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Constructing Digital Literacy Instrument and its Effect on College Students' Learning Outcomes

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This research aims to develop and test the effectiveness of digital literacy instruments on students' learning outcomes. This study is a mixed method that combines survey and pre-experimental research. The survey research was conducted through a quantitative approach using a questionnaire as the research instrument with assessed numerical items. The survey respondents consisted of 318 students from various universities in Indonesia who were taken through cluster random sampling technique. The implementation of the instrument was carried out through a pre-experimental design to 103 students to test the instrument's effectiveness. The confirmatory factor analysis result shows that the model forms three factors, which are factor 1 (communicating digital content), factor 2 (exploring digital content), and factor 3 (creating and using digital content). The result of the goodness of fit model shows that the instrument has met all the criteria with a value of $X^2/df = 1.642$ (<3.00), RMSEA = .079 (≤ .08), GFI = .900 (≥ .90), AGFI = .825 (≥ .90), TLI = .939 (≥ .90), and CFI = .951 (≥ .90). Empirically the instrument has good discrimination power so that it can measure students' digital literacy skills at different academic ability levels (Sig. <.05). In addition, the instrument has been effectively used to measure and predict student learning outcomes (R square = .255, Sig. < .05). The instruments' result is relevant to current conditions and can further explore students' digital literacy skills.

Keywords: digital literacy instrument, students' learning outcomes, college students, constructing digital literacy, learning

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INTRODUCTION

The era of digital technology plays a vital role in every aspect of life, including learning activities (Martin & Grudziecki, 2006). This era shows the importance of digital literacy due to digital literacy being a fundamental and essential skill needed to survive in a very competitive world, including education (Phuapan, Viriyavejakul, & Pimdee, 2016; Sharp, 2018). Digital literacy means more than just having technical skills to operate digital devices properly. Digital literacy requires a variety of skills in carrying out tasks in a digital environment, such as information processing skills, cognitive skills, and socio-emotional skills, so that students can use the digital environment effectively (Kaeophanuek et al., 2019). The current era of technology demands digital capabilities, including digital literacy, as necessary, which becomes essential for society (Tsankov, N., & Damyanov, 2019; Saputra & Al Siddiq, 2020), and even Liu et al (2020) stated that it is impossible to conduct an effective educational process in an era of accelerated digitalization without digital literacy.

Digital literacy is the ability to observe, select, open, find reading sources from websites, determine reading, including storing and sending reading material and providing suggestions or comments on certain websites, including on social media (Leu et al., 2007; H. A. Spires, C. Medlock Paul, 2018; Cordell, 2013). Digital literacy is related to the ability and capacity to use digital means to access, manage, integrate, analyze, and synthesize digital information (Kaeophanuek et al., 2018). This definition shows that digital literacy skills are related to cognitive, technical, and sociological interactions. It can lead to social interactions through the opening of online communication networks, which usually occurs through social media (Abdelraheem & Ahmed, 2018). In the context of establishing digital communication, digital literacy skills can be used to facilitate learning activities by providing suggestions, input and narratives related to specific learning topics.

So far, the context of digital literacy has different scopes according to the perspective of different researchers. According to Martin & Grudziecki (2006), there are three digital literacy levels, namely digital competence, digital usage, and digital transformation. On the other hand, Eshet-Alkalai (2004) divides digital literacy into six skills: photo-visual digital skills, digital reproduction skills, branching digital skills, digital information skills, social-emotional digital skills, and real-time digital skills. Meanwhile, Phuapan et al (2016) divides digital literacy into six indicators; they access, manage, integrate, evaluate, create, and communicate information to function in a knowledge society. This difference probably occurs due to the broad definition of digital literacy. ALA (American Library Association) in 2013 defined digital literacy as cognitive and technical skills needed to find, understand, evaluate, create, and communicate digital information in various formats (Cordell, 2013). In addition, the European Information Society defines digital literacy as an attitude, awareness, and individual ability to use digital tools and facilities appropriately to identify and create media expression for constructive social action (Martin & Grudziecki, 2006).

