Development of Digital Literacy Performance Items to Improve Digital Electronics Competence of Vocational School Students

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Abstract. This study aims to analyze and synthesize the development of performance items to improve digital literacy instruments using classical Test Theory and Item Response Theory by looking at the fit model index results on digital literacy instruments of Electrical Engineering vocational students. Research products produce a set of digital literacy instruments that can be used as a tool to measure student performance in using digital literacy instruments. This study uses quantitative methods, on digital literacy instruments to measure the performance of Electrical Engineering vocational students. The steps of instrument preparation begin with designing several variables, developing indicators, arranging instrument grids, compiling several indicators, making improvements to some suggestions from experts, validating theories by experts, and refining, and writing instruments consisting of several items and validation theoretically and empirically. The number of performance items is 39 items, and the number of samples is 638 students. The number of items about the ability of digital electronics theory is 40 items. The study produced eight indicators, namely LD1-LD8. Normality testing using Q-plot shows normal results by observing diagonal lines, spreading evenly, and not forming patterns. The X-LD variable produces LD1 (0.052), LD2 (0.761), LD3 (0.701), LD4 (0.693), LD5 (0.688), LD6 (0.744), LD7 (0.621), and LD8 (0.624), so it can be said that the 8 indicators are normal or valid. Variable y-KT has 1 indicator is not normal or Invalid, namely KT1 ($0.490 < 0.5$) and 3 indicators are valid or normal with the results of KT2 ($0.644 > 0.5$), KT3 ($0.703 > 0.5$) and KT4 ($0.748 > 0.5$). Cronbach's alpha variable values are X-LD ($0.829 > 0.5$) and Y-KT ($0.679 > 0.5$). The value of the path coefficient is 0.092 and the p- value is 0.005 so that the hypothesis testing can be expressed as significant and H1 is accepted. Fit model index on SRMS obtained $0.079 < 0.080$, so the data can be expressed better.

Keywords: Digital literacy · Validity · reliability · Normality · Cronbach's alpha · Fit model index

1 Introduction

The development of literacy is currently growing, both domestically and abroad. Digital literacy design began to emerge in 1990. Gilster explained that digital literacy is

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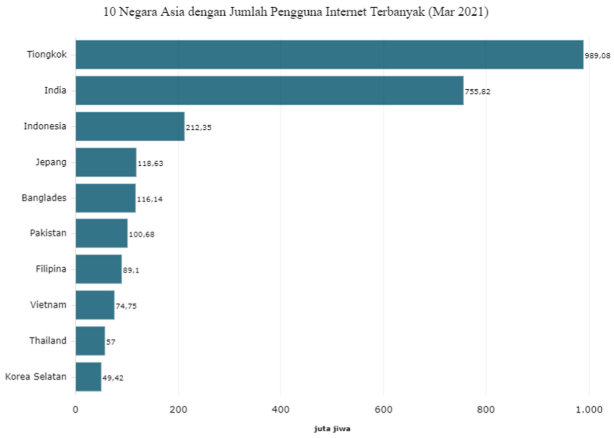

Fig. 1. The highest number of internet users from 10 Asian countries [4].

the ability to understand and use information from various digital sources. The current term literacy is not only able to read but can create, and implement information systems [1]. Kompas [2] wrote that internet users in Indonesia at the beginning of 2021 reached 202.6 million people, the number increased by 27 million people (15.5%) compared to 2020. The population in Indonesia reached 274.9 million people, and internet users at the beginning of 2021 reached 73.7%. Based on [3], it was explained that the students did online learning during the pandemic, as for the number of students/students who did learning from home. From the survey conducted by APJII, it is known that at the level of higher education there are 6.3 million internet users, and at the level of SMA/SMK/MA/equivalent, there are 11.3 million internet users. As for when viewed from the media used in obtaining information.

Based on [4], it is clear that Indonesian internet users are in 7th place with 62.6% of users, and Malaysia is in 3rd place with 81.4%. From the survey results, both conducted APJII and internet user statistics are increasing. This makes it clear that digital literacy is needed in meeting the needs to develop students both for everyday life and for the needs of subject matter, especially digital electronics because digital electronics requires additional media, namely digital literacy both online and offline. The 10 Asian countries with the highest number of internet users can be seen in Fig. 1.

