Validity Test Analysis of Virtual Laboratory-Based Job Sheet for Power Electronics Course

Doni Tri Putra Yanto*, Hastuti, Hermi Zaswita, Maryatun Kabatiah, Sukardi, and Ambiyar

***Abstract*—This study discusses the validity test analysis of a Virtual Laboratory-Based Job Sheet (VLBJS), which is used as a practicum learning medium for vocational education students in higher education. The Virtual laboratory-based Job Sheet is used as a practicum guide for students in the Power Electronics Practicum Course, at the Department of Electrical Engineering, Universitas Negeri Padang, Indonesia. Validity test analysis is important to ensure that this VLBJS is suitable for use in the learning process. This study involved 18 experts: learning material experts, learning media experts, and language experts. The rubric for assessing validity with a Likert scale was used to collect the research data. The validity test analysis was carried out based on the results of the expert's assessment by filling out the validity assessment instrument. Partial Least Square (PLS) analysis was used to analyze the validity and reliability of the indicators of each variable in the research instrument. Meanwhile, the analysis of validity tests on Virtual Laboratory-Based Job Sheets was carried out using the Aikens' V formula. The results showed that Virtual Laboratory-Based Job Sheets met the valid criteria from all aspects, namely the aspects of learning materials, learning media, and language. Thus, it can be concluded that the Virtual Laboratory-Based Job Sheet is valid as a practicum guide for vocational education students in the Power Electronics Practicum learning process.**

***Index Terms*—Virtual Laboratory, job sheets, vocational education students, validity test analysis**

I. Introduction

Vocational Education (VE) aims to produce competent and professional graduates in specific fields of expertise. In general, VE also aims to produce graduates who are ready for work. VE is more oriented towards practical competencies or psychomotor abilities to perform specific jobs well and correctly. Graduates of VE programs must have the skills and competencies that are appropriate to the needs of the world of work and industry. Furthermore, VE must continue to develop and be adaptive to the development of science and technology so that its goals can be achieved optimally. Therefore, the learning process in VE must continue to be developed in line with the development of Information and Communication Technology (ICT). VE is different from general education, as it is more dominantly oriented towards practical abilities and the implementation of practical learning in laboratories. Hence, the optimization of the practical learning implementation needs to be a special concern to be continuously improved.

The Covid-19 pandemic that emerged in late 2019 has resulted in rapid changes in the implementation of learning. Learning that was previously conducted face-to-face in classrooms has now shifted to remote learning [1, 2]. Such swift changes require educators to continuously innovate in the learning process. These innovations can take the form of models, methods, strategies, and learning media that can be applied in the learning process [3–5]. This will ensure that learning can still be carried out effectively, and achieve optimal learning goals and outcomes even in the absence of face-to-face interaction in the classroom.

Changes in how to implement learning at the beginning of the Covid-19 pandemic also occurred in the implementation of vocational education in both secondary and higher education [6–8]. VE with a more dominant practical learning process than theoretical learning certainly requires more innovation in models, strategies, methods, and learning media, especially practical learning [3, 9, 10]. Several innovations have been made to make practical learning carried out remotely run optimally like face-to-face learning in the laboratory. One of the popular innovations is the practicum learning process using a Virtual Laboratory (VL) [7, 11]. The practical learning process using VL is also implemented in the power electronics practical course for VE students at Universitas Negeri Padang.

The Virtual Laboratory (VL) is computer software that is used to observe or carry out experimental activities as is done in Real Laboratories (RL). The VL is designed to have the same shape, atmosphere, function, tools, and practicum materials as Real Laboratories (RL) [12–14]. In other words, the VL is a representation of RL. Therefore, it is expected that the student experiences in carrying out practical learning will remain the same as learning in RL. Several research results show that VL is a practicum learning implementation whose use has increased significantly during the Covid-19 pandemic to support the implementation of remote learning [12, 15, 16]. The VL is also effectively applied in the practicum learning process in the fields of natural sciences, engineering, vocational, chemistry, biology, and nursing [16–18].

In early 2022, Covid-19 active cases began to decrease. The learning process is gradually carried out face-to-face with a blended learning model that combines face-to-face learning with remote learning [19, 20]. The VL is still used as a practicum learning media combined with face-to-face learning in RL [12, 16]. The results of previous research indicate that one of the factors influencing the success of implementing the practicum learning process using VL is the availability of job sheets that can serve as a guide for students in conducting practicum activities. [12, 21]. Job sheets are guidelines or practical work procedures that are arranged

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according to the learning material. Ideally, during practicum, the job sheet acts as a guide that can make it easier to train students' skills in carrying out practicum activities [22, 23]. Therefore, to ensure the optimal implementation of practical learning using VL, a valid and high-quality job sheet is needed [22, 24]. However, before it can be used, the prepared job sheets require several tests, one of which is validity testing. Validity testing aims to ensure that the job sheet is feasible to be used as a learning medium and can function properly.