The broad definition of digital literacy caused many types of assessment instruments to emerge, which function to measure this ability. A large number of instrument's types

caused varied arguments for the validation and effectiveness of their measurements. As a result, each instrument used tends only to measure a part of the digital literacy aspect instead of a whole. This condition can be seen from Powell (2017), which measures digital literacy with six aspects: defining, accessing, evaluating, managing, integrating, creating, and communicating. Meanwhile, Salim et al (2020) only measures digital literacy dimensions through two aspects: the access and competence aspect, including information, communication, content-creation, social-emotional, and problem-solving. Such conditions mean that each measurement of digital literacy does not reflect all aspects and tends to be partial following the aspects the researcher wants to study. The conditions which were described above make it important to develop digital literacy instrument that is appropriate to the local context. This aims to prevent misinterpretation of the research subject which can make the results of the research ambiguous or inaccurate. The facts show that existing digital literacy instruments are mostly only adopted and re-translated so the construct and content validity tests have not been carried out during the implementation. Thus, it can be concerning due to the instrument being not in accord with local conditions and circumstances and causing the results or the assessment of said instrument inaccurate.

In Indonesia, several researchers have conducted some assessments to reveal students' digital literacy skills. Salim et al (2020) have measured two aspects of digital literacy, namely aspects of access and competence. This previous study shows that the instruments used are adopted from other researchers and have not carried out the construct analysis and content validity. Research Alamsyah (2017) that studies digital literacy skills based on three aspects, namely, information skills, connection skills, and redesign skills, did not use instruments with good instrument validity. Thus, to get a comprehensive framework regarding digital literacy skills, it is necessary to develop instruments that can measure all aspects of digital literacy according to the context of the situation and condition in Indonesia (Rahmah, 2015). Therefore, it is necessary to develop digital literacy instruments that are appropriate to the local context and conditions. This study aims to develop a digital literacy instrument and test its effectiveness on students' learning outcomes.

METHOD

Research design and participants

This study used a survey research design (Ponto, 2015;Creswell, J. W., & Creswell, 2017). Survey research is a method of collecting information from a sample of individuals through their responses to the questions given to them. In this study, the research method used was quantitative research using a questionnaire with assessed numeric items (Ponto, 2015). The research sample was 318 students who participated in lectures using e-learning since the even semester of the 2020/2021 school year. The sample distribution comes from 7 different universities in Java and outside Java. The respondents' composition consisted of 286 women (90%) and 32 (10%) men. The comparison of male and female respondents cannot be controlled because the sample was taken using random cluster sampling (Fraenkel, J. R., Wallen, N. E., & Hyun, 1993) by considering the representation of each region in Indonesia and students' level in their

study. Students are in the age range of 18 to 22 years, ranging from the first year to the fourth year. The distribution of respondents aims to obtain comprehensive responses.

Instrument

The digital literacy component is adopted from various sources, summarized into one instrument and adapted to the current condition in Indonesia (Martin & Grudziecki, 2006; Spires & Bartlett, 2012). The instrument is arranged in the form of a statement with four answer items, namely 1 = never at all, 2 = sometimes (once a week), 3 = quite often (once or twice a week), and 4 = very often (every day). The instrument is then made in digital format using Google Form, which consisted of 18 statements and distributed to respondents.

Instrument's Specifity

Instruments must contain items that have specificity to reflect their validity. The comparison of the correlation between items with other items on the same factor (A) and the correlation between items with other items on the whole instrument (B) shows that the majority of items in A (range .33-.80) are higher than B (range .14-.40). It provides evidence that the instrument has specificity and is considered a special measure to measure the particular factor.

Reliability

To test the reliability of the instrument, the Alpha Cronbach approach was used. The Cronbach Alpha reliability analysis results showed that the if item deleted value of each factor ranged from .616 to .933, while the if item deleted value of all instruments ranged from .839 to .869. The overall value of the reliability of the calculated instrument was .861. This data provides evidence that all items in the instrument are reliable.

