Journal of Mathematics Education andApplication(JMEA)
Vol. 2, No 2, Juni 2023, pp. 108-116 DOI: https://doi.org/10.30596/jmea.v2i2.15285

Analysis of the Influence of E-learning Services on User Satisfaction with Structural Equation Modeling (Case Study: Mathematics Student at University of North Sumatra)

Putri Patresia Sihombing[1*]

[1]Student of Mathematics, Universitas Sumatera Utara, Indonesia
*Corresponding Author. E-mail :putrisihombing2509@gmail.com

Article Info

Article History
Received : 16 Juni 2023
Accepted :22 Juni 2023
Published : 30 Juni 2023

Keywords:
Structural Equation Modeling, AMOS, e-learning

ABSTRACT

Building a hypothetical model consisting of a structural model and a measurement model in the form of a path diagram is the main requirement for using SEM. According to research findings, not all criteria affect the level of satisfaction with e-learning services at the University of North Sumatra. Of the six existing factors such as content (X1), accuracy (X2), form (X3), timeliness (X4), security and privacy, and media response speed (X6) only the media response speed factor (X6) shows a significant influence on user satisfaction (Y1). So based on the data analysis techniques that have been carried out in this study, there is only one factor that influences e-learning user satisfaction, namely accuracy. With a CR value of 1.916 where the value is greater than the critical value of 1.65 with a coefficient value of 0.320

To cite this article:

INTRODUCTION

Technological developments such as the internet as a source of learning provide convenience, freedom, and flexibility in exploring knowledge online. Utilization of the internet in tertiary institutions for students can access various literature and scientific references needed quickly, so as to facilitate the learning process. Internet-based learning method is called e-learning (electronic learning). E-learning or electronic learning was first introduced by the University of Illinois at Urbana-Champaign using a computer-assisted instruction system and a computer called PLATO. Since then, the development of e-learning internet-based learning has developed in line with developments and advances in technology.

Structural equation model (SEM) is a kind of multivariate analysis that looks at how different factors interact with each other. According to Hair et al (2006) SEM is used to investigate and defend models. Creating a hypothetical model in the form of a structural model and a measurement model in the form of a route diagram is the main prerequisite for SEM. Factor analysis from the field of psychology and simultaneous equation models from econometrics combine to form the SEM. According to Ghozali (2005) factor analysis was first introduced by Galton (1869) and Pearson (1913) (Pearson and Lee, 1904).

Vol. 2, No 2, Juni 2023, pp. 108-116 DOI: https://doi.org/10.30596/jmea.v2i2.15285

There are several reasons underlying the use of SEM, according to Dillala (2000), including: (1) the model analyzed is relatively complicated so it will be difficult to solve with the path analysis method in linear regression; (2) SEM has the ability to estimate the relationship between variables that are multiple relationships; (3) errors in each observation are not ignored but still analyzed, so that SEM is accurate enough to analyze questionnaire data involving perceptions; (4) Researchers can easily modify the model to improve the model that has been compiled to make it more statistically feasible; (5) SEM is able to analyze mutual relations simultaneously.

RESEARCH METHOD

Structural Equation Modeling analysis can be performed using several software, such as AMOS, EQS, LISREL with PRELIS, LISCOMP, Mx, SAS PROC CALIS, and STATISTICA-SEPATH. According to Ghozali (2005), the Amos software was chosen because of the easier accessibility of using graphics (Amos Graphic) when describing structural models. The findings of studies on how e-learning services affect student satisfaction can serve as a kind of benchmark and source of insight for improving e-learning development.

RESULTS AND DISCUSSION

Description of Respondent Data

The survey was conducted on 250 university student respondents from June to October 2022. By using the SPSS 22.00 application, the results obtained from respondents based on gender are as follows:

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Man	103	41.2	41.2	41.2
	Woman	147	58.8	58.8	100.0
	Amount	250	100.0	100.0	

By using the SPSS 22.00 application, the results of respondents based on the year of entry are obtained as follows:

Entry year

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2018	83	33.2	33.2	33.2
	2019	84	33.6	33.6	66.8
	2020	39	15.6	15.6	82.4
	2021	44	17.6	17.6	100.0
	Amount	250	100.0	100.0	

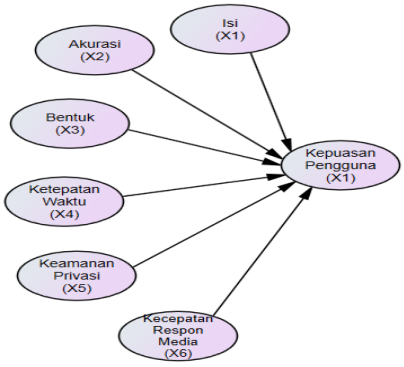
Data processing

Vol. 2, No 2, Juni 2023, pp. 108-116 DOI: https://doi.org/10.30596/jmea.v2i2.15285