Thus, it is necessary to research the validity test analysis of virtual laboratory-based job sheets (VLBJS) in the learning process of power electronics practicum for VE students. The general purpose of this study is to reveal the validity of the VLBJS as a practicum learning media for the power electronics practical course, at the Electrical Engineering Department, Faculty of Engineering, Universitas Negeri Padang. The specific objectives of this research are: (1) to produce a valid VLBJS for power electronics laboratory course that can be effectively used in learning; (2) to conduct a validity test on the produced VLBJS by testing it on several variables such as learning material, learning media, and language; and (3) to provide empirical evidence on the validity and implementation of VLBJS in power electronics practical course. The research on the validity test analysis of the VLBJS is innovative because it combines two rapidly growing technologies, namely Information and Communication Technology (ICT) with learning technology. This study produces a valid VLBJS product that can be used to assist students in the learning process. Furthermore, the presence of a valid VLBJS will optimize the implementation of VLs in the learning process, which is increasingly favored as an alternative for learning implementation. The results of this study contribute to producing information related to the use of the VLBJS as a choice of learning media for practicum in practical learning using a VL.

This research has important implications for improving the quality of learning in the power electronics practical course, including (1) Increasing the validity of learning, by testing the validity of VLBJS used in learning, it can be ensured that the VLBJS is appropriate for learning objectives and can provide benefits in strengthening students' understanding of concepts; (2) Enhancing the quality of learning, valid VLBJS will provide a more interactive and effective learning experience; (3) Optimizing the use of virtual technology, valid VLBJS can help optimize the use of virtual technology in learning. With the use of this technology, students can access learning from anywhere and at any time, thus increasing the flexibility and efficiency of learning. This research can contribute to the literature by adding empirical evidence on the validity and implementation of the VLBJS in the power electronics practical course. The results of this study can serve as a reference for other researchers who are interested in conducting similar research and gaining insight into the use of technology in education. Additionally, this research can provide benefits to stakeholders such as lecturers and students in enhancing the quality of learning, particularly in the power electronics practical course. With the valid VLBJS, students can benefit from interactive and effective learning experiences in understanding power electronics concepts.

II. Literature Review

A. Virtual Laboratory

The VL is a system used to replace or complement the physical laboratory with a virtual simulation environment that can be accessed via the internet or specific software. In a VL, students can perform experiments, observations, and analyses using computer models or simulations consisting of images, videos, audio, and animations [25, 26]. The use of VL in the learning process has several advantages, including (1) Accessibility: the VL can be accessed from anywhere and at any time without being limited by time and location, thus allowing students to learn flexibly; (2) Cost efficiency: Compared to physical laboratories, The VL has lower operating costs; (3) Safety: In VL, the risk of accidents can be avoided so that students can learn more safely; (4) Control: The VL allows for easy experiment setup and repetition, allowing students to repeat experiments as many times as necessary to deepen their understanding [12, 20, 27, 28]. In addition to these advantages, the application of the VL in the learning process also has several disadvantages such as (1) Limited access: Not all students have adequate access to the software and hardware needed to access the VL; (2) Limited experience: the VL cannot provide physical experience and direct interaction as obtained in physical laboratories; (3) Testing limitations: Sometimes under certain conditions, the VL cannot show realistic results as found in physical laboratories [20, 25, 28].

B. Virtual Laboratory-Based Job Sheet

The VLBJS is a Job sheet designed to guide students in conducting experiments or simulations using VL as a substitute for physical laboratories. This Job sheet contains complete instructions on step-by-step procedures, and questions to stimulate thinking and analysis, as well as a job sheet to record the results and observations of students during experiments or simulations.

Several aspects need to be considered in creating a good VLBJS, such as (1) Relevance: The VLBJS is relevant to the learning objectives and materials that will be studied; (2) Interactive: The VLBJS is interactive and allows students to actively engage in learning; (3) User-friendly: The VLBJS is easy to use by students with an intuitive and easily understood interface; (4) Appropriate Language: The language used in the VLBJS should be following the student’s level of understanding and scientific writing standards; (5) Attractive: The VLBJS is attractive and can motivate students to learn; (6) Independent Learning: The VLBJS as a learning media supports the implementation of independent learning by students; (7) Effectiveness: The VLBJS is effective in improving students’ understanding of the material being studied [25, 29, 30].

