COVARIANCE BASED-SEM ON RELATIONSHIP BETWEEN DIGITAL LITERACY, USE OF E-RESOURCES, AND READING CULTURE OF STUDENTS[*]

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Abstract

In this paper, a relationship model among latent variables using Covariance Based-Structural Equation Modeling (CB-SEM) is studied. The latent variables are digital literacy, use of e-resources and reading culture of students. The goal of the study is to build a simultaneously model between those three variables, determine the influence of digital literacy on the use of e-resources and reading culture of students, and the influence of the use of e-resources on reading culture of students. The parameters of the model are estimated by the Maximum Likelihood method. This study took data from 256 questionnaires of students at STMIK Sumedang. Results showed that digital literacy significantly influences the use of e-resources and the reading culture of students. In contrast, there are no significant influences on the use of e-resources on the reading culture of the student.
Keywords: cb-sem, digital literacy, use-of e-resources, reading culture, covariance based

1. Introduction

Structural Equation Modeling (SEM) is one of the most widely applied methodologies to analyze the relationship between latent variables. Latent variables in SEM generally correspond to hypothetical construct or explanatory entities presumed to reflect a continuum which is not directly observable and can represent a wide range of phenomena (Kline, 2016). In this research, three latent variables i.e. digital literacy, the use of e-resources and the reading culture of students are studied. These variables are not directly observable, but they observed through each construct. An observed variable used as an indirect measure of a construct is an indicator, and the statistical realization of a construct based on analyzing scores from its indicators is a factor (Kline,

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2016). The indicators of constructs for digital literacy (Kurniawati & Baroroh, 2016; Nasrullah *et al.*, 2017; Nurjanah *et al.*, 2017a), the use of e-resources (Abubakar, 2015; Adeleke *et al.*, 2017; Akussah & Adu-sarkodee, 2015; Ani *et al.*, 2015; Bala, 2016; Egberongbe, 2011; Imsong, 2016; Madondo *et al.*, 2017; Noreh, 2009; Nurjanah *et al.*, 2017a) and reading culture of students (Periyeti, 2017; Sapril, 2010) can be seen at Figure 1.

Some studies showed that there is a significant relationship between digital literacy and the use of e-resources. Nurjanah *et al.* (2017) showed that digital literacy has a high correlation with the use of e-resources. Egberongbe (2011), Noreh (2009), Bala (2016), Madondo *et al.* (2017) and Akussah *et al.* (2015) showed that low use of e-resources caused by low digital literacy. The concept of digital literacy refers to literacy activities that inseparable from reading, writing, and mathematics related to Education (Nasrullah *et al.*, 2017; Yanti, 2016). One component of digital literacy is the basic ability of digital literacy which includes an ability to read, write, understand symbols in representing languages and calculate numbers (Nurjanah *et al.*, 2017a). Clear that digital literacy has a reciprocal relationship with the reading culture. Another study showed that the use of e-resources has a relationship with the reading culture. Bala (2016) and Ajayi (2014) indicate that the use of e-resources can improve the reading culture of students. The use of e-books increases the time and frequency of reading students (Akpokodje & Ukwuoma, 2016). From those studies, if digital literacy and the reading culture of students increase, it is expected that the use of e-resources will be higher than the use of unreliable sources. Thus, not only the quality of the academic assignments of students will improve, but also the quality of the students and graduates will increase.

Relationship analysis between these three variables is separate. Nurjanah *et al.* (2017) used Pearson product-moment correlation to analysis of the relationship between digital literacy and the use of e-resources. Egberongbe (2011), Noreh (2009), Bala (2016), Madondo *et al.* (2017) and Akussah *et al.* (2015) used descriptive statistics. Separately, the relationship modeling between the use of e-resources and reading culture also used descriptive statistics (Ajayi, 2014; Akpokodje & Ukwuoma, 2016; Bala, 2016). While, the relationship between digital literacy and reading culture is studied based on the definition of literacy (Kurniasih, 2016; Nasrullah *et al.*, 2017; Nurjanah *et al.*, 2017a; Yanti, 2016).

The use of descriptive statistics and Pearson product-moment correlation to analyze the relationships of those three variables cannot interpret the relationship between the indicators of the constructs and their latent variable. To make a relationship modeling more effective, a simultaneously model that can analyze the relationship between digital literacy, the use of e-resources and the reading culture of students is needed. The simultaneous relationship modeling can be used to know not only the influence of digital literacy on the use of resources, the influence of digital literacy on the reading culture of students, the influence of using e-resources on the culture of reading students, but also can interpret the relationship between these three variables and their indicators of the construct (see Figure 1). As we mentioned before, one of the statistical analysis that can be used is Structural Equation Modeling (SEM).