Data Analysis

This study analyzed data using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) (Hurley, A. E., Scandura, T. A., Schriesheim, C. A., Brannick, M. T., Seers, A., Vandenberg, R. J., & Williams, 1997). EFA is carried out to determine how many factors are formed and each item's grouping in the instrument. EFA is carried out through analysis of 18 statement items using Principal Component with Varimax rotation. Before the EFA analysis, the KMO test and the Bartlett Test were performed. If the test results show the value of KMO > .05, then EFA can be continued (Hidayat et al., 2018). To confirm the EFA results, CFA was carried out. The goodness of fit of the CFA results was assessed based on the value of chi-square ($p > .05$), Comparative Fit Index (CFI > .90), Tucker Lewis Index (TLI> .90), Root Mean-Square Error of Approximation (RMSEA < .08), Goodness of Fit Index (GFI > .90), and Adjusted Goodness of Fit Index (AGFI > .80) (Hidayat et al., 2018). EFA analysis was assisted using the SPSS program version 24 (Yong, A. G., & Pearce, 2013), while the CFA analysis used the AMOS program version 21 (Shek & Yu, 2014).

Effectiveness of the Instrument

To test the effectiveness of the instrument, the implementation was carried out on 103 students at the University of PGRI Madiun, Indonesia. The implementation uses a

modified pre-experimental design (Campbell, D. T., & Stanley, 2015). The measuring of digital literacy skills is carried out before learning activities, while the measuring of student learning outcomes is after the entire learning activities were carried out. The implementation of the instrument is done to find out two things, namely (1) the discrimination power of the instrument, which was found out through the analysis of students' digital literacy skills profile and the analysis of digital literacy abilities based on the digital literacy level, and (2) the effectiveness of the instrument to determine the relationship and influence of digital literacy in improving student learning outcomes.

The analysis of the discrimination power of the instrument is carried out descriptively to determine the digital literacy profile of students. The score for digital literacy skills is classified into 5 categories, namely very low (score = 16-31), low (score = 32-47), moderate (score = 48-63), high (score = 64-80) and very high (score ≥ 80) which adopts the digital literacy assessment model developed by Alamsyah (2017). The profile of digital literacy skills is displayed in the form of diagrams and box plots to determine the distribution of data in each category. In addition, to strengthen the discriminatory power test, an analysis of the differences in students' digital literacy skills was carried out on different academic abilities levels. Academic abilities are categorized based on the Grade Point Average as follows; low academic ability (GPA <3.00) and high academic ability (GPA ≥3.00).

In determining the instrument's effectiveness, an analysis of the differences in student learning outcomes is conducted in each digital literacy category. Student learning outcomes are measured after a digital literacy questionnaire is given in lectures. Furthermore, a regression analysis is carried out to determine the relationship between digital literacy skills and students' learning outcomes. The analysis of digital literacy skills on students' learning outcomes uses one-way anova analysis (Hesamian, 2016), while the regression uses linear regression analysis (Uyanık & Güler, 2013).

FINDINGS AND DISCUSSION

Exploratory Factor Analysis (EFA)

EFA is carried out on 18 statement items in the instrument. EFA uses the principal component method with varimax rotation. Before the EFA, the KMO prerequisitetest and the Bartlett Test were carried out with the results, as shown in Table 1.

Table 1
KMO and Bartlett's Test Analysis Result

Variable		Value
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.843
Bartlett's Test of Sphericity	Approx. Chi-Square	2301.348
	df	153
	Sig.	.000

Table 1 reveals that the KMO MSA value is > .05, which is .843. It shows that the use of EFA has fulfilled the number of sampling for analysis. Based on Table 1, it is also known that the Sig. for Bartlett's Test of Sphericity is <.05. These results reveal that the instrument has met the factorability, so the analysis can be continued using EFA

(Zulkepli, Sipan, & Jibril, 2017; Surastina, 2018). The factor analysis results using the principal component method and the rotation method using varimax with Kaiser Normalization resulted in 3 factors. These factors are later named into factor 1 (communicating digital content), factor 2 (exploring digital content), and factor 3 (creating and using digital content). These formed factors consist of 18 statements that reflect students' attitudes towards digital literacy. Communalities, variances and factors formed from the EFA results are shown in Table 2.