The VLBJS developed in this study has the following advantages: (1) it is developed according to the learning material needs; (2) it is developed according to the characteristics of the students; (3) it contains complete virtual laboratory-based practicum material; (4) it is developed with an orientation towards student learning activities, enabling independent use; (5) the developed VLBJS contains clear work steps and is equipped with adequate drawings; (6) it has an attractive design; and (7) it can be accessed remotely by students through e-learning platforms.

The validity test analysis of VLBJS is important to ensure the validity, accuracy, and feasibility of the VLBJS before it can be effectively used in the learning process and help students achieve the desired learning objectives [12, 30]. The validity of the VLBJS is determined through the analysis of validity testing on several variables, namely learning material, learning media, display, ease of use, and language [20, 31, 32]. In this study, the validity variables tested for the VLBJS are learning material, learning media, and language, where the display and ease of use aspects are combined into the learning media aspect. So, the research questions in this study are (1) Is the VLBJS valid to be used in the power electronics practical course when viewed from the variables of learning material, learning media, and language? And (2) can the variables of learning material, learning media, and language measure the validity of the VLBJS?

III. Method

In this study, the validity test analysis of the VLBJS was carried out based on several expert assessments (Expert-judgment). 18 experts were involved in assessing the VLBJS validity consisting of 6 experts in power electronics learning materials, 6 learning media experts, and 6 language experts. The validator will provide a validity assessment based on the validity instrument. There are three validation aspects, namely learning material, learning media, and language. The validity instrument was prepared based on the indicators of each validity aspect known from the literature review. The indicators for each aspect of the validity assessment in this study are presented in Table I.

A. Research Instruments

The research instrument used in this study was a validity assessment sheet using a Likert scale (1−5), distributed into three aspects, and with five answer choices [33]. Variables and indicators are formulated based on a review of relevant literature based on the results of previous studies. So that the validity of the VLBJS instrument variables in this study was: The validity of the learning material aspect, the validity of the learning media aspect, and the validity of the language aspect [12, 34].

TABLE I: Operationalization Table for Research Instrument

Variables	Theoretical framework	Indicators
Learning Materials	[12, 16, 35]	MT.1. The VLBJS is aligned with the learning materials MT.2. The VLBJS contains accurate material MT.3. The VLBJS contains up-to-date material MT.4. The VLBJS encourages student curiosity
Learning Media	[12, 35, 36]	MD.1. The VLBJS fulfills the Function as a Learning Media MD.2. The VLBJS has clear and easy-to-understand work steps MD.3. The VLBJS supports student independent learning MD.4. The VLBJS makes it easier for students to carry out practicums MD.5. The VLBJS has clear and easy-to-understand instructions for use
Language	[12, 32, 35, 36]	LA.1. The VLBJS uses straightforward language LA.2. The VLBJS uses communicative language LA.3. The VLBJS uses an interactive and dialogic language LA.4. The VLBJS uses language that conforms to language rules

B. Technique of Data Analysis

After the data was obtained through the research instrument, the data were first analyzed using the Partial Least Square-Structural Equation Modeling (PLS-SEM) analysis approach using the SmartPLS application. PLS-SEM analysis is carried out for outer model analysis (measurement of indicators) which functions to analyze whether each indicator from each aspect/variable meets the criteria of validity and reliability [37, 38]. Hence, the research instrument can determine the validity of the VLBJS studied. The validity and reliability of the indicators for each aspect/variable were analyzed based on the values of Convergent validity, Construct Reliability, Average Variance Extracted-AVE, Discriminant validity, cross-loading, and model unidimensionality [38, 39].

After indicators meet the criteria of validity and reliability, the obtained data can be used as a reference in analyzing the validity of the VLBJS. Then the validity of the VLBJS was analyzed by using Aiken's V formula [35, 40]. The v value obtained for each indicator and the average V value are interpreted by the validity category proposed by Aiken. If the v value for each indicator and the average v value is greater and equal to 0.60 ($V \geq 0.60$) then the VLBJS is declared valid, conversely, if the v value for each indicator and the average v value is less than 0.60 ($V < 0.60$) then the VLBJS is declared invalid [35, 41]. The consequence if a product is declared invalid is that it needs to be revised and re-tested for validity before it can be used or tested further in the learning process.

IV. Result and Discussion

A. Results

The VLBJS is the object tested in this study, Job sheets are guidelines or practical work procedures that are arranged according to the learning material. The VLBJS is a guide to implementing practical learning for students using a virtual laboratory. The laboratory used is the PSim application which is an application to create circuits and simulate power electronic circuits [22, 23].