SEM has two approaches, i.e. Covariance Based-Structural Equation Modeling (CB-SEM) and Partial-Least Square Structural Equation Modeling (PLS-SEM) (Hair, M.Hult, *et al.*, 2014; Jr *et al.*, 2014; Wong & Wong, 2013). CB-SEM is used when the goal of the study is to test a theory, confirm a theory and compare several alternative theories with large sample sizes and normally distributed data (Hair, M.Hult, *et al.*, 2014; Jr *et al.*, 2014; Wong & Wong, 2013). Whereas, PLS-SEM is a nonparametric

method that does not need distribution assumptions from data. PLS-SEM can be used on data that is not normally distributed. The PLS algorithm transforms abnormal data through the central limit theorem (Jr *et al.*, 2014).

CB-SEM aims to confirm theories by determining how well a model can estimate a covariance matrix for the sample data, while PLS-SEM operates much like a multiple regression analysis (Jr *et al.*, 2014). Estimation procedures for PLS-SEM are based on an Ordinary Least Squares (OLS) method and the Maximum Likelihood (ML) method for CB-SEM. Unlike CB-SEM, PLS-SEM focus on composites, composites aggregate indicators but do not fully incorporate measurement error and only viewed as approximations of factors, it causes the method yield biased estimates of various parameters even as samples sizes grow to infinity, among these asymptotically biased parameters are path coefficients, indicator weight and indicators loading (Kock, 2018).
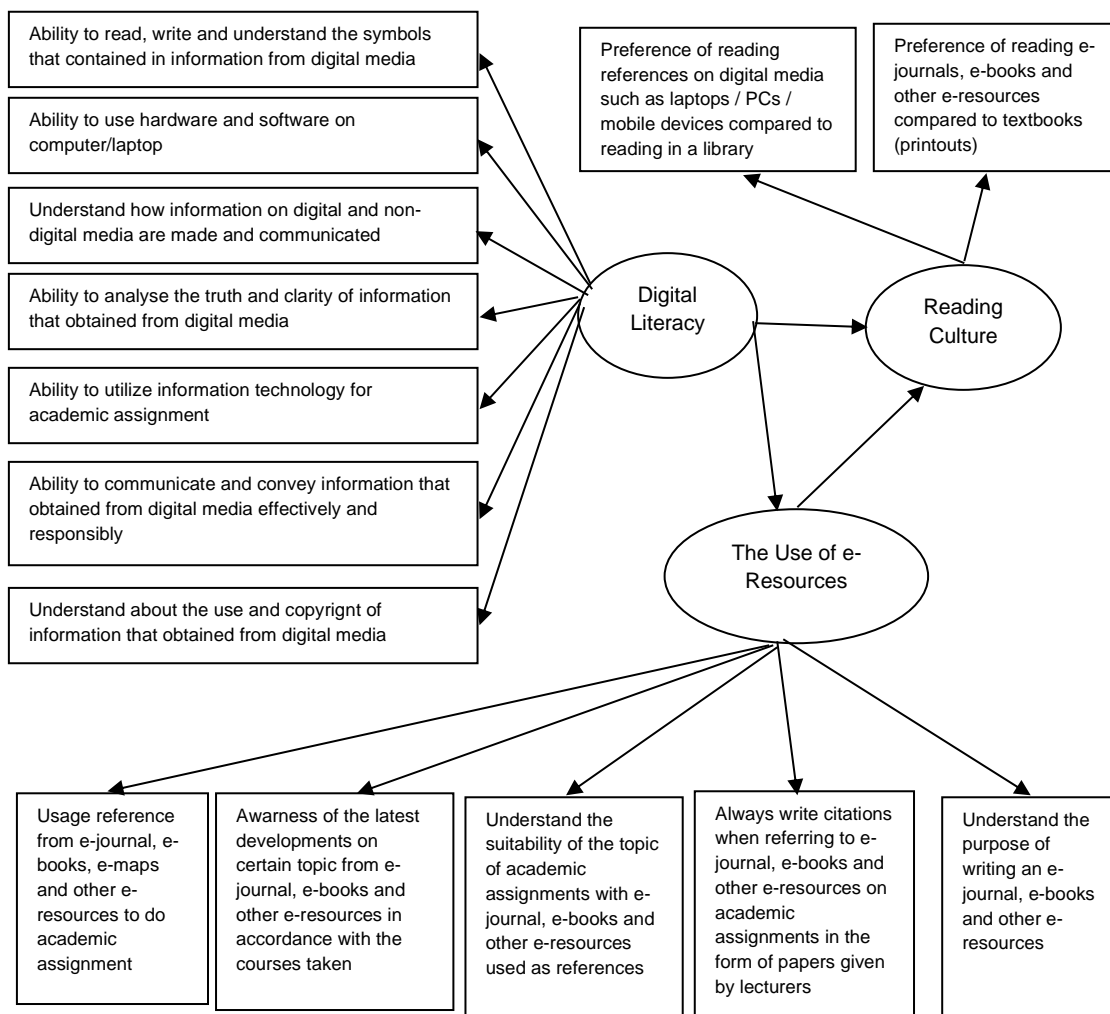