Table 2
Communalities and variance of each formed factor

Factor and Items	λ	%
Factor 1 (Communicating Digital Contents)		18.25
I write positive responses regarding assignments/discussions regarding information in online discussion forums (P9)	.877	
I respond to discussions by actively providing feedback in online discussion forums (P10)	.856	
I write responses to assignments in good Indonesian through online discussion forums (P8)	.853	
I write a report or paper to be uploaded into eLearning (P11)	.768	
Factor 2 (Exploring Digital Contents)		17.34
I use presentation software (MS PowerPoint, storyline, video and the like) to do assignments and supporting lectures (P17)	.771	
I use writing software (MS words and the like) to do assignments and supporting lectures (P16)	.757	
I read important information from digital contents (online newspapers, research publications, blogs or videos) (P2)	.639	
I know how to use cell phones and laptops in order to read e-books, journals or news portals (P12)	.583	
I am able to find digital content from various sources (Example: youtube, google / mozilla, research gate, sage etc.) (P1)	.561	
I look for all the lecture materials I need through contents on the internet (P4)	.479	
I download course materials (ppt, pdf, words) in e-LMA or search engines (P3)	.451	
I use games and music applications in my spare time (P18)	.369	
Factor 3 (Creating and Using Digital Contents)		16.00
I use special software to support lectures (for example: Mendeley, endnote, mindmaple lite, zoom, Mevideo,) (P13)	.763	
I use analysis software (SPSS, Excel, Minitab, and the like) to do assignments supporting lectures (P14)	.733	
I make videos with special software (Camtasia, animoto, WeVideo, Powtoon, or others) supporting lectures (P7)	.713	
I use drawing software (paint, Photoshop, CorelDraw, and the like) to do assignments supporting lectures (P15)	.685	
I have an email that I used to facilitate the communication process (P5)	.510	
I have specific software knowledge through the internet to organize assignments or to convey my ideas (P6)	.434	
Overall		51.06

Based on Table 2, it is known that factor 1, communicating digital content, has four items with loading factor ranging from .768-.877. Factor 2 consists of 8 items with loading factors ranging from .369-.771. Meanwhile, factor 3 consists of 6 items with loading factors ranging from .434-.763. The total variance formed from these three factors is 51.06%, with details of factors 1, 2 and 3, respectively are 18.25%, 17.34%, and 16.00%. Table 1 also shows that several factors have a reasonably small loading

factor, namely item P18 with a loading factor of .369 and item P6 with a loading factor of .434. The overall results show that the instrument has good construct validity with all communalities values > .3 (Siembida et al., 2018).

The EFA result shows that the instrument has good construct validity because it has a value of commonalities that exceeds .3 (Siembida et al., 2018). These results also indicate that digital literacy instruments are organized into three factors. The three factors of the EFA result has some similarities with the three levels of digital literacy initiated by Martin & Grudziecki (2006), namely digital competence, digital usage and digital transformation. These three factors are later named as communicating digital content (factor 1), exploring digital content (factor 2), and creating and using digital content (factor 3). From these three factors, factor 1 has 4 statement items, factor 2 has 8 statement items, while factor 3 has 6 statement items. The variance formed from these three factors is 51.06%, with the factor that has the most significant variance contribution is factor 1.

Confirmatory Factor Analysis (CFA)

To test the consistency and validity of the factors formed based on factor analysis, confirmatory factor analysis was performed (Tomé-Fernández et al., 2020). CFA analysis was tried out on a sample with 318 students as the total number of respondents with 18 statement items, as in the factor analysis. The following figure shows the confirmatory analysis for 3 factors and 18 statement items using the standardized estimates method (Figure 1).

