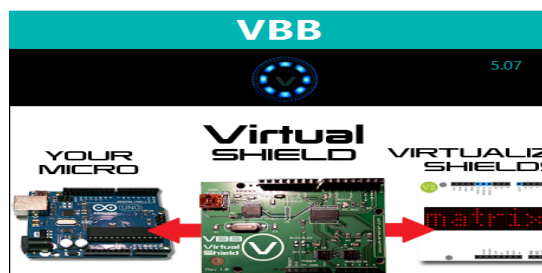


Figure 1: Initial View of Virtual Breadboard Simulator.

Figure 1 depicts the display of the Virtual Breadboard simulator. This simulator enables students to design circuits that are more complex and sophisticated than in actual practice. Due to the limited number of components available in the physical kit, this is the case (Lum Tan & Venema, 2019). In Virtual Breadboard there is a menu for building sequential or combinational sequences.

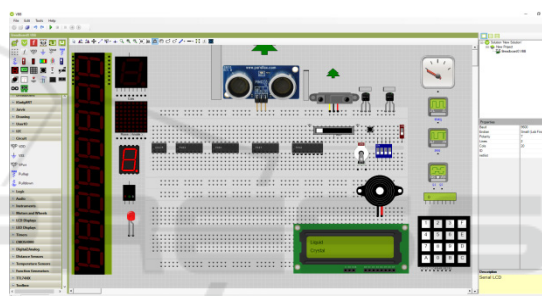


Figure 2: Tools in the Virtual Breadboard Simulator.

### 1.2 TeamViewer

During the Covid-19 pandemic, the use of communication media for digital electronics practicums needs to be increased. Communication media used to support practicum activities can run collaboratively online so that there is interaction between lecturers and students, between students and practicum equipment. One of the software used is TeamViewer. The TeamViewer interface looks like Figure 3.

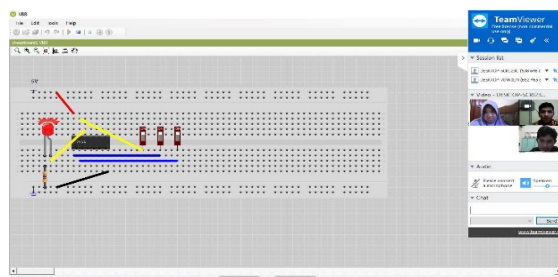


Figure 3: TeamViewer Interface and Virtual Breadboard Simulator.

Supporting online practicum activities with software that offers a collaborative approach, with an online meeting menu and TeamViewer remote desktop access. TeamViewer is a speedy and easy-to-use remote meeting and desktop control solution that also boasts a high level of security. For the sake of a complete answer, TeamViewer can be used to (1) meeting functions, such as for training sessions; (2) display the desktop for meetings, collaborations or presentations; (3) assist coworkers, friends, or customers remotely on an as-needed basis; (4) Use these free Android and iOS meeting applications to join in on the go! (5) Linked machines may use a variety of operating systems; and (6) TeamViewer operates under Windows, Linux Operating System or Mac OS.

Based on the need to conduct a Digital Electronics practicum, this study seeks to characterize student reactions to the display component of the Digital Electronics Practicum which was carried out with a Virtual Breadboard simulator and online collaboration with TeamViewer.

## 2 METHOD

This research uses descriptive quantitative research methods. The research subjects were 21 students majoring in Electronics Engineering D3 Padang State University who took the Digital Electronics Practicum course. Data on responses were obtained from student response questionnaires with indicators: 1) clarity of usage instructions, 2) image display quality, 3) legibility, 4) color composition, 5) ease of operation, and 6) communication facilities (Muchlas, 2015). Determination of the tendency of student responses is done by using the percentage technique using equation (1) as follows:

$$P = \frac{(n_1x_1) + (n_2x_2) + (n_3x_3) + (n_4x_4) + (n_5x_5)}{Nx5} \times 100\%$$

P represents the percentage of reaction, as described by the expression in Equation (1),  $n_1, n_2, n_3, n_4, n_5$  each represents the number of selections for a score of 1 for the choices STS (strongly disagree), 2 for TS (disagree), 3 R for (undecided), 4 for S (agree), and 5 for SS (strongly agree); and N indicates the number of questionnaire items.