Figure 1: Specified Relationship model between Digital Literacy, The Use of e-Resources and Reading Culture of Students based on Previous Studies.

2. Covariance Based-Structural Equation Modeling (CB-SEM)
2.1   Model Specification

Model specification is making a path diagram (Figure 2) that illustrates the relationship between exogenous and endogenous variables (structural model) and the relationship

between exogenous and endogenous variables on each indicator (measurement model). The indicators of constructs for digital literacy, the use of e-resources and reading cultures of students showed in Figure 1 and Table 1. The relationship model between digital literacy (ξ_1) and the use of e-resources (η_1) formed based on Nurjanah *et. Al* (2017), Egberongbe (2011), Noreh (2009), Bala (2016), Madondo *et al.* (2017) and Akussah *et al.* (2015). The relationship model between the use of e-resources (η_1) and the reading culture (η_2) formed based on Bala (2016), Ajayi (2014) and Akpokodje *et al* (2016). The relationship model between digital literacy (ξ_1) and the reading culture (η_2) formed based on Kuniasih (2016), Nurjanah et. Al (2017), Nasrullah *et al.* (2017) and Yanti (2016).

Table 1: List of construct's indicators.

| Construct	No	Indicator	Notation
Digital Literacy (ξ_1)	1	Ability to read, write and understand the symbols that contained in information from digital media	X_1
	2	Ability to use hardware and software on computer/laptop	X_2
	3	Understand how information on digital and non-digital media are made and communicated	X_3
	4	Ability to analyze the truth and clarity of information that obtained from digital media	X_4
	5	Ability to utilize information technology for an academic assignment	X_5
	6	Ability to communicate and convey information that obtained from digital media effectively and responsibly	X_6
	7	Understand the use and copyright of information that obtained from digital media	X_7
The Use of e-Resources (η_1)	1	Usage reference from e-journal, e-books, e-maps and other e-resources to do academic assignment	Y_1
	2	Awareness of the latest developments on a certain topic from e-journal, e-books, and other e-resources in accordance with the courses taken	Y_2
	3	Understand the suitability of the topic of academic assignments with e-journal, e-books and other e-resources used as references	Y_3
	4	Always write citations when referring to an e-journal, e-books and other e-resources on academic assignments in the form of papers given by lecturers	Y_4
	5	Understand the purpose of writing an e-journal, e-books and other e-resources	Y_5
Reading Culture (η_2)	1	Preference of reading references on digital media such as laptops / PCs / mobile devices compared to reading in a library	Y_6
	2	Preference of reading e-journals, e-books and other e-resources compared to textbooks (printouts)	Y_7
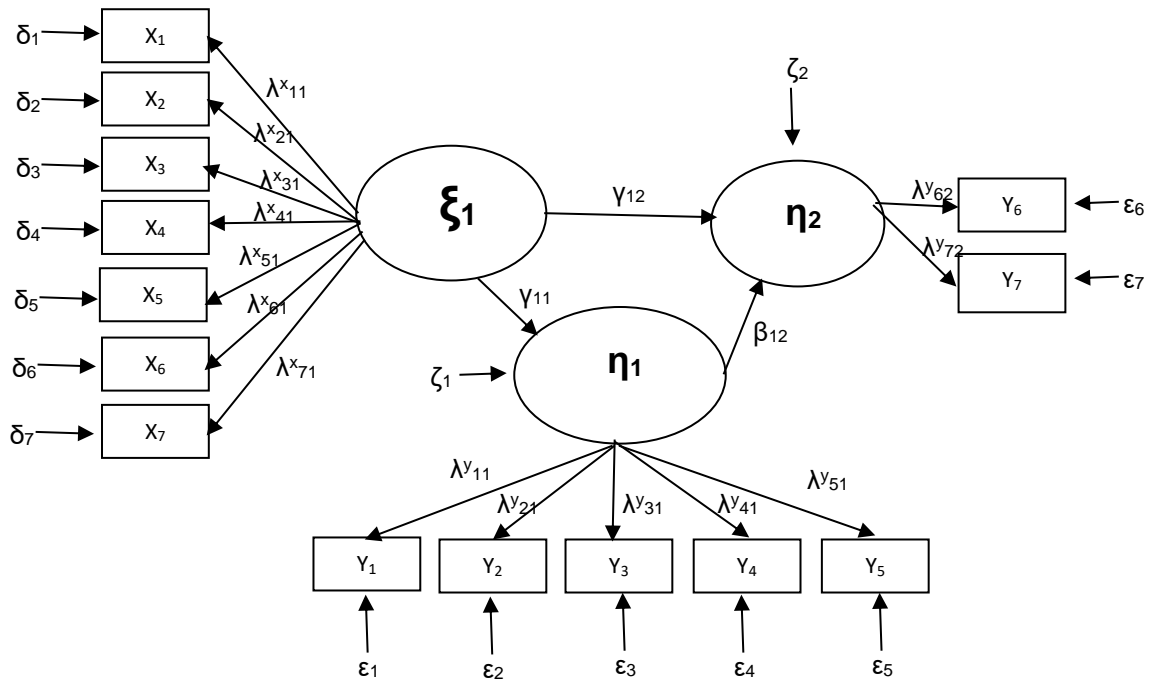
Figure 2: Model specification.