1) VLBJS content

The VLBJS in this panel consists of several main contents that were compiled and developed to make it easier for students to conduct practicum activities using a virtual laboratory. Some of the main content in the VLBJS that will be validated are as follows.

a) *Cover* is the front cover page of the VLBJS which contains information about the Title, Course Identity, and Author. The cover image is presented in Fig. 1.

b) *Course Identity:* contains information related to courses, topics of discussion, titles, codes, and time of implementation of learning, course identity is presented in Fig. 2.

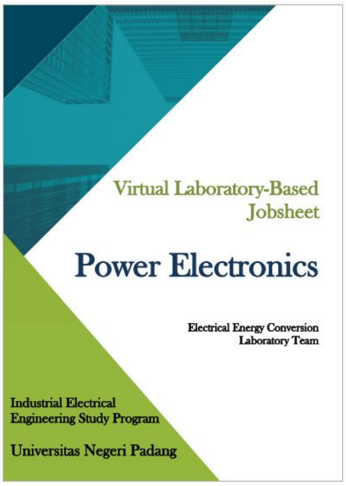
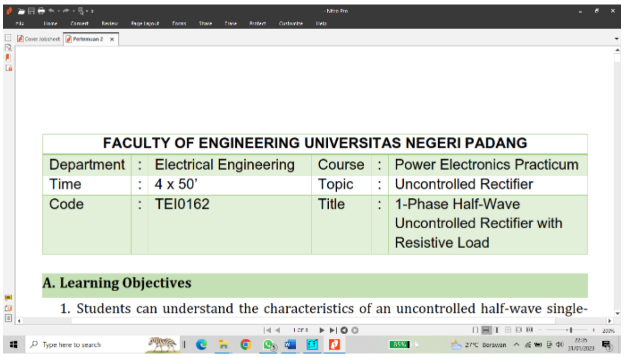


Fig. 1. Cover of the VLBJS.



FACULTY OF ENGINEERING UNIVERSITAS NEGERI PADANG

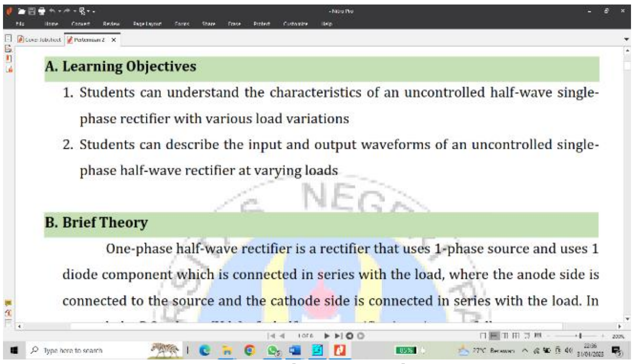
Department	: Electrical Engineering	Course	:	Power Electronics Practicum
Time	: 4 x 50'	Topic	:	Uncontrolled Rectifier
Code	: TEI0162	Title	:	1-Phase Half-Wave Uncontrolled Rectifier with Resistive Load

A. Learning Objectives

1. Students can understand the characteristics of an uncontrolled half-wave single-

Fig. 2. Course identity in the VLBJS.

c) Learning Objectives: contains information related to learning objectives that will be achieved after following the practicum learning process, Learning Objectives are presented in Fig. 3.



A. Learning Objectives

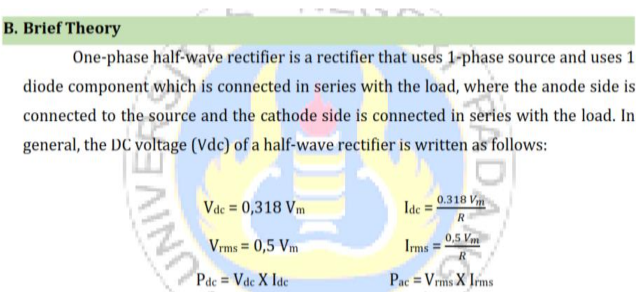
1. Students can understand the characteristics of an uncontrolled half-wave single-phase rectifier with various load variations
2. Students can describe the input and output waveforms of an uncontrolled single-phase half-wave rectifier at varying loads

B. Brief Theory

One-phase half-wave rectifier is a rectifier that uses 1-phase source and uses 1 diode component which is connected in series with the load, where the anode side is connected to the source and the cathode side is connected in series with the load. In

Fig. 3. Learning objectives in the VLBJS.

d) Brief Theory: contains a brief theory that directly discusses the practicum title to be studied, the appearance of the brief theory is presented in Fig. 4.



