© 2018 IJSRSET | Volume 4 | Issue 4 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section : Engineering and Technology

Structural Equation Modeling Of National Standard Education of Vocational High School Using Partial Least Square Path Modeling

Muh. Hijrah*, Budi Susetyo, Bagus Sartono
Department of Statistics, Bogor Agricultural University, Bogor, Indonesia

ABSTRACT

Partial Least Square Path Modeling (PLS-PM) is a covariance or component-based Structural Equation Modeling (SEM) method. PLS-PM uses a nonparametric analysis so that all preliminary assumptions of SEM are unnecessary to be fulfilled. This study employed PLS-PM to the data of SMK's national education standard in the Province of Banten in 2017 to obtain a good structural model besides evaluating indicator variables. This study revealed that there are 38 indicator variables that have to be evaluated or eliminated. Modified model is the model without non significance path coefficients of initial model. R-squares of modified structural model are greater than 0.75 except SI and SPL variables which mean that the modified models are good models.

Keywords: Partial Least Square Path Modeling, Structural Equation Modeling, National Education Standard.

I. INTRODUCTION

Structural Equation Modeling (SEM) is an analytical method used to describe the pattern of linear relationship between indicator and the latent variable (Schumacker and Lomax 2010). More specifically, SEM is a combination of path analysis, confirmatory factor analysis, and regression analysis. There are 2 (two) model components of SEM, those are structural model and measurement model (Bollen 1989). The structural model describes the relationship between the latent variables. While the measurement model describes the relationship between latent variable and the indicators.

SEM was initially developed by Jöreskog (1973) with a covariance approach and then called covariance-based SEM (CBSEM). However, there are two deficiencies to this approach, it can cause the inadmissible solution and factor indeterminacy. In addition, CBSEM still relies on fulfilling the assumption of double normality and limited to reflective indicator variable.

In 1982, Wold developed an approach to estimate latent variable that considered as a linear combination of the indicator variable that called Partial Least Square Path Modeling (PLS-PM). Multiple normality assumptions is not required in the PLS-PM, the data should not have a specific scale, the number of samples may be small, and may be even used in large amounts of data when CBSEM has reached its limits (Haenlein and Kaplan 2004). The analysis results using PLS can avoid two major problems faced by CBSEM as mentioned earlier.

In the application of SEM, various methods are often used in social research, among others are in the field of psychology, education, economics, and management. According to the authors, one of the interest areas to be studied more deeply is the field of education, especially education quality assessment. The education quality of a country is one of the indicators of a country's progress. Indonesia has

formulated the education quality assessment by using National Education Standard (SNP).

SNP is a benchmark on various aspects relating to the implementation of national education system. SNP aims to ensure the quality of education, which is organized by each provider or unit of education. To achieve the quality of education, educational providers can use SNP as a basis for education planning, implementation, and supervision. Therefore, every educational provider in the territory of a Unitary State of Republic Indonesia should continue to strive in order to meet the criteria of SNP.

SNP consists of 8 (eight) standards, namely Standard of Content (SI), Standard of Process (SPR), Standard of Graduate Competency (SKL), Standard of Educators and Educational Personnel (SPT), Standard of Facilities and Infrastructure (SSP), Standard of Management (SPL), Standard of Financing (SB), and Standard of Educator Assessment (SPN). SKL is a minimum graduate competency criteria. SKL consists of qualification criteria of students' ability, which is expected to be achieved after completing their study. SI, SPR, SPT, SSP, SPL, SB, and SPN are made with reference to SKL. The eight SNP are used by National Accreditation Board of Schools/Madrasah (BAN-S/M) to undertake the accreditation process as a guidelines for classification of school accreditation.

The accreditation tool used should be reliable in order to the measurement model is compatible with the condition in the field. Therefore, evaluation of accreditation tools needs to be done on an ongoing basis. Some of the reasons for the importance of an accreditation tools' evaluation are because there are a few items that require to be adapted to the conditions in the field, there are some points that may give rise to different understandings, and there are some incomplete points in the data collection instrument and supporting information (Ferezagia 2015).

The eight SNP used in the accreditation are referred to as latent variable because it is not available to be measured directly. However, it can be measured through the indicator variables. One of the methods to find out relationship between the latent variables and relationship of latent variable with the indicator variable is by using SEM.

II. METHODS

A. Research Objectives

The purposes of this study are as follows:

1. Identify the structural equation model of SNP.
2. Applying the PLS-PM to the relationship pattern of eight National Education Standard on the data of SMK accreditation results in 2017 in Banten Province.