From the model specification (Figure 2.) we get the measurement model as seen at Table 2 and the structural model is seen in Table 3.

2.2   Model Identification

Model identification related to the direction of whether a model has enough information to get a solution for the model's parameters to be estimated. Model identification can be done using:

$$df = \frac{(p+q)(p+q+1)}{2} - t \qquad (1)$$

(p+q) is the number of indicators of exogenous and endogenous variables, t is the number of parameters to be estimated or all paths include the variances of all exogenous variables and errors. If df <0 then the model is *under-identified*, df = 0 then the model is *just-identified* and with df> 0 the model is *over-identified*. From Figure 2 and using equation (1), the model in this study give df=72 or an *over-identified* model.

An *under-identified* model is a model that has more unknown than known information, which it is impossible to get a unique estimate of all the model's parameters (Hoyle, 2012). A model called a *just-identified* model if there is an equal amount of known and unknown information, and because of this equality, it is possible to derive a unique estimate for all the model's parameters. A *just-identified* model is also called as a *saturated model* (Hoyle, 2012). Unlikely an *under-identified model*, an *over-identified model* has more known information than unknown information, which it is possible to get the estimate of all the model's parameters using several equations from the known information. Only *over-identified* models provide fit statistics as a means of evaluating the fit of the overall model (Hoyle, 2012).

Table 2: Measurement model.

Construct	Measurement Model
Digital Literacy	$X_1 = \lambda_{11}^X \xi_1 + \delta_1$
	$X_2 = \lambda_{21}^X \xi_1 + \delta_2$
	$X_3 = \lambda_{31}^X \xi_1 + \delta_3$
	$X_4 = \lambda_{41}^X \xi_1 + \delta_4$
	$X_5 = \lambda_{51}^X \xi_1 + \delta_5$
	$X_6 = \lambda_{61}^X \xi_1 + \delta_6$
	$X_7 = \lambda_{71}^X \xi_1 + \delta_7$
The Use of E-Resources	$Y_1 = \lambda_{11}^y \eta_1 + \varepsilon_1$
	$Y_2 = \lambda_{21}^y \eta_1 + \varepsilon_2$
	$Y_3 = \lambda_{31}^y \eta_1 + \varepsilon_3$
	$Y_4 = \lambda_{41}^y \eta_1 + \varepsilon_4$
	$Y_5 = \lambda_{51}^y \eta_1 + \varepsilon_5$
Reading Culture	$Y_6 = \lambda_{62}^y \eta_2 + \varepsilon_6$
	$Y_7 = \lambda_{72}^y \eta_2 + \varepsilon_7$

Table 3: Structural model.

Construct	Measurement Model
The Use of E-Resources	$\eta_1 = \gamma_{11}\xi_1 + \zeta_1$
Reading Culture	$\eta_2 = \gamma_{12}\xi_1 + \beta_{12}\eta_1 + \zeta_2$

2.3   Parameter Estimation Method

Parameters of the model (Figure 2) are estimated iteratively by using the Maximum Likelihood (ML) method and LISREL. ML is a normal theory method which assumes multivariate normality for the joint population distribution of endogenous variables, given exogenous variables, it describes principle which underlies derivation of parameter estimates that maximize the likelihood which data were drawn from this population (Kline, 2016). Under the assumption, the ML estimator is asymptotically consistent, unbiassed, efficient and normally distributed, and the model fit statistic is asymptotically distributed as chi-square with *df=p(p+1)/2-t*, where *t* is the number of model parameters estimated (Hoyle, 2012). A consistent estimator is an estimator that approaches the true parameter when sample size increases toward infinity. An unbiased estimator is an estimator which its expected value (the averages of estimates from an infinity number of independent samples from the same population) equals to population parameter. An estimator called efficient if it has smallest variability among consistent estimators.