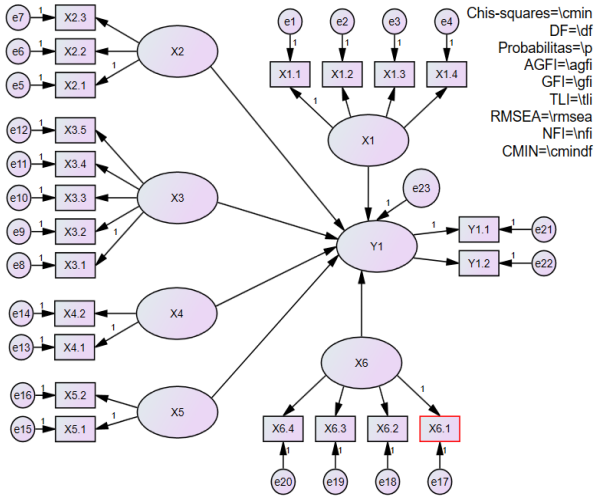
To determine the factors that affect student learning achievement at the University of North Sumatra, it can be determined by the SEM path based on each step by step as follows:

1. Theory-based model development

Based on the existing studies, a model of the relationship between variables is proposed as follows:



2. Compile SEM Diagrams



3. Converting Path Diagrams Into Structural Equations

The structural equation of the path diagram is expressed in the following form:

User Satisfaction= $\beta_1 X1 + \beta_2 X2 + \beta_3 X3 + \beta_4 X4 + \beta_5 X5 + \beta_6 X6 + Z_2$

4. Selecting Matrix Input Values and Obtaining Estimating Models

The structural equation model provides a matrix input in covariant form. For confirmatory factor analysis both types of matrix input can be used. The AMOS program will convert the raw data into covariance or correlation form first as input for analysis, then for estimation the Maximum Likelihood estimate is selected to estimate the data that has been input. Maximum Likelihood has a sensitive level if the sample is between 100-200 samples. If the sample is above 100 then the level of sensitivity increases to detect between data

Vol. 2, No 2, Juni 2023, pp. 108-116 DOI: https://doi.org/10.30596/jmea.v2i2.15285

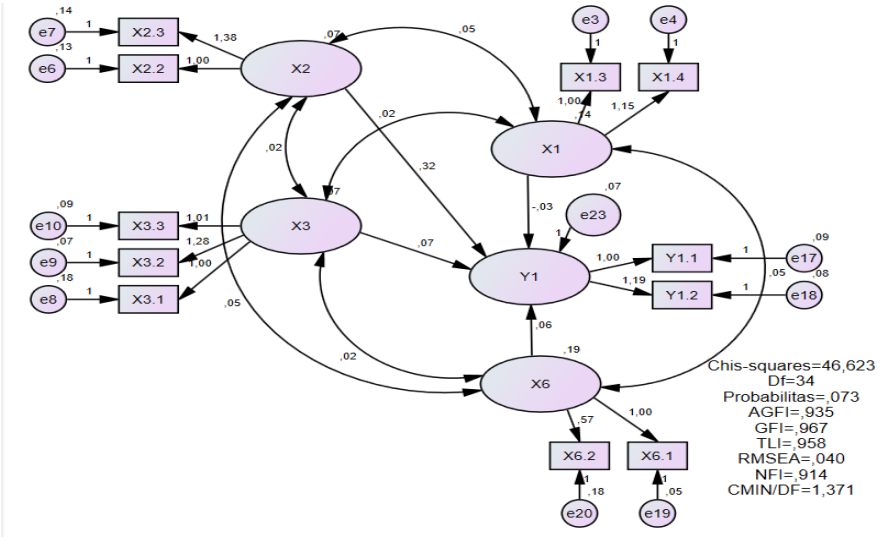
and always produces significant differences so that the Goodness of Fit measure becomes ugly. So for a sample of 100-200 it is highly recommended to use the Maximum Likelihood method.

5. Testing the unidimensionality of each construct

Confirmatory analysis was carried out between exogenous variables and between endogenous variables. In this model there are six exogenous variables namely Content, Accuracy, Form, Timeliness, Privacy Security, and Media Response Speed. Then there is one endogenous variable, namely User Satisfaction, while the confirmatory test refers to the fit model criteria in the following table:

Goodness of fit index	Cut-off Value
χ^2(*Chi-square*)	**Diharapkan kecil**
Significance Probability	**≥ 0.05**
RMSEA	**≤ 0.08**
GFI	**≥ 0.90**
AGFI	**≥ 0.90**
CMIN/DF	**≤ 2.00**
TLI	**≥ 0.95**
CFI	**≥ 0.95**

Based on the results of the GOF test, this initial model cannot be said to be fit with the existing data because the probability value still does not meet the GOF value. Therefore, the addition of connection lines needs to be done again. The next additional connection is the connection between the Shape and Media Response Speed variables until finally the model is declared fit. The following is the result of the GOF value after connecting the variables.