The Nasional Institut Literasi [5] describes literacy as "individual abilities that include: reading, writing, speaking, counting and problem-solving/case solving at an expert level used in performance, family and community". Jack Goody explained that the notion of literacy is a person's ability to read and also write [6]. [7] explains that the meaning literacy is the ability of a person to write and read. [8] defines literacy as the ability to read and write, improve cognitive and psychomotor aspects, critical thinking in solving cases, as well as the ability to deliver sparingly that can improve development and participate in blending into the community. [9] mentions that digital literacy is an ability used in understanding and use information from several formats, in literacy design not only discusses the ability to read but also read with meaning and understanding. Donohoe & [10] explained that digital literacy is needed in Chemistry learning and that in

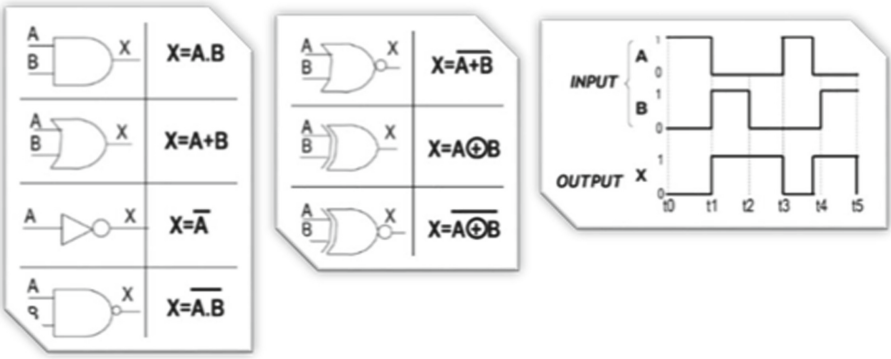

Fig. 2. Logic gates and timing diagrams.

Generation Z students, digital literacy is a medium to access or search for information related to education, digital literacy can help improve quality and lead to better learning in chemistry teaching on practical, cognitive, and social aspects. [11] explained that in general, digital literacy students are in the category of high-level groups, from the results of tests conducted digital literacy has significantly higher interest and there is a positive correlation between learning outcomes and digital literacy. [12] explains that the results of the survey data analysis show that school teachers and college lecturers produce higher digital literacy and significantly exceed the average adult population reaching 52% of the probability of 100%, school teachers -87%, college lecturers-88%. Some experts explain that digital literacy has several abilities including skills in operating, thinking skills, and cooperation skills. The results of several previous studies obtained significant and positive results on abilities, skills learning outcomes, and training outcomes.

The term classical Test Theory can also be called classical Test Theory which has been widely used in the process of analyzing the item of the problem. Advantages and disadvantages can be calculated at the level of difficulty and discrimination in the subject matter in classical Test theory that can be used in calculating manually. Weaknesses and deficiencies in the degree of difficulty and discrimination against acquired items depend on the sample [13]. Another weakness and weakness of classical Test Theory is that it is more test-oriented than item- oriented. Classical Test theory does not pay attention to how respondents respond to items. How it is applied to the ability of respondents is seen from the total score of the number of correct answers from respondents that is, without distinguishing whether the item answered correctly by the respondent is an easy or difficult item. Classical Test Theory has a true score model expressed $X = T + E$, with X as the manifest variable or also called the observable score obtained from the test item, T as the latent variable or also called the invisible true score, and E as the error component [13]. In the selection process on grains based on the correlation between grains maintain some grains that are highly correlated with other grains and discard some low correlated grains.

IRT is a model-based measurement with ability level estimation depending on test-taker response and test grain parameters. The IRT is structured from the notion that the probability of a respondent correctly answering an item can be described as a simple

function of the respondent's position on a latent trait, coupled with one or more parameters that are characteristic of the item [14]. This study aims to analyze and synthesize the results of the development of performance items to improve digital literacy instruments of digital electronics competence in SMK students by looking at the results of the fit model index.

Digital electronics competence will be used as an instrument of theoretical ability for vocational school students. Digital electronics materials include Gates and, or, NOT, NAND, NOR, EX-or, EX-NOR, combination circuits, timer diagrams, and logic gate circuit designs. Some 40 multiple-choice items, gate circuits, and time diagrams are shown in Fig. 2.

2 Method

The research method used is quantitative research. Starting with field studies, observations, and comparisons between categories, phenomena, and situations based on various assessments, such as inductive, deductive, and verification studies of an indicator until data is obtained as an instrument. The research steps can be seen in Fig. 3.

Field study is one of the methods of data collection in quantitative research that does not require in-depth knowledge of the literature used and certain abilities on the part of the researcher [15]. Field studies are conducted to decide against research based on context [16]. In the field, research is carried out outdoors. Observation is carried out to know something from some case that corresponds to the knowledge and ideas of an idea.

With knowledge or ideas that have been previously observed, and to obtain some necessary information useful to continue a research. The process of finding or obtaining some objective, real, and accountable information.