B. Data

The data to be used in this research is the result of accreditation of Vocational High School (SMK) Banten Province in 2017 obtained from Research and Development Board of Culture and Education Ministry. The data used are 124 SMK skills programs, consisting of 133 indicator variables that compose 8 latent variables. The indicator variables are the items of questions raised on the accreditation instrument of SMK/MAK. Responsible person for the answer of the device is the head master. All items on the instrument are closed questions with five answer options namely A, B, C, D, and E provided that the score of each answer option is 4 for A, 3 for B, 2 for C, 1 for D, and 0 for E. The option is selected according to the available evidence.

The SI component is arranged by indicators 1 to 9, the SPR component arranged by indicators 10 to 30, the SKL component arranged by indicators 31 to 37, the SPT component arranged by indicators 38 through 59, the SNP component arranged by the indicator 60 to 87, the SPL component arranged by the indicator 88 to 102, the SB component is arranged by indicators 103 to 120, and the SPN component is arranged by indicators 121 to 133.

C. The Stages of Analysis

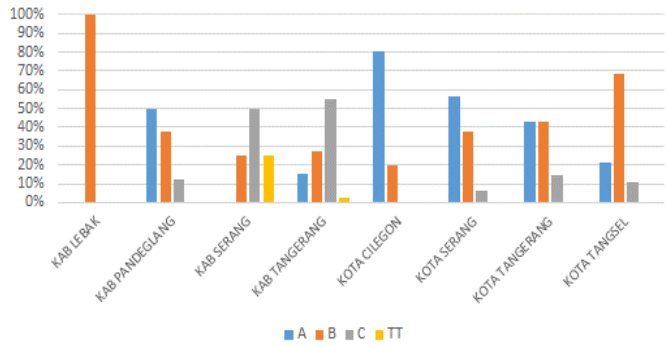
The stages of data analysis in this study are as follows:

1. Collecting data.
   The data used is secondary data of accreditation result from 124 skills program of SMK in Banten Province in 2017.
2. Exploring data.
   Data exploration is used to provide an overview of the accreditation results of SMK.
3. Modeling the data by using PLS-PM.
   Data are modeled by using PLS-PM to evaluate the measurement and structural coefficient of the model.
4. Making conclusion.

III. RESULTS AND DISCUSSION

A. Data Exploration

Accreditation of SMK in 2017 in Banten Province was conducted on 124 skill programs consisting of 37 skill programs at SMKN and 87 skill programs at SMKS. The percentage of accreditation result of the overall skill program in Banten Province, those are school which is accredited A at 31.5%, accredited B at 41.1%, accredited C at 25.8% and TT at 1.6%. Percentage of skill program accreditation results



based on regency/city region shown in Figure 1.

Figure 1. Percentage of skill program accreditation status of SMK in Banten Province

Figure 1 shows that all of the accredited skill programs in 2017 that have accreditation status A is dominated by schools located in urban areas. In contrast, schools located in district areas tend to obtain accreditation status B, C and TT except for some schools in Kab. Pandeglang and Kab. Tangerang.

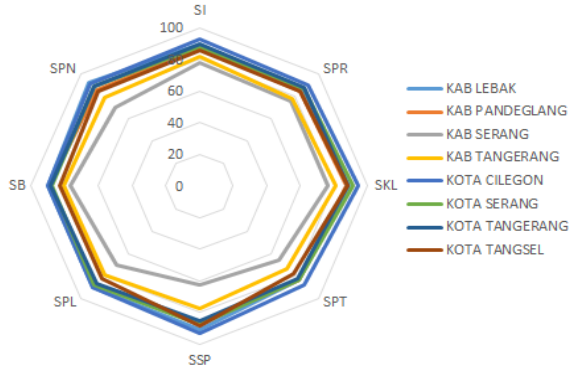


Figure 2. Achievement of SNP for each regency/city in Banten Province

The achievement of the average SNP value for each regency/city region in Banten Province is shown by the available graph in Figure 2. Referring to the figure, it is seen that the average achievement of SNP of each regency/city in Banten Province is over 60. Cilegon city has the highest value while Lebak regency has the lowest average value.

The result of biplot analysis in Figure 3 illustrates the relationship between the latent variables of SNP. If the angle between the latent variables get smaller, then the correlation between the latent variables will get greater.