2.4   Model Fit Testing

A model fit testing consists of a measurement model assessment, structural model assessment, and global fit testing. The aims of the measurement model assessment to evaluate validity and reliability of indicators using standardized loading, composite reliability and average variance extracted (AVE). Indicators of latent variables are valid

if the standardized loading higher than 0.7, but others stated that the standardized loading which lies on between 0.5 to 0.6 still acceptable. At the same time, composite reliability used to evaluate the reliability of latent variables. Composite reliability values are range from 0 to 1, the higher value indicates a higher level of reliability. To say a latent variable is reliable, the composite reliability value must greater than or equal to 0.6. In addition, the reliability of latent variables can be measured using AVE which must greater than 0.5. If the AVE less than 0.5, it means that the measurement errors give more contribution to the indicators than to the latent variable.

The structural model assessment focuses on the significance of the relationships between exogenous (ξ) and endogenous (η) latent variables and the relationship among the endogenous variables using *t-values* and R^2. The critical value of *t-values* for the two-tailed hypothesis with a significance level (α) 10%, 5%, and 1% are 1.65, 1.96 and 2.57. The R^2, a coefficient of determination indicates the amount of variance on endogenous latent variables that can be explained simultaneously by independent latent variables. The higher R^2 means a better structural equation obtained.

Global fit testing focuses on assessing the goodness-of-fit of the overall model. Goodness-of fit evaluate how well the specified model reproduces observed covariance matrix among the indicators (Hair, Black, *et al.*, 2014). Goodness-of fit test carried out using Chi-Square with cut off *p-value > 0.025* for significance level 5%, Root Mean Square Error of Approximation (RSMEA) that must lies on range 0.03 to 0.08 for confidence interval 95% (Hair, Black, *et al.*, 2014), Normed Fit Index (NFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI) and Relative Fit Index (RFI). NFI, CFI, IFI and RFI range between 0 and 1 and a model with perfect fit would produce values near to 1.

2.5   Modification Model

Model modification is considered if the fit of the model being evaluated is considered inadequate. The goal of model modification is to improve the fit of the model. One of the ways in the model modification is letting the error of a few indicators correlated. This will reduce Chi-square and increasing other goodness-of-fit statistics, which means improving the fit of the model.

3. Results and Discussion

This study took data from 256 questionnaires of students at STMIK Sumedang. CB-SEM analysis performed using LISREL 10.10 Student version. The parameter estimators can be seen in Figure.3.