B. Brief Theory

One-phase half-wave rectifier is a rectifier that uses 1-phase source and uses 1 diode component which is connected in series with the load, where the anode side is connected to the source and the cathode side is connected in series with the load. In general, the DC voltage (Vdc) of a half-wave rectifier is written as follows:

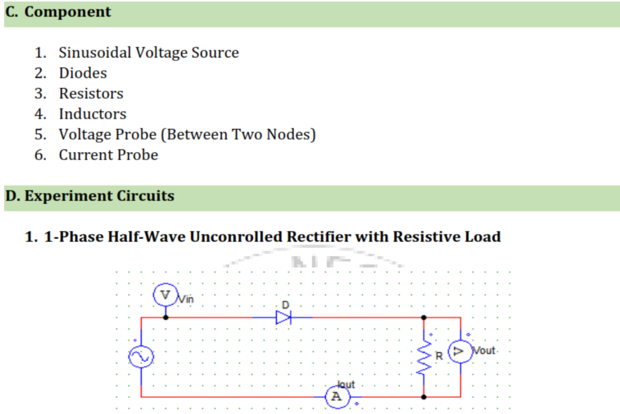
$V_{dc} = 0{,}318\ V_m$ $\qquad I_{dc} = \frac{0.318\ V_m}{R}$

$V_{rms} = 0{,}5\ V_m$ $\qquad I_{rms} = \frac{0{,}5\ V_m}{R}$

$P_{dc} = V_{dc}\ X\ I_{dc}$ $\qquad P_{ac} = V_{rms}\ X\ I_{rms}$

Fig. 4. Brief theory in the VLBJS.

e) Components and Experimental Circuits: contains the explanation of the components needed and pictures of experimental circuits when conducting virtual laboratory-based practicums using the PSim application. Components and Experimental Circuits are presented in Fig. 5.



C. Component

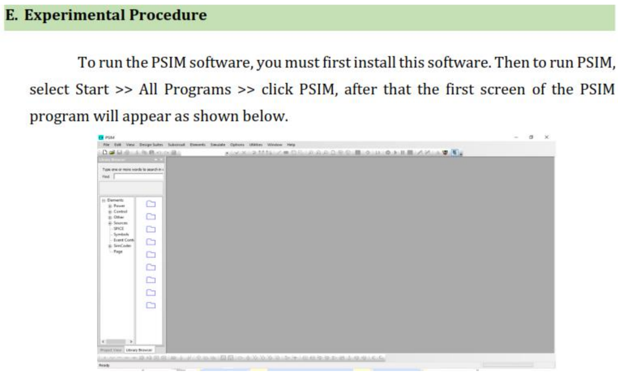
1. Sinusoidal Voltage Source
2. Diodes
3. Resistors
4. Inductors
5. Voltage Probe (Between Two Nodes)
6. Current Probe

D. Experiment Circuits

1. 1-Phase Half-Wave Unconrolled Rectifier with Resistive Load

Fig. 5. Components and experimental circuits in the VLBJS.

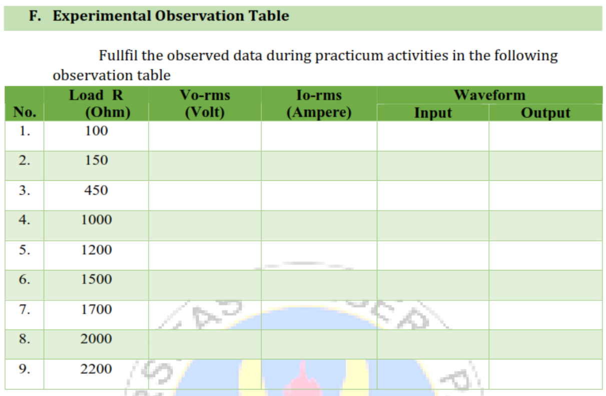
f) Experimental Procedures: contains information about the procedure for carrying out virtual laboratory-based practicum learning activities using the PSim application. This section is very important because it will be a guide for students in carrying out practicum activities correctly. The Experimental Procedure is presented in Fig. 6.



E. Experimental Procedure

To run the PSIM software, you must first install this software. Then to run PSIM, select Start >> All Programs >> click PSIM, after that the first screen of the PSIM program will appear as shown below.

Fig. 6. Experimental procedures in the VLBJS.



F. Experimental Observation Table

Fullfil the observed data during practicum activities in the following observation table

No.	Load R (Ohm)	Vo-rms (Volt)	Io-rms (Ampere)	Waveform	
				Input	Output
1.	100				
2.	150				
3.	450				
4.	1000				
5.	1200				
6.	1500				
7.	1700				
8.	2000				
9.	2200				

Fig. 7. Experimental observation table and experimental task in the VLBJS.

g) Experimental Observation Table and Experimental Task: Contains experimental tables that must be filled in by students when doing practicum and assignments that must be done by students after getting practicum data.

The Experimental Observation Table and Experimental Task are presented in Fig. 7.