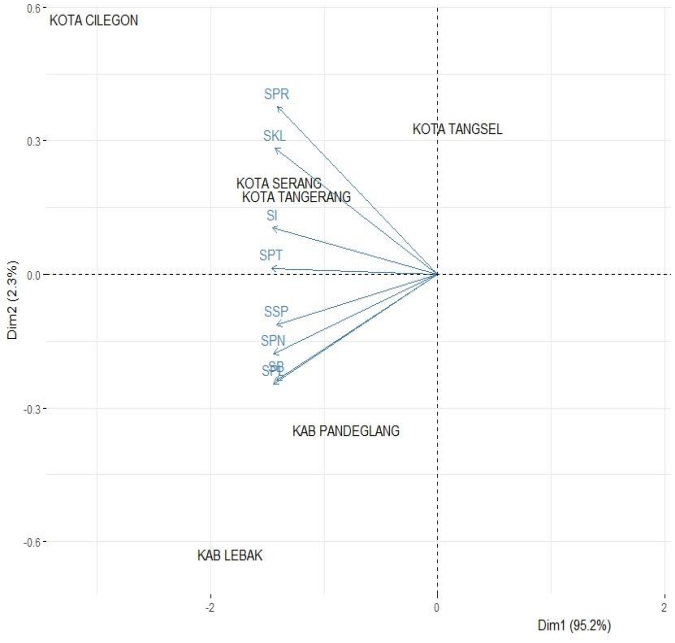


Figure 3. Biplot analysis between latent variables towards the region

According to Figure 3, every latent variable have a positive correlation each other since every angles formed are not greater than 90º. This means that authors can freely determine the relationship pattern among latent variables.

Taking into account the theory of education and research that has been done by previous researchers and as described in the literature review, the authors argue that the pattern of relation between the eight SNP are as follows.

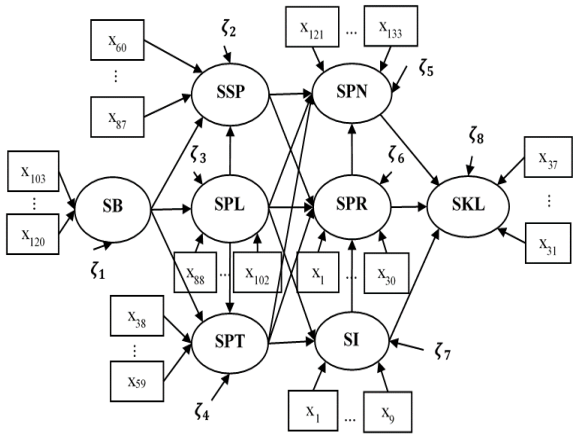


Figure 4. Path Diagram of eight SNP (initial model)

B. Evaluation of Measurement Model

A high correlation between two formative indicators also means that both indicators have a collinierity that may cause problems in methodology and interpretation (Hair *et al.*, 2013). One way to know the collinierity of the indicator variable is by looking at the value of variance inflation factor (VIF) in each variable. The VIF < 5 denotes that the variable do not have collinierity problem.

In this study all indicator variables have VIF value smaller than 5. In other words, that all indicator variables do not have a problem of collinierity. Therefore, further tests may be performed.

The next test is significance test to convince us that the indicator variable we use have built the latent variable that we assumed before. This is done by using the bootstrapping procedure. In this study, the bootstrapping procedure yielded 95 significant indicator variables and 38 other insignificant indicator variables.

From 38 variables, there are 3 variables that must be eliminated from the model namely items 13, 46, and 61. Other insignificant variables can be recommended to the related parties (BNSP) to be evaluated for accreditation process of SMK.

C. Evaluation of Structural Model

Structural model testing is done through several stages of collinierity and significance test between latent variables. In line with formative measurement model testing, structural model collinierity testing is also done by looking at the VIF value of the structural relationship formed. If the value of VIF < 0.5 then it can be said that the relationship is free from the problem of collinierity.

Based on the analysis result, the VIF value has four paths indicated to have the problem of collinearity, those are SPR toward SKL and SPN and SPT toward SPN and SPR with VIF value respectively are 7.07, 5.46, 7.20 and 5.85. This means that there is a probability that the indicator variable measures the same latent variables so that a merger or separation must be performed at the level of the latent variable to overcome the problem of the collinearity.