After conducting field studies and making observations, then make comparisons obtained from several categories that produce a phenomenon. Then some of these phenomena carried out several studies related to research. The results of the study were verified to obtain several indicators that would be used as instruments. To obtain the instruments produced and used to measure the competence of vocational high school

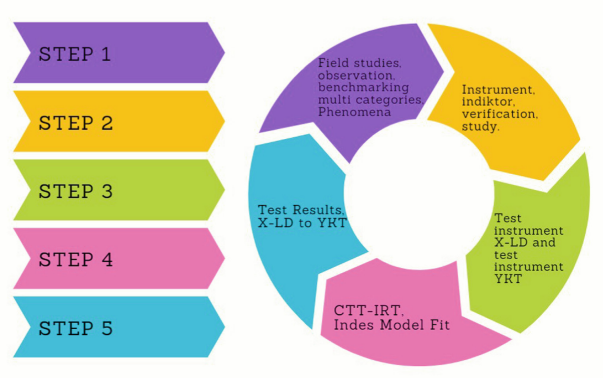

Fig. 3. Research steps.

students in digital electronics subjects, test instruments using CTT and IRT by taking into account the results of the fit model index.

3 Results and Analysis

The study produced eight indicators of digital literacy performance: (LD1) ability to understand and use information, (LD2) ability to find information, (LD3) ability to convey information, (LD4) ability to analyze information, (LD5) ability to evaluate information, (LD6) ability to develop creativity, (LD7) ability to build information networks, and (LD8) ability to evaluate the truth of information. The details of each indicator include: LD1 indicator produces 4 sub-indicators of 4 performance items, LD2 indicator produces 4 sub-indicators of 7 performance items, LD3 indicator produces 4 sub-indicators of 4 performance items, LD4 indicator produces 4 sub- indicators of 5 performance items, LD5 indicator produces 3 sub-indicators of 3 Performance items, LD6 indicator produces 5 sub-indicators of 5 performance items, LD7 indicator produces 3 sub-indicators of 3 Performance items, and LD8 indicator produces 5 sub-indicators of 6 performance items. Variable ability theory produces 4 indicators, namely: (KT1) interpret the atomic model of semiconductor materials, characteristics of diodes and apply diodes, (KT2) test diodes, transistors on electronic circuits and determine the Working point on transistors, (KT3) apply Boolean algebra on digital logic gates, various logic gates, and (KT4) build various basic gates of logic circuits. Normality test results using boxplot which is used to measure the level of digital literacy performance, normality testing can be done by observing diagonal lines. The test results can be seen in Fig. 4.

In addition to observing the results of position values around diagonal lines, position values above zero and below zero and spreading evenly and not forming patterns, the results show that the indicators of digital literacy (X-LD) and theoretical ability (Y-KT) can represent and can be used. From some of the indicators produced above, modeling testing can be described as a modeling structure as in Fig. 5.

From Fig. 2 it is explained that the independent variable X-LD has several indicators of digital literacy (LD1-LD8). While the dependent variable Y-KT has an indicator of theoretical ability (KT1-KT4). The structure of the described model can be described in Fig. 6.

The results of outer loading in Table 1 explain that the data obtained is normal or valid if > 0.7, so that the indicators on the variables used in the study can represent variables. If it is abnormal or Invalid < 0.7 then the indicator on the variable cannot represent the variable used. The results obtained here are 4 indicators that can not represent the variable x-LD because the value is < 0.7, while the details include LD1 (0.517), LD5 (0.643), LD7 (0.537), LD8 (0.577). There are 4 indicators that can represent the variable X-LD because its value > 0.7, consisting of LD2 (0.805), LD3 (0.760), LD4 (0.719), and LD6 (0.712). The variable Y-KT has 1 indicator that is not normal or invalid and can not represent the variable Y-KT that is KT1 with a result of $0.585 < 0.5$), so the indicator of the interpretation of the atomic model of semiconductor materials, characteristics of diodes, and the application of diodes in the ability of theory in vocational high school students to the ability of digital literacy does not affect the learning of various logic gates in digital electronics, because the material is more directed to analog electronics. The

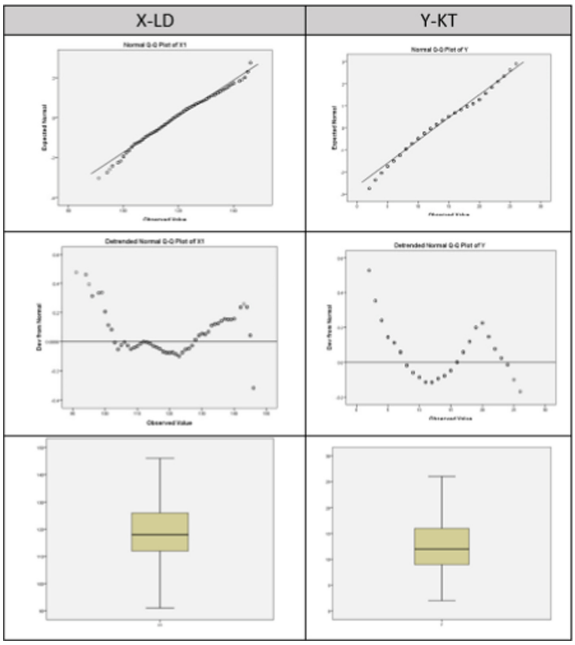

Fig. 4. The results of the normality test of digital literacy variables X-LD and the ability of Y-KT theory using Boxplot.