2) *Indicator measurement (outer model analysis)*

The initial step in the outer model analysis using PLS-SEM is the preparation of the path model. Based on the literature review, the path model obtained in this study is presented in Fig. 8.

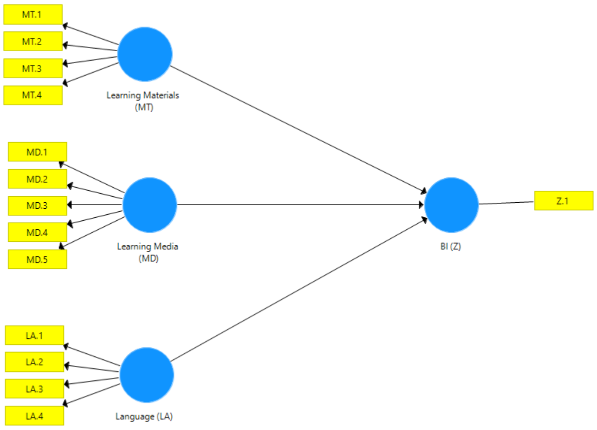


Fig. 8. Initial path model.

The assumptions or conditions that must be met in the outer model analysis are that there are no multicollinearity problems. The multicollinearity is indicated by the Variance Inflating Factor (VIF) value at the indicator level > 5. If there is a VIF indicator value<5 then there is no multicollinearity problem. The analysis results of the Outer VIF Values in Table II can be seen that all VIF values are still below 5 (VIF Value<0.5) [37, 38]. So, it can be seen that there is no multicollinearity problem for each indicator.

TABLE II: THE RESULTS OF OUTER VIF VALUE ANALYSIS

Indicators	VIF	Indicators	VIF	Indicators	VIF
MT.1	1.678	MD.1	2.169	LA.1	1.532
MT.2	2.017	MD.2	2.579	LA.2	1.724
MT.3	1.654	MD.3	2.574	LA.3	1.402
MT.4	2.477	MD.4	1.431	LA.4	1.387
		MD.5	2.934		

The Goodness of Fit (GoF) Analysis is performed to ensure that the path model compiled meets the GoF criteria. The results of the GoF analysis for the path model presented in table III show that the path model used in this study has met the model fit criteria, where the Standardized Root Mean Square (SMSR) value is 0.057<0.08 [37, 38]. The NFI value is 0.993>0.9. And the Root Mean Square Theta (RMS Theta) value is 0.079<0.102 [37, 38]. So, based on these three values, it can be seen that the path model in this study has met the GoF criteria. Thus, further analysis can be carried out, such as testing the validity and reliability of indicators and latent variables.

TABLE III: GOODNESS OF FIT ANALYSIS

	SRMR < 0.08 [37, 38]	**NFI > 0.9** [37, 38]	**RMS theta < 0.102** [37, 38]	**Goodness of Fit (Gof)**
Saturated Model	0.057	0.993	0.079	Fit
Estimated Model	0.057	0.993	0.079	Fit

Measurement of indicators (Outer Model) is conducted by looking at the values of Convergent validity, Construct Reliability, Average Variance Extracted (AVE), Discriminant validity, cross-loading, and model unidimensionality. The results of the outer loading analysis using SmartPLS presented in table IV show that all indicators obtain a value greater than 0.7. Thus, it can be seen that based on the outer loading validity analysis, all indicators are valid in item validity. The final path model image resulting from the outer model analysis using smart PLS is shown in Fig. 2.

TABLE IV: RESULTS OF OUTER LOADING ANALYSIS

	MT	MD	LA	Item Validity
MT.1	0.811			Valid
MT.2	0.842			Valid
MT.3	0.743			Valid
MT.4	0.878			Valid
MD.1		0.822		Valid
MD.2		0.761		Valid
MD.3		0.873		Valid
MD.4		0.871		Valid
MD.5		0.859		Valid
LA.1			0.806	Valid
LA.2			0.842	Valid
LA.3			0.738	Valid
LA.4			0.700	Valid

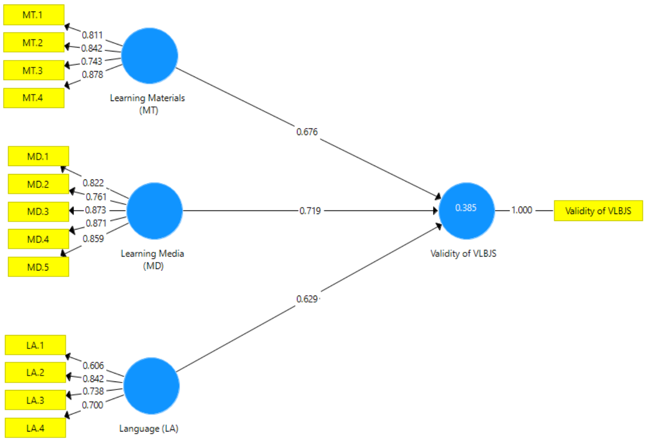


Fig. 2. Outer model analysis of path model.