Measurement model assessment signifies that all the standardized loading of all indicators lies between 0.52 to 0.79 (Figure 4) which means all indicators of digital literacy, reading culture and the use of e-resources are valid. Furthermore, composite reliability of digital literacy and the use of e-resources are greater than 0.6 but composite reliability of reading culture is quite small (Table 4). Even though the composite reliability of reading culture was less than 0.6, we tend to keep the indicators of this variable in the model (Figure 2). Due to this variable only has two indicators, then one or more indicators removed, we would lose the information about this variable. For the same reason, despite all the AVE are less than 0.5 with only a small gap (Table 4), we keep all the indicators of the model (Figure 2).
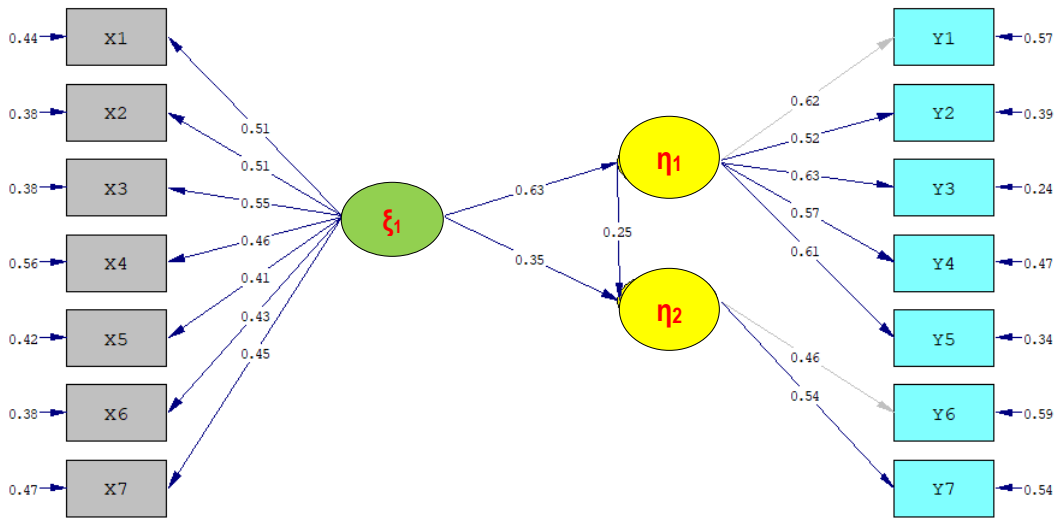
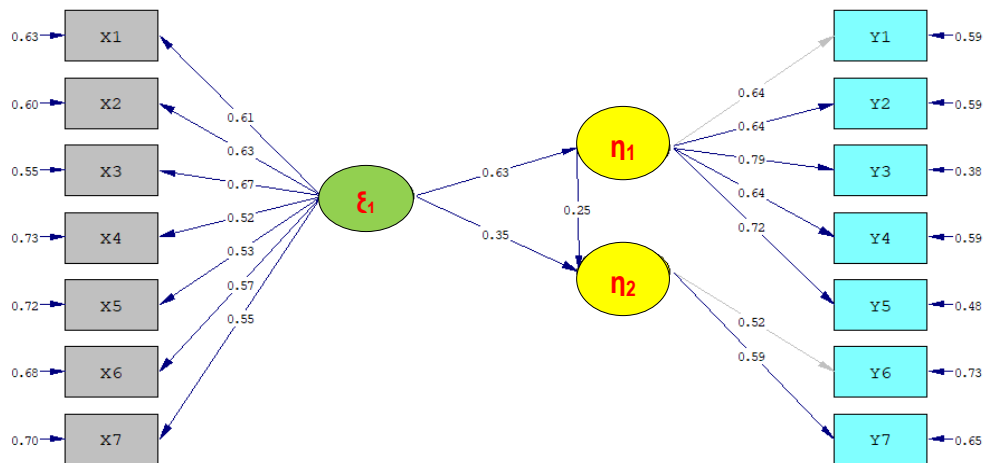Figure 3: Parameter's estimator of the model.

Figure 4: Standardized solutions.

Table 4: Composite reliability and AVE.

Variable	Composite Reliability	Average Variance Extracted (AVE)
Digital Literacy	0,864	0,343
The Use of E-Resources	0,817	0,473
Reading Culture	0,470	0,308

Table 5: Total effect to digital literacy.

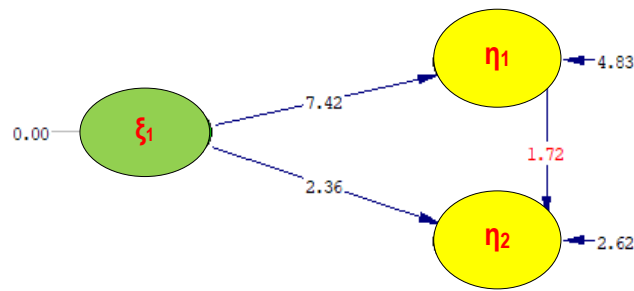| Variable	Direct Effect	Indirect Effect
The Use of E-Resources	0.635	
Reading Culture	0.510	0.157

Figure 5: T-Values of structural model.

From the structural model assessment, with t-values higher than 1.96 (Figure 5), digital literacy significant influences on the use of e-resources and reading culture of students. Meanwhile, the use of e-resources does not significant influences on the reading culture of students because the t-values are less than 1.96 (Figure 5). The significant relationship between digital literacy and the use of e-resources suggests the same relationship model obtained by Nurjanah et. Al (2017), Egberongbe (2011), Noreh (2009), Bala (2016), Madondo *et al.* (2017) and Akussah *et al.* (2015). The significant relationship between digital literacy and reading culture indicates the same output which showed by Kuniasih (2016), Nurjanah et.al (2017), Nasrullah *et al.* (2017) and Yanti (2016) as well. In contrast, the significance test indicates a different outcome of the relationship model between the use of e-resources and the reading culture explained by Bala (2016), Ajayi (2014) and Akpokodje *et al* (2016). The variance of the use of e-Resources and reading culture of students influenced by digital literacy in 40.3% and 26.1% with the total effect of 0.635 and 0.51 (Table 5). Whereas only 29,7% the variance of reading culture of students simultaneously influenced by digital literacy and the use of resources.