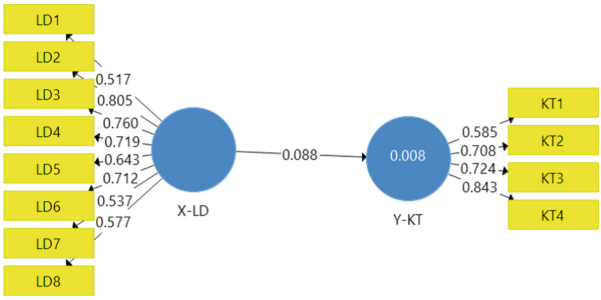

Fig. 5. Model Structure.

three indicators KT2, KT3, and KT4 have normal or valid results > 0.7 of the observation results include 0.708, 0.724, and 0.843.

A reliability test is used to see the level of reliability of research variables. The test results are described in Fig. 7.

From the test results obtained Cronbach's alpha in each variable > 0.60. The value of each variable x-LD produces 0.829 and variable y-KT produces 0.712, so it can be concluded that all variables have high reliability.

Mediation analysis, observing the direct or indirect influence on each variable, namely the variable x-LD on Y-KT by looking at the level of significance through

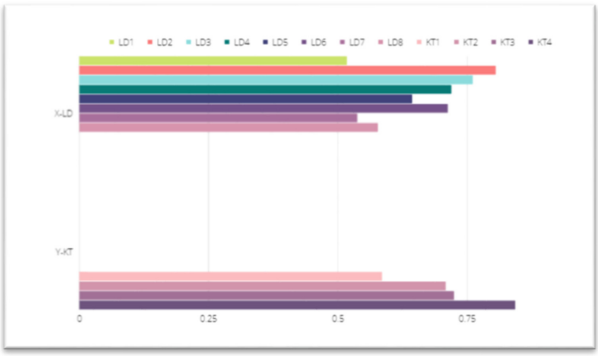

Fig. 6. Outer loading.

Table 1. Saturated Model and Estimated Model Value

	Effect Size Value	Criterion
SRMS	0.078	0.078
D_ULS	0.472	0.472
d_G	0.145	0.145
Chi-Square	716.239	716.239
NFI	0.744	0.744

p-value, should be < 0.10. The results of these observations produce a level of significance by proving the value of the path coefficient 0.092 and p-value 0.005 so that the hypothesis testing can be declared significant and H1 accepted. The fit model index using SEM-PLS is a measure of the hypothetical model by predicting the correlation matrix in a sample. As shown in Table 1.

From Table 1 it can be observed that the way to compare the correlation matrix model with the data. From the results of statistical analysis that the fit model index is obtained by observing the results on SRMS (Standardized Root Mean Square Residual). From the test results obtained SRMS value (0.078). The smaller the SRMS value < 0.080 in the data, the better.

4 Conclusion

Based on the analysis results in the study can be concluded as follows: (1) produce 8 indicators, the ability to understand and use information/LD1, the ability to find information/LD2, the ability to convey information/LD3, the ability to analyse information/LD.4, the ability to evaluate information/LD5, the ability to develop creativity/LD6, the ability to build information networks/LD7, and the ability to evaluate the truth of information/LD8. (2) normality test using a plot shows normal results by observing the value is on a diagonal line, spread evenly, and does not help the pattern, (3) 4 indicators cannot

represent the variable x-LD because the value < 0.7 includes LD1 (0.517), LD5 (0.643), LD7 (0.537), LD8 (0.577), and 4 indicators that can represent the variable x-LD value > 0.7 LD2 (0.805), LD3 (0.760), LD4 (0.719), and ld6 (0.712). Variable Y-KT there is 1 indicator that cannot represent the variable y- KT IE KT1 with a result of 0.585 < 0.5). The indicators KT2, KT3, and KT4 adapt to represent these variables with values > 0.7, including 0.708, 0.724, and 0.843. SRMS value 0.078 < 0.080. So the data is getting better.

Authors' Contributions. In this work, Nur Kholis is responsible in curriculum development and data acquisition as well as Bambang Suprianto and Munoto Munoto are PIC of data analysis and evaluation.

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