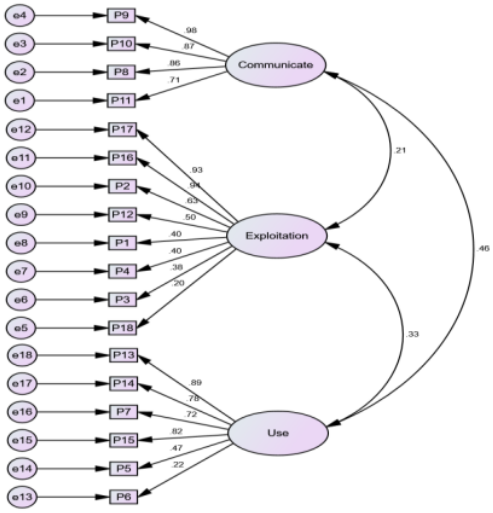

Figure 1
CFA analysis result

To find out the model's result is acceptable or not, the model needs to be compared with the Goodness of fit index criteria (Hidayat et al., 2018; Zainudin et al., 2019; Tungkunanan, 2020). The results of the Goodness of fit index are shown in Table 3.

Table 3
Goodness of fit index analysis result

Goodness of fit index	Cut off value	Result	Criteria
X^2	>.05	313.943	Good
X^2/df	<3.00	2.380	Pretty Good
Probability	≥.05	.000	Pretty Bad
RMSEA	≤.08	.116	Pretty Bad
GFI	≥.90	.753	Pretty Bad
AGFI	≥.90	.681	Pretty Bad
TLI	≥.90	.797	Pretty Bad
CFI	≥.90	.825	Pretty Bad

The Goodness of fit index analysis results in Table 3 shows that all indicators have not met the fit criteria for model acceptance. Therefore, to obtain better results, the model's modification was carried out by selecting the most significant modification indexes (MI) value (Efendi & Purnomo, 2012). The results of the factor analysis after modification are shown in Figure 2.

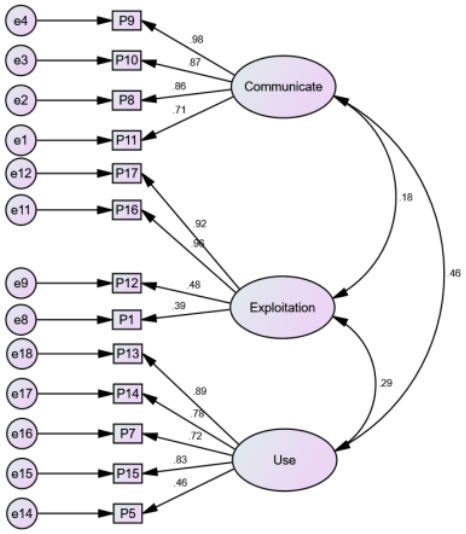

Figure 2
Confirmatory factor analysis result after modification

The goodness of fit index of the CFA results after modification is shown in Table 4.

Table 4
Goodness of fit index factor analysis result after modification

Goodness of fit index	Cut off value	Result	Criteria
X^2	>.05	101.835	Good
X^2/df	<3.00	1.642	Good
RMSEA	≤.08	.079	Good
GFI	≥.90	.900	Good
AGFI	≥.90	.825	Pretty Good
TLI	≥.90	.939	Good
CFI	≥.90	.951	Good

The Goodness of fit in Table 4 shows that the RMSEA score has good criteria, while GFI and AGFI are in good and pretty good criteria (marginal fit). Overall, all criteria meet the fit criteria. Therefore, the results obtained indicate that the model is acceptable. The grouping of factors and loading factor values after the confirmatory analysis is presented in Table 5.