Table 6: Goodness-of-fit statistics.

Statistics	Values	Cut-off	Results
Chi-Square	165.274 (*p-value* =0.000)	P-value > 0.025	Does not Fit
RMSEA	0.0694	<0.05	Does not Fit
NFI	0.842	>0.9	Acceptable
CFI	0.905	>0.9	Fit
IFI	0.907	>0.9	Fit
RFI	0.807	>0.9	Acceptable

Further analysis depicts goodness-of-fit the overall model (Table 6). The results suggest improving the fit of the model. Therefore, we need a model modification which is letting the error of a few indicators correlated (Figure 6). The modification model performed goodness-of-fit statistics which is not only reducing Chi-square and RSMEA but also increasing NFI, CFI, IFI, and RFI (Table 7). The changes of these values mean improving the fit of the model (Table 8 and Table 9).

Table 7: Goodness-of-fit statistics of modification model.

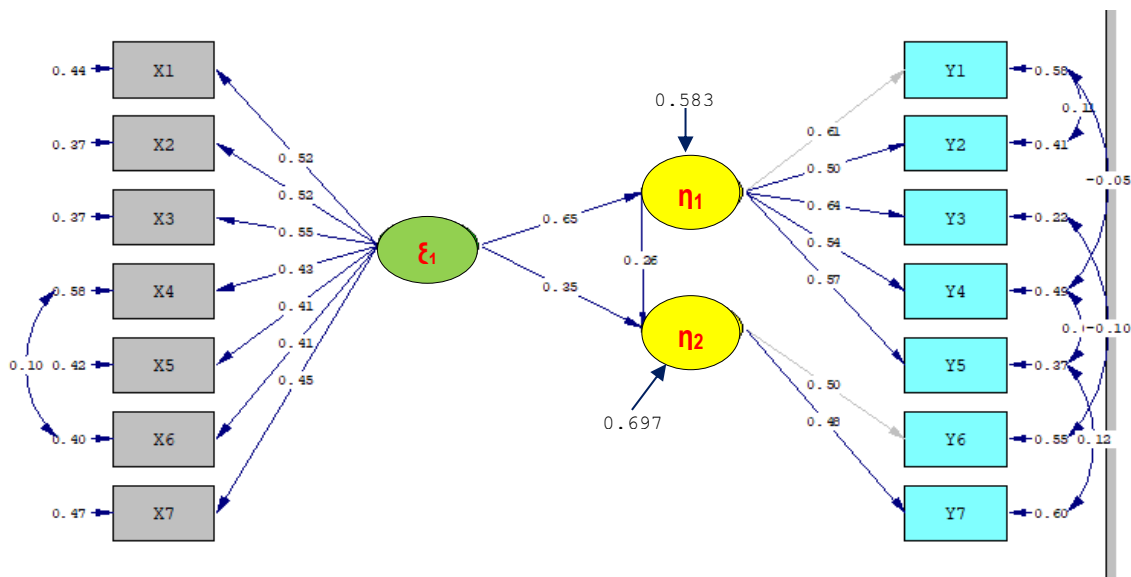| Statistics	Values	Cut-off	Results
Chi-Square	109.553 (*p-value* =0.0011)	P-value > 0.025	Does not Fit
RMSEA	0.0489	<0.05	Does not Fit
NFI	0.896	>0.9	Acceptable
CFI	0.957	>0.9	Fit
IFI	0.958	>0.9	Fit
RFI	0.861	>0.9	Acceptable

Figure 6: Parameter estimator of modification model.

Then from the estimation of the modification model's parameters (Figure 6), we get the fitted measurement model as seen in Table 8.

Table 8: The Fitted measurement model.

Construct	Measurement Model
Digital Literacy	$X_1 = 0.52\xi_1 + 0.44$
	$X_2 = 0.52\xi_1 + 0.37$
	$X_3 = 0.55\xi_1 + 0.37$
	$X_4 = 0.463 + 0.58$
	$X_5 = 0.41\xi_1 + 0.42$
	$X_6 = 0.41\xi_1 + 0.40$
	$X_7 = 0.45\xi_1 + 0.47$
The Use of E-Resources	$Y_1 = 0.61\eta_1 + 0.58$
	$Y_2 = 0.50\eta_1 + 0.41$
	$Y_3 = 0.64\eta_1 + 0.22$
	$Y_4 = 0.54\eta_1 + 0.49$
	$Y_5 = 0.57\eta_1 + 0.37$
Reading Culture	$Y_6 = 0.50\eta_2 + 0.55$
	$Y_7 = 0.48\eta_2 + 0.60$