From the output diagram it is evident that the last modified model is fit with the existing data. The following is the GOF value of the final modification.

Goodness of FitIndex	***Cut-off Value***	**NilaiPenelitian**	**Keterangan**

Chi-square	Semakinkecil, semakinbaik	46,623	
CMIN/df	<2,0	1,371	Goof of fit
P(probabilitas)	>0,05	0,073	Goof of fit
GFI	>0,90	0,967	Goof of fit
AGFI	>0,90	0,935	Goof of fit
NFI	>0,90	0,914	Goof of fit
TLI	>0,90	0,958	Goof of fit
RMSEA	>0,08	0,040	Goof of fit

6. Evaluation of Structural Models

Testing the proposed hypothesis can be seen from the results of the Standardized regression coefficient. The result is as follows:

Regretion weights

			Estimate	S.E.	C.R.	P	Label
Y1	<---	X1	-,026	,094	-,274	,784	par_1
Y1	<---	X2	,320	,167	1,916	,055	par_2
Y1	<---	X3	,073	,103	,704	,482	par_3
Y1	<---	X6	,057	,071	,803	,422	par_4
X1.3	<---	X1	1,000				
X1.4	<---	X1	1,145	,200	5,725	***	par_5
X2.2	<---	X2	1,000				
X2.3	<---	X2	1,377	,287	4,802	***	par_6
X3.1	<---	X3	1,000				
X3.2	<---	X3	1,279	,210	6,083	***	par_7
X3.3	<---	X3	1,015	,165	6,154	***	par_8
X6.1	<---	X6	1,000				
X6.2	<---	X6	,571	,183	3,119	,002	par_9
Y1.1	<---	Y1	1,000				
Y1.2	<---	Y1	1,192	,380	3,134	,002	par_10

Stndardized Regression Weights

			Estimate
Y1	<---	X1	-,035
Y1	<---	X2	,303
Y1	<---	X3	,070
Y1	<---	X6	,087
X1.3	<---	X1	,733
X1.4	<---	X1	,843
X2.2	<---	X2	,588
X2.3	<---	X2	,700

Vol. 2, No 2, Juni 2023, pp. 108-116 DOI: https://doi.org/10.30596/jmea.v2i2.15285

			Estimate
X3.1	<---	X3	,535
X3.2	<---	X3	,784
X3.3	<---	X3	,664
X6.1	<---	X6	,889
X6.2	<---	X6	,498
Y1.1	<---	Y1	,678
Y1.2	<---	Y1	,760

Variance

	Estimate	S.E.	C.R.	P	Label
X1	,141	,032	4,480	***	par_17
X2	,071	,020	3,533	***	par_18
X3	,073	,020	3,704	***	par_19
X6	,186	,060	3,083	,002	par_20
e23	,069	,025	2,801	,005	par_21
e3	,121	,026	4,736	***	par_22
e4	,075	,031	2,433	,015	par_23
e6	,135	,019	7,159	***	par_24
e7	,140	,030	4,728	***	par_25
e8	,181	,020	9,108	***	par_26
e9	,075	,018	4,230	***	par_27
e10	,095	,013	7,031	***	par_28
e17	,049	,057	,873	,383	par_29
e18	,184	,025	7,335	***	par_30
e21	,093	,026	3,553	***	par_31
e22	,082	,036	2,292	,022	par_32

a. Reliability Test

Reliability is a measure of the internal consistency of the indicators of a formed variable which shows the degree to which each indicator indicates a general formed variable. There are 2 ways that can be used, another snstsra is composite (construct) reliability and variance extracted. The cut-off value of construct reliability is at least 0.70 while the cut-off value for variance extrad is at least 0.50. Composite reliability is obtained by the formula:

$$Construct\ Reability = \frac{(\sum Standardized\ Loading)^2}{(\sum Standardized\ Loading)^2 + \sum \varepsilon_j}$$

SUM *StandarlizedLoading* for:

X1 = 0.733 + 0.843 = 1.576

X2 = 0.588 + 0.700 = 1.288

X3 = 0.535 + 0.784 + 0.664 = 1.983

Vol. 2, No 2, Juni 2023, pp. 108-116 DOI: https://doi.org/10.30596/jmea.v2i2.15285

X6 = 0.889 + 0.498 = 1.387

Y1 = 0.678 + 0.760 = 1.438

SUM Measure Error for:

X1 = 0.267 + 0.157 = 0.424

X2 = 0.412 + 0.3 = 0.712

X3 = 0.465 + 0.216 + 0.336 = 1.017

X6 = 0.111 + 0.502 = 0.613

Y1 = 0.322 +0.24 = 0.562

Reliability calculation:

$$X1 = \frac{1.576^2}{1.567^2 + 0.424} = 0.8541$$

$$X2 = \frac{1.288^2}{1.288^2 + 0.712} = 0.6996$$

$$X3 = \frac{1.983^2}{1.983^2 + 1.071} = 0.7945$$

$$X6 = \frac{1.387^2}{1.387^2 + 0.613} = 0.7583$$

$$Y1 = \frac{1.438^2}{1.438^2 + 0.562} = 0.7862$$

The reliability construct calculation above shows that the indicators of the research construct have a standard ≥0.070, so that all of them have good validity.

b. Variance Extracted

variance extracted shows the amount of variance from the indicators extracted by the variable whose form is developed. The amount of the variance extracted value is obtained by the formula:

$$Variance\ Extracted = \frac{(\sum Standardized\ Loading)^2}{(\sum Standardized\ Loading)^2 + \sum \varepsilon_j}$$

Sum of Squared Standardized Loading

X1 = $0.733^2 + 0.843^2$ = 1.2479

X2 = $0.588^2 + 0.700^2$ = 0.8357

X3 = $0.535^2 + 0.784^2 + 0.664^2$ = 1.341

Vol. 2, No 2, Juni 2023, pp. 108-116 DOI: https://doi.org/10.30596/jmea.v2i2.15285

X6 = $0.889^2 + 0.498^2$ = 1.0383

Y1 = $0.322^2 + 0.24^2$ = 0.1612

Variance Extracted :

$$X1 = \frac{1.2479}{(1.2479)^2 + 0.9040} = 0.5070$$

$$X2 = \frac{0.8357}{(0.8357)^2 + 0.7402} = 0.5808$$

$$X3 = \frac{1.341}{(1.341)^2 + 0.6242} = 0.7425$$

$$X6 = \frac{1.0383}{(1.0383)^2 + 0.7356} = 0.5944$$

$$Y1 = \frac{1.0372}{(1.0372)^2 + 0.8387} = 0.5619$$

The calculation of the variance extracted above shows that the indicators of the research construct have a standard ≥0.50, so that all of them have good validity

Conclusions

The results of the analysis in the study show that not all factors influence the level of satisfaction with e-learning services at the University of North Sumatra. Of the six existing factors such as content (X1), accuracy (X2), form (X3), timeliness (X4), security and privacy, and media response speed (X6) only the media response speed factor (X6) shows a significant influence on user satisfaction (Y). So based on the data analysis techniques that have been carried out in this study, there is only one factor that influences e-learning user satisfaction, namely content and form. It can be seen from the content and form reliability test that the highest values are 0.8541 and 0.7954

REFERENCES

Alamsyah, Purnama. (2008). *Membangun Indeks Kepuasan Pelanggan*. Jurnal bisnis dan manajemen UNPAD (Vol.IX, No.1). Hlm. 62-81.

ChristofNachtigall, UlfKroehne, Friedrich Funke. “Pros and Cons of Structural Equation Modeling” University of Koblenz-Landau. Methods of Psychological Research Online 2003, Vol.8, No.2, pp. 1-22

CHRISTOPHER L. SHOOK, DAVID J. KETCHEN, G. TOMAS M. HULT and K. MICHELE KACMAR “An Assessment Of The Use Of Structural Equetion Modeling In Strategic Management Research” Strategic Management Journal. Strat. Mgmt. J., 25: 397–404 (2004)

Darin E. Hartley.(2001). *Selling e-Learning*.American Society for Training and Development.

Gerson, Richard F. (2002). MengukurKepuasanPelanggan. Cetakankedua, Jakarta: PPM.

Ghozali, Imam &Fuad. (2005). *Struktural Equation Modelling.* Semarang: Badan Penerbit Universitas Diponegoro.

Hair, J. F. JR., Anderson, R.E, Tatham, R.L. and Black, W.C. (2006).*Multivariate Data Analysis*. Six Edition. New Jersey : Pearson Educational, Inc

Hair, J.F., Jr., et.al. (1998). *Multivariate Data Analysis 5th ed*. Englewood Cliffs, NJ: Prentice-Hall Int'l.

Hall, James A.(2002). Accounting Information System. (terjemahan). Buku Dua Penerbit Salemba Empat.

Kerlinger. 2004. Variabel independen dan variabel dependen.58-59

Nurmala Ahmar dan Yud aParamon.(2005). Faktor-Faktor yang Berpengaruh Pada Tingkat Kepuasan Pengguna Sistem Informasi Berbasis Web, dalam Jurnal Ventura. Vol. 8, No. 1, April 2005.