The successful implementation of the digital electronics practicum learning model may be determined based on the descriptive analysis of the collected data and the student response rate criteria presented in Table 1.

Table 1: Student responses rate criteria.

Range	Level
80% - 100%	Very Good
66% - 79%	Good
56% - 65%	Poor
0% - 55%	Very Poor

## 3 RESULT AND DISCUSSION

Students data responses on product display aspects are presented in Table 2.

Table 2: Student responses to product display aspect.

Component	Student		
	Score	Maximum Score	%Average
Clarity of learning and usage instructions	468	630	74,29
Image display quality	245	315	77,78
Legibility	242	315	76,83
Color composition	258	315	81,90
Ease of operation	279	315	88,57
Quality of communication facilities	280	420	66,67
Total	1772	2310	76,71

Based on Table 2, a graph can be made showing student responses to the product display aspect as shown in Figure 4.

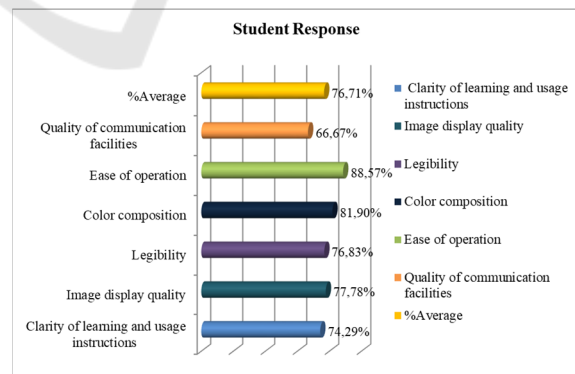


Figure 4: Student responses to product display aspect.

In the aspect of clarity of instructions for use, a value of 74.29% was obtained. The meaning of these values explains that the models and support systems developed for the user guide are easy to learn and apply.

The picture quality was also responded well by students. The results obtained are 77.78%. This value indicates that the images and illustrations displayed on the model and its support system, in particular, Simulator programs and online collaborative support systems are effective in arousing curiosity and fostering student motivation.

Figure 4 also shows that the readability of the perceived product is very good with a perception level of 76.83%. These results indicate that the display of letters in the Virtual Breadboard simulator program as a substitute for real tools and materials, as well as the TeamViewer program as an online collaborative work tool, facilitates pupil comprehension because it is simple to read.

The color composition aspect was very well received by students with an average level of education by 81.90%. These results indicate that the composition of the supporting colors has been changed to generate an aesthetically acceptable composition in the student's answer.

In the aspect of ease of operation, a response of 88.57% was obtained, which indicates that the model and its supporting system are easy to operate. Ease of use is reflected in the results of student assessments which show that the menus provided by learning support devices are easy to recognize, read, understand, and execute.

Regarding the quality of communication, it was revealed that there was a poor response from the qualitative data collected. This is due to the fact that participants may encounter unanticipated technological issues, such as slow internet connections, which prevent the practicum from being completed normally. Nevertheless, with a mean response rate of 66.67%, the subject generally gave a good response to aspects of the communication skills of the support system. This demonstrates that services like as chat rooms, voice over IP, video conferencing, and file transfers may be utilized efficiently and without difficulty used to support practical activities. Researchers pay attention to the results of the analysis, it can be stated that in student responses, the product applied has given a good appearance with an average response rate of 77.71%.

## 4 CONCLUSIONS

The conclusion of this study is that the Digital Electronics Practicum using Virtual Breadboard Simulator gets a positive reaction when TeamViewer is used to facilitate its implementation. This is confirmed by response statistics indicating that

students respond well to practicum activities. Due to the epidemic, TeamViewer can be utilized to facilitate online collaborative digital electronics practicum through online practicum learning.

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