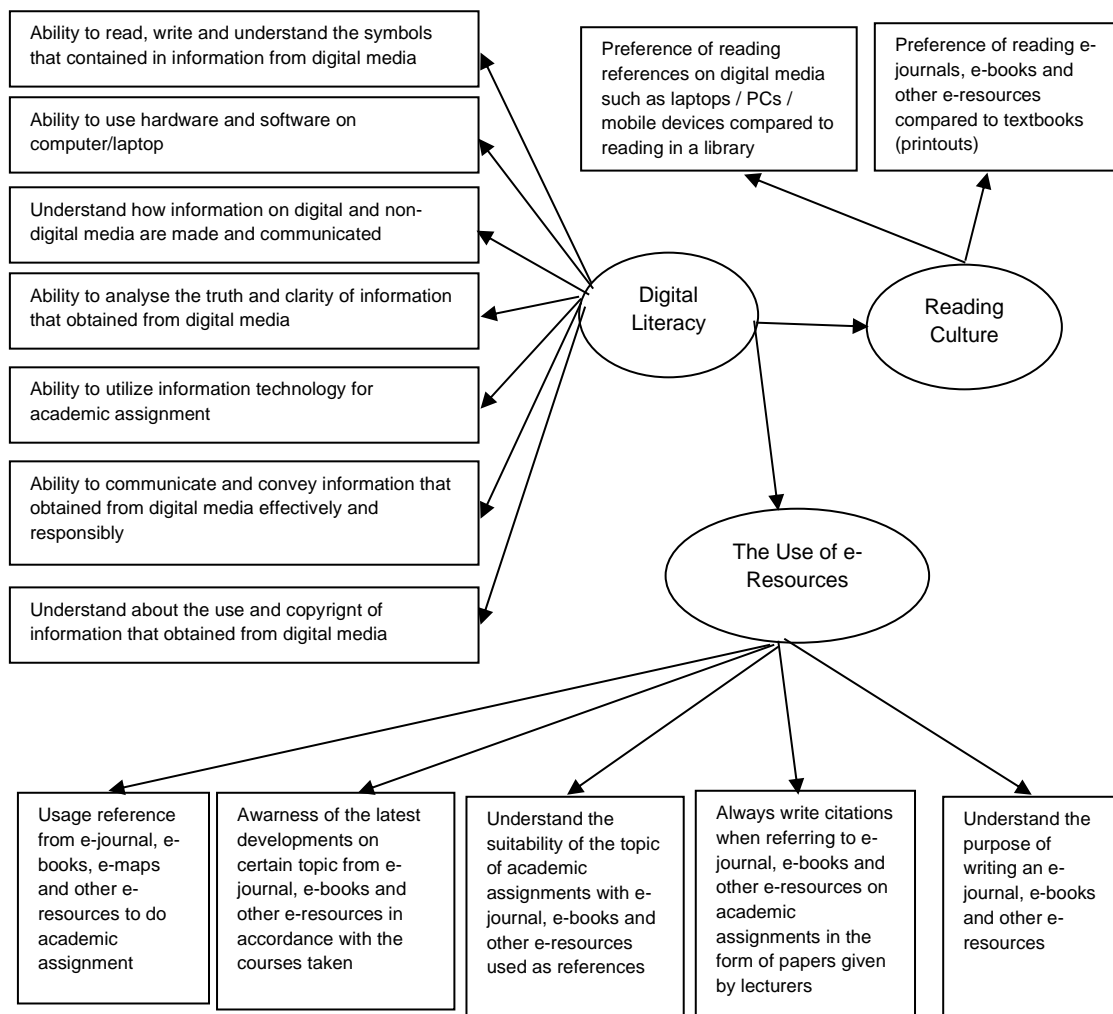Whereas the fitted structural model is seen in Table 9.

Figure 7: Fit model of the Relationship between Digital Literacy, The Use of e-Resources and Reading Culture of Students.

Table 9: The Fitted Structural Model

Construct	Measurement Model
The Use of E-Resources	$\eta_1 = 0.65\xi_1 + 0.583$
Reading Culture	$\eta_2 = 0.35\xi_1 + 0.26\eta_1 + 0.697$

4. Conclusions

Based on the CB-SEM analysis that has been performed, the simultaneous relationship model between digital literacy, the use of e-resources and the reading culture of students with each indicator is illustrated in Figure 7. There is a significant influence of digital literacy on the use of e-resources and the reading culture of students. In addition, due to differences in the outcome obtained in the previous study, we need further analysis of the relationship between the use of e-resources and reading culture.

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