Table 5
Factors formed according to CFA result

Factor	Loading Factor		
	Factor 1	Factor 2	Factor 3
Factor 1 (Communicating Digital Contents)			
I write positive responses regarding assignments/discussions regarding information in online discussion forums (P9)	.98		
I respond to the discussion by actively providing feedback in the eLMA discussion forum (P10)	.87		
I write responses to assignments in good Indonesian through the eLMA discussion forum (P8)	.86		
I write a report or paper to be uploaded later in the eLMA (P11)	.71		
Factor 2 (Exploring Digital Contents)			
I use presentation software (MS power point, storyline, video and the like) to do assignments supporting lectures (P17)		.92	
I use writing software (MS words and the like) to do assignments supporting lectures (P16)		.90	
I know how to use cell phones and laptops in order to read e-books, journals or news portals (P12)		.48	
I am able to find digital content from various sources (Example: youtube, google / mozilla, research gate, sage etc.) (P1)		.39	
Factor 3 (Creating and Using Digital Contents)			
I use special software supporting lectures (for example: Mendeley, endnote, mindmaple lite, zoom, Mevideo,) (P13)			.89
I use drawing software (paint, Photoshop, CorelDraw, and the like) to do assignments supporting lectures (P15)			.83
I use analysis software (SPSS, Excel, Minitab, and the like) to do assignments supporting lectures (P14)			.78
I make videos with special software (Camtasia, animoto, WeVideo, Powtoon, or others) to do assignments supporting lectures (P7)			.72
I have an email that I used to facilitate the communication process (P5)			.46

The consistency test using CFA shows that the three factors formed from EFA did not change. The three factors remain clustered with their respective items (Figure 1). However, based on the first CFA result, there is still low factor loading values as in items P18 (Factor 1) and P6 (Factor 3). Besides, the CFA result does not meet the goodness of fit criteria, so the model needs to be modified (Table 3). After modifying items with a small factor loading value, a different model is obtained from the previous results (Figure 2). Second, CFA shows that 4 items, namely P2, P4, P3, and P18, were eliminated from factor 2. Furthermore, item P6 was eliminated from factor 3, while items for factor 1 did not change. Item P6 is the only item that was eliminated from factor 3. It proves that item P6 is not suitable for inclusion in factor cluster 3. The Goodness of the fit model on the second CFA shows that all parameters such as RMSEA, GFI, AGFI, TLI, CFI, and X^2/df have met the criteria. Therefore, this model is considered appropriate, so the resulting instrument has met good validity. These results reinforce the results of previous research conducted by Spires & Bartlett (2012), which divided digital literacy into three, namely (1) searching for and using digital content, (2) creating digital content, and (3) communicating digital content.

Result of Effectiveness Test

The profile of students' digital literacy skills

The implementation of digital literacy instrument on 103 students of University PGRI Madiun, Indonesia, grouped digital literacy skills into four groups, namely low, quite good, good, and very good. The digital literacy skills of students are shown in Figure 3. Figure 3 shows that the instruments that have been arranged can distinguish students' digital literacy skills. Arifin (2017) supported this result, who reveals that one of the characteristics of a good instrument is that it has discrimination power. The result of this study proves that digital literacy instruments can differentiate students' digital literacy skills. According to Gronlund et al. (2009), one of the characteristics of a good instrument is its usefulness. This study also indicates that the instrument has a level of usefulness in measuring students' digital literacy skills. Testing the quality of the instrument is very important because a good instrument will produce good quality research, and vice versa (Arifin, 2017).