TABLE V: RESULTS OF CONSTRUCT VALIDITY AND RELIABILITY

	C. Alpha (> 0.7)	Rho A (> 0.7)	C. Reliability (> 0.7)	AVE (> 0.5)
MT	0.838	0.850	0.891	0.673
MD	0.894	0.906	0.922	0.703
LA	0.707	0.740	0.815	0.528

Internal Consistency Reliability is an analysis to determine the ability of each indicator to measure its latent variables. Internal Consistency Reliability can be viewed from the composite reliability and Cronbach's alpha values [37, 38]. Table V shows that all variables have a Cronbach value>0.7, so it can be said that all of these variables are reliable [37, 38]. The unidimensionality test is indicated by the value of composite reliability and Cronbach's alpha. Table V shows that all constructs meet the unidimensionality requirements because the composite reliability value is>0.7 [37, 38, 42]. The AVE value evaluates the convergent validity of a variable with its reflective indicator. Table V shows the AVE value of each variable is greater than 0.50, so it can be seen that all variables have fulfilled the convergent validity requirements [38, 43].

Discriminant validity can be seen in the Fornell-Larcker Criterion value, which is a method that compares the root value of the AVE of each variable with the correlation between other variables in a path model being tested [38, 39]. Table VI shows that all AVE root values (Fornell-Larcker Criterion) for each variable are greater than the correlations between variables. So, it can be seen that all the variables tested have met the criteria of validity and discriminant validity.

TABLE VI: RESULTS OF THE DISCRIMINANT VALIDITY ANALYSIS

	MT	**MD**	**LA**	**The Root of AVE**
MT	0.760			0.820
MD	0.674	0.620		0.838
LA	0.554	0.567	0.616	0.727

3) Validity analysis of virtual laboratory-based job sheet

The validity data obtained from the validation sheet filled in by the validator for each aspect was then analyzed using Aiken's V analysis. This test was carried out for each validity aspect/variable, namely learning materials, learning media, and language. The analysis results of the VLBJS Validity Test from all validity aspects/variables are presented in Table VII.

TABLE VII: RESULTS OF THE VLBJS VALIDITY ANALYSIS

Indicators	Aiken's V Value	Average of V Value	Categorize
Learning Materials			
MT.1	0.88	0.845	Valid
MT.2	0.83		Valid
MT.3	0.92		Valid
MT.4	0.75		Valid
Learning Media			
MD.1	0.92	0.860	Valid
MD.2	0.75		Valid
MD.3	0.88		Valid
MD.4	1.00		Valid
MD.5	0.75		Valid
Language			
LA.1	0.83	0.865	Valid
LA.2	0.83		Valid
LA.3	0.92		Valid
LA.4	0.88		Valid

The validity of the learning material aspects is performed by experts in power electronics learning materials. The validation assessment data were obtained from validators through a validity instrument. The validation process by validators was conducted after they read and observed the contents of the VLBJS. The results of the VLBJS validity analysis presented in table VII show that the average value of V obtained is 0.845 with a valid category, all indicators validated based on validity instruments all indicators obtain a value of V≥0.75 which means valid. Thus, it can be seen that VLBJS for the learning process of the Power Electronics Practicum is stated to be valid in the learning material aspects.

The validity of the learning media aspects is carried out by learning media experts, especially practicum learning media. The validation assessment data were obtained from validators through a validity instrument. The validation process by validators was conducted after they read and observed the contents of the VLBJS. The results of the VLBJS validity analysis presented in table VII show that the average value of V obtained is 0.60 with a valid category. all indicators validated based on validity instruments obtain a value of V≥0.75 which means valid. Thus, it can be seen that VLBJS for the learning process of the Power Electronics Practicum is declared valid in the learning media aspects.

The validity of the language aspects is performed by experts in language and academic writing. The validation assessment data were obtained from validators through a validity instrument. The validation process by validators was conducted after they read and observed the contents of the VLBJS. The results of the VLBJS validity analysis presented in table VII show that the average value of V obtained is 0.89 with a valid category. all indicators validated based on validity instruments obtain a value of V≥0.75 which means valid. Therefore, it can be seen that the VLBJS for the learning process of the Power Electronics Practicum is declared valid in the language aspects. Thus, it can be seen that based on the results of the analysis of validity testing of VBLJS in the learning process of power electronics practicum for vocational education students in the field of industrial electrical engineering, it is declared valid.