The next test is significance test for structural path coefficient done by using bootstrapping procedure. In this research, there are five insignificant paths: SI to SKL, SPL to SI, SPL to SPN, SPL to SPR, and SPT to SPN. So it can be said that in this case there is no relationship from SI to SKL, SPL toward SI, SPN, and SPR, and SPT to SPN.

Table 1. Insignificant path coefficients

	Coefficient	P *Values*
SI -> SKL	0.074	0.492
SPL -> SI	0.084	0.446

SPL -> SPN	0.126	0.179
SPL -> SPR	-0.078	0.336
SPT -> SPN	0.146	0.210

The insignificant path is removed from the model to form a better structural model. After the structural path is abandoned and reprocessed, the entire structural path formed has become significant. Modified structural model with R-*square* value and path coefficient can be seen in the following figure.

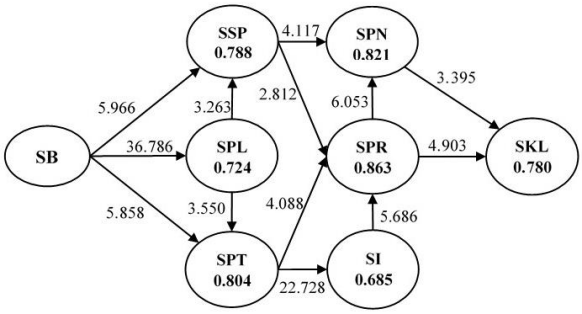


Figure 5. Modified structural model

The number contained within the latent variable circle represents the R-*square* value of each structural model, while the numbers contained outside the circle are the coefficients of each path. Based on the picture above shows that the SKL variable is directly affected by SPN and SPR variables with SPR influence of 4.903 greater than SPN variables of 3.395. Similarly, interpretation for other path coefficients.

The R-*square* value of structural model except SI and SPL is more than 0.75 indicating that the model is extremely good. The highest R-*square* value is in the model with the SPR variable as the dependent variable of 0.863. In other words, 86.3 percent of SPR diversity can be explained by the SSP and the SPT, the remainder is explained by other unavailable variables in the model.

IV. CONCLUSION

In this research, the relation model of SNP is constructed from educational theory, previous research result, and descriptive analysis to accreditation data of SMK in Banten Province in 2017. The model is analyzed by using PLS-PM. Based on the evaluation results of the measurement model, it can be concluded that there are 3 indicator variables that must be eliminated from the model and 35 others can be recommended to related parties to be evaluated or eliminated from the accreditation instrument of SMK. The formed structural model is adequately good because most of the R-*square* value is more than 0.75.

V. REFERENCES

[1]. [PPMP] Pusat Penjaminan Mutu Pendidikan. 2012. Pedoman Pemenuhan Standar Nasional Pendidikan pada Sekolah Menengah Kejuruan (SMK)/Madrasah Aliyah Kejuruan (MAK). Jakarta (ID).

[2]. Bollen KA. 1989. Structural Equation Modeling with Latent Variables. New York (USA): John Wiley and Sons.

[3]. Ferezagia DV. 2015. Model Persamaan Struktural Delapan Standar Nasional Pendidikan dengan Generalized Stuctured Component Analysis Tesis]. Bogor (ID): Institut Pertanian Bogor

[4]. Hair JF, Ringle CM & Hult GM, Sarstedt M. 2013. Primer on Partial Least Square Structural Equation Modeling (PLS-SEM). Los Angles (USA): Sage Publications

[5]. Haenlein M, Kaplan AM. 2004. A Beginner's Guide to Partial Least Squares Analysis. Understanding Statistics. Vol.3 No.4: pp. 283-297

[6]. Jaya M, Sumertajaya IM. 2008. Pemodelan persamaan struktural dengan partial least square. Prosiding Seminar Nasional Matematika dan Pendidikan Matematika. Bogor (ID):118-132.

[7]. Joreskog KG. 1973. A General Method for Estimating a Linear Structural Equation System. In A.S Goldgerger & O. D. Duncan (Eds). Structural Equation Models in Social Sciences (pp. 85-112). New York: Academic Press

[8]. MacKenzie SB, Podsacoff PM, Jarvis CB. 2005. The problem of measurement model misspecification in behavioral and organizational research and some recommended solutions. Journal of Applied Psychology. 90(4):710-730.

[9]. Schumacker RE, Lomax RG. 2010. A Beginner's Guide to Structural Equation Modeling Third Edition. New York (USA): Routledge Taylor & Francis Group. B