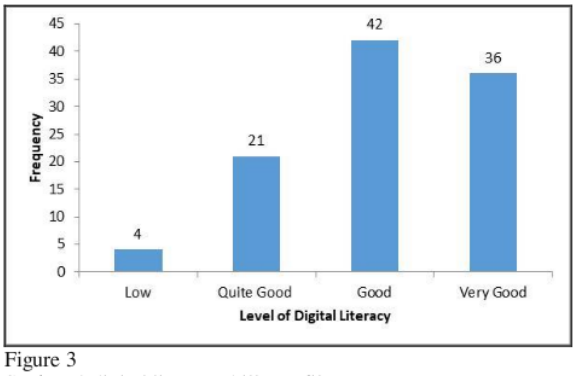

Figure 3
Students' digital literacy skills profile

The students' digital literacy skills profile shows different data distribution at each digital literacy level. This information is obtained from the boxplot, which can determine the variation and distribution of data in research (Darsyah, 2014). The result of the box plot analysis shows the distribution of data at each student's digital literacy level (Figure 4). The different range of each literacy category on students' digital literacy ability data is shown on Figure 4. Figure 4 also shows the difference in ability between the low, quite good, good and very good literacy levels. In addition, the data distribution is evenly distributed for each digital literacy level and is symmetrical, except for the very good literacy level. The data also shows the absence of outliers that are important for the use of further statistical analysis (Ohyver & Tanty, 2012).

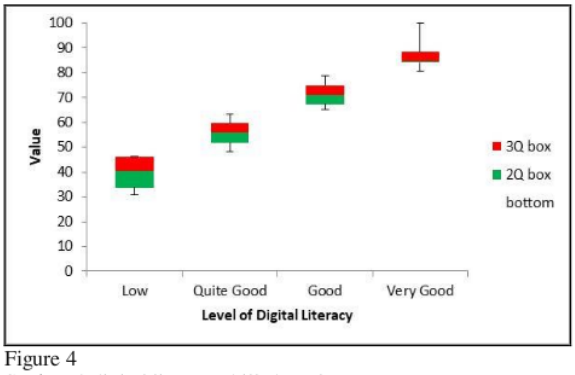

Figure 4
Students' digital literacy skills boxplot

Students' digital literacy on different levels of academic ability

To determine the discrimination power of the instrument, a hypothesis analysis is carried out to determine the differences in digital literacy skills at different academic ability levels. The analysis result of students' digital literacy skills at each level of academic ability, especially on low and high academic levels, is shown in Table 6.

Table 6
Variant analysis result of digital literacy skills on different academic ability level

source	Sum of Squares	df	Mean Square	F	Sig.
treatment	6.9316	1	6.9316	99.9593	1.1102e-16
error	7.0038	101	.0693		
Total	13.9354	102			

The result of the hypothesis analysis in Table 6 shows differences in digital literacy skills for all levels of student academic ability. This result is reinforced by the Post hoc test shown in Table 7, which shows that students' digital literacy skills at a low academic level (A) are different from the high academic ability level (B). The result proves that the digital literacy instrument has an excellent differentiating ability because it can differentiate students' academic abilities. According to Perdana (2018), a good instrument must have discrimination power to differentiate students' abilities at low and high levels. This result indicates that the instrument has met the content standards and empirical analysis to be considered a suitable instrument (Desstya et al., 2019).

Table 7
The post hoc test result of students' digital literacy skills

Treatments pair	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inferfence
A vs B	14.1393	.0010053	** p<.01

Differences in students' learning outcomes on each level of digital literacy

In addition, to check the instrument's effectiveness to differentiate students' academic abilities, the implementation of the instrument also determines the discrimination power of the instrument on students' learning outcomes. The one-way ANOVA analysis shows that there are differences in students' learning outcomes at each digital literacy level (Table 8). The result of the post hoc analysis shows that students with low digital literacy skills have low learning outcomes, students with sufficient digital literacy abilities have fairly good learning outcomes, and students with good and very good digital literacy skills have good learning outcomes. (Table 9). This result indicates a relationship between digital literacy skills and students' learning outcomes (person correlation = 0.505). The higher the digital literacy skills, the higher the students' learning outcomes. The result of this study is reinforced by the results of previous studies, which found that digital literacy affects student academic achievement and student learning achievement (Pagani, Argentin, Gui, & Stanca, 2016; Effendi, Bustanur, & Mailani, 2019). To strengthen this result, a regression analysis is carried out to predict how much digital literacy affects student learning outcomes.