B. Discussion

The VLBJS is one of the practicum learning media that contains guidelines for conducting practicums using a VL in the learning process of the Power Electronics Practicum. The VLBJS in the practicum learning process plays a role in assisting students to be able to carry out the practicum learning process using a VL properly and independently [12], [36]. Thus, the learning experience gained by students in the learning process using a VL is relatively the same as the experience in the learning process in a real laboratory. This VLBJS is prepared based on the curriculum and learning materials in the learning process of the Power Electronics Practicum for Vocational Education students in the field of Industrial Electrical Engineering in Higher Education. Before utilization, this VLBJS must undergo various testing phases. One of them is the validity test which aims to ensure the VLBJS is suitable for use as a learning media and can function properly [16, 35].

The validity test analysis of the VLBJS is carried out in three validity variables, namely learning materials, learning media, and language [16, 35]. Each variable consists of several indicators. The learning material aspect consists of 4 reflective indicators, the learning media aspect consists of 5 reflective indicators, and the language aspect consists of 4 reflective indicators. The analysis results of indicator measurements (outer model) using PLS-SEM analysis can be seen that all indicators of each variable meet the assumptions and criteria of validity & reliability. This shows that each indicator is valid and reliable in showing the measurement results of each variable. Thus, the measurement data using a research instrument consisting of three validity aspects can be used as data analysis for testing the VLBJS validity. This is in line with previous research by other researchers who also found that several variables meet the criteria to be used as a reference in testing the validity of job sheets, worksheets, or lab sheets. These variables include (1) learning material; (2) learning material and language variables; (3) learning material, display, and ease of use variables [12, 32, 34].

The research results show that the developed VLBJS is valid to be used as a learning media in the power electronics practical learning process. The valid VLBJS is used to assist students and lecturers in using VL in the learning process. This is consistent with previous research by other researchers who also found that VLBJS is valid to be applied in the learning process [15, 36]. However, the study only considered the learning material variable and has not yet considered the learning media or language variables. Another study that considered the learning material, learning media, display, ease of use, and language variables in the validity test analysis of VLBJS also found that VLBJS is valid to be used in experimental learning using VL [27, 30, 44, 45]. Furthermore, subsequent research even shows that valid VLBJS can be an effective learning media in helping students understand practical learning concepts.

In this study, The VLBJS is declared valid in terms of learning material, learning media, and language aspects. The learning material aspect functions to ensure that VLBJS is relevant to the curriculum and syllabus. The learning media aspect functions to ensure that VLBJS can function well as a learning media when used by meeting interactive, practical, efficient, and effective criteria. Meanwhile, the language aspect functions to ensure that VLBJS meets the rules of scientific writing and grammar. It also functions to ensure that VLBJS uses language that is appropriate for the student's level of understanding.

The VLBJS which was compiled based on the needs of learning media for the practicum learning process using a VL is declared valid. Thereupon, it can be used as a practical learning media for vocational education students in the field of industrial electrical engineering, especially in the learning process of power electronics practicum. This valid VLBJS is expected to optimize the implementation of practical learning using VL, especially in achieving student learning objectives and outcomes.

V. Conclusion

The VLBJS is one of the practicum learning media that functions as an implementation guide of practicum activities in the learning process for vocational education students. VLBJS plays a role in optimizing the practical learning implementation that uses virtual laboratories in remote learning. The results showed that the VLBJS which was developed for the learning process of power electronics practicum using a virtual laboratory met the valid criteria. VLBJS as a whole has proven valid in terms of learning materials, learning media, and language aspects. Thus, based on the results of the validity test analysis, VLBJS can be used as a practicum learning media to help students optimize the learning process of power electronics practicum using a VL for vocational education students in the field of industrial electrical engineering.

VI. Limitations And Future Work

This study discusses the validity test analysis of the VLBJS for the power electronics practical course, however, there are limitations such as the small number of validators and the use of only one type of VL in the VLBJS. Further research should involve a larger number of validators to confirm the validity of the VLBJS before its implementation in a wider range of laboratory learning processes. The various types of VLs that can be applied in laboratory learning provide opportunities for further research on the VLBJS using different types of VL applications based on the needs and characteristics of the course. Additionally, a new approach should be developed to evaluate the validity of the VLBJS that is more sophisticated and relevant.

Conflict of Interest

The author declares no conflict of interest.

Author Contributions

D.T.P.Y., H., H.Z., and M.K. conduct research conceptualization, D.T.P.Y., M.K. analyze and determine research methods, H.A. collect research data; D.T.P.Y., H.Z., and A prepare original draft; H.Z., M.K., and H. did the editing and visualization; all authors had approved the final version.

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