Table 8
The differences of students' learning outcomes on each digital literacy level

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1727.685	3	575.895	11.354	.000
Within Groups	5021.675	99	50.724		
Total	6749.359	102			

Table 9
The post hoc analysis result of students' learning outcomes on each digital literacy level

	Category_DL	N	Subset for alpha = 0.05		
			1	2	3
Duncan[a,,b]	Low	4	65.5000		
	Quite Good	21		72.5714	
	Good	42			79.3095
	Very good	36			81.3889
	Sig.		1.000	1.000	.486

Regression analysis of digital literacy skills on students' learning outcomes

Based on the analysis of students' learning outcomes at each digital literacy level, it is known that there is a linear relationship between digital literacy skills and students' learning outcomes (r = .505). Simple linear regression analysis is performed to determine how much digital literacy influences students' learning outcomes, which is shown in Table 10. Table 10 shows that the R square value is .255. It shows that digital literacy skills influence 25.5% of students' learning outcomes, and the rest is influenced by other factors (Table 10). To find out whether the regression equation can be used to predict the dependent variable or not, a model hypothesis is tested as shown in Table 11.

Table 10
Linear regression model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.505[a]	.255	.247	7.05732

a. Predictors: (Constant), Digital literacy skills

b. Dependent Variable: Students' learning outcomes

Table 11
The results of the regression equation analysis

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	56.666	3.718		15.239	.000
	Digital literacy skills	.296	.050	.505	5.875	.000

a. Dependent Variable: Students' learning outcomes

The analysis in Table 11 shows that the regression analysis produces the equation Y = 56,666 + .296 X. This shows a positive relationship between digital literacy skills and students' learning outcomes, which means that any increase in digital literacy skills will increase student learning outcomes. The result of the analysis Table 11 also shows that Sig. value is <.05 for both constants and independent variables. It proves that the regression equation formed is valid and can predict the dependent variable, namely students' learning outcomes. This result proves that digital literacy skills have a significant effect on improving students' learning outcomes. This is confirmed by the scatterplot regression standardized predicted value which is used to test the feasibility of the resulting regression model. The scatterplot result shows that the data spread around the zero (0) number on the Y-axis and does not form a particular pattern or trend line (Figure 5). So, this proves that the resulting regression model meets the requirements to predict student learning outcomes (Santoso, 2011).

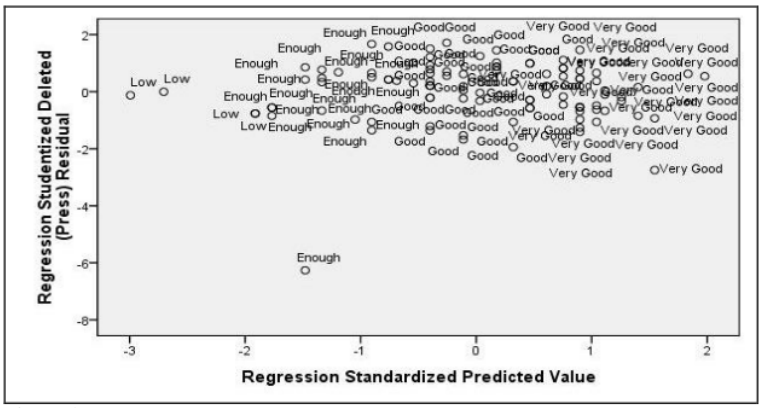

Figure 5
The scatterplot to check the feasibility of regression model

CONCLUSION

The result of the confirmatory factor analysis (CFA) shows that the digital literacy instrument is divided into three factors, which are factor 1 (communicating digital content), factor 2 (exploring digital content), and factor 3 (creating and using digital content). This instrument has good reliability and validity because it meets all the goodness of fit criteria.

Overall, the digital literacy instrument has fulfilled the construct and empirical validity to be considered reliable and valid to explore students' digital literacy skills. The instrument's implementation proves that (a) the instrument has good distinguishing power so that it can measure students' digital literacy skills at different levels of academic ability, and (b) the instrument has been effectively used to measure and

predict students' learning outcomes (R square = .255, Sig. <.05). The instruments' result is relevant to current conditions and can further explore students' digital literacy skills. To get more comprehensive results on students' digital literacy skills, this developed instrument can be implemented at different grades and majors.

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