

Designing Education Development Model: The Educational Supply Chain

Bedi Susanto^{1,2}, Endang Chumaidiyah¹ and Husni Amani¹

¹Industrial Engineering, Telkom University
JL. Telekomunikasi 1 Bandung, Indonesia

²PPPTK BMTI, Ministry of Education of the Republic of Indonesia, Bandung, Indonesia
beriesell@yahoo.com, endangcn@gmail.com, husni.amani@gmail.com

Abstract.

Increasing competency for teacher is necessary, with high competence the teacher can teach well so as to produce competent graduates. The X training centre is an institution that has the task of increasing the competency of vocational teachers in Indonesia. Education Development refers to the Integrated Tertiary Educational Supply Chain Management (ITESCM) model influenced by four factors namely Program Establishment, culture, capabilities, and facilities. In this study four construct variables will be investigated in related to education development from the three decision levels (strategic level, planning level and operating level). The method used in this study is to use a variance-based analysis of Structural Equation Modelling (SEM) that is Partial Least Square (PLS) either partially or simultaneously. The final results in this study are, partially Education Development (SL, PL, OL) = 0.007 Program Establishment + 0.409 Culture + 0.331 Capabilities + 0.312 Facilities, with a simultaneous R-square value of 0.507, this implies that the education development variation can be explained by the variable constructs of the Program Establishment, culture, capabilities and facilities by 50.7% while the remains 49.3% is affected by other variables.

Keywords

Supply Chain Management, Education Development and Model

1. Introduction

Teacher as educators from early childhood education, basic education and secondary education level has a very important role in determining the success of students. Teacher becomes the determinant of the quality education improvement at school. The importance of the role of teacher in education is mandated in *Laws of The Republic Indonesia* (2005) regarding teacher and lecturer which behest the teacher training and development as the actualization of teaching profession. The term education development in this study refers to the efforts endeavoured in improving the quality of educational process and outcomes. Education development comprises pedagogic, professional, personality, and social competence.

Referring to a study by Habib and Jungthirapanich (2009), higher education supply chain management comprises of two fields namely education and research. Educational supply chain is divided into two: education assessment and education development that originally developed by (Habib 2009). This study aims at developing Education Development model at the X training centre is a part of, Ministry of Education and Culture of Republic of Indonesia. The educational supply chain in Integrated Tertiary Educational Supply Chain Management (ITESCM) model has four variables (Lau 2007) which are analysed in this study, they are programs establishment, university culture, faculty capabilities and facilities. The four variables will be adopted to create a new model to gain a new overview of education development model using educational supply chain at the X training centre.

The study of the X training centre educational supply chain was conducted to examine the effect of each variable to education development variable through ITESCM model. ITESCM model was developed by (Habib 2009) with variable adjustment: (1) Program establishment or education and training program in the X training centre includes Vocational Teacher Competence Improvement Program in the field of technology and engineering from 12 provinces in Indonesia with dimensions of training materials, training program structure and time of training, (2) Culture is an organizational culture in the X training centre with dimensions of work culture, work ethic, creativity and innovation, (3) Capabilities is the capability of educational and service system at the X training centre with dimensions of teaching and service system, (4) Facilities refer to all existing facilities at the X training centre used by instructors and participants with dimensions of

learning facilities, practice facilities, accommodation, and logistics. Partial Least Square Structural Equation Modelling (PLS-SEM) is one of methods used in this study revealing the truth of the concept of theories about the factors that affect education development in the X training centre. PLS it self is a powerful analysis method because the method is not based on many assumptions where the data do not have to be multivariate normally distributed and the sample does not have to be large.

2. Literature Review

2.1. Supply Chain Management

According to Habib (2011), the definition of supply chain as follows: Supply chain is all activity of the flow of goods and services from upstream to downstream accompanied by information flow. While Robberta and Bernard (2011) and Chumaidiyah (2017) stated that supply chain management Supply chain management is an activity that starts from raw materials, processes and delivery to customers. Supply chain management is an activity of suppliers, producers and consumers. Based on this definition, supply chain management (SCM) is related to the management of raw material and service flow, production process, and its distribution along the supply chain flows. The purpose of the supply chain is to integrate the flow of goods and service as well as information along the supply chain to maximize the value to customers at cost-efficient level.

2.2. University Educational Supply Chain

The role of supply chain management in the universities is shown in Figure 1. The study conducted by Heizer et al. (2014) elaborated the concept of Integrated Tertiary Educational Supply Chain Management (ITESCM). ITESCM is a university supply chain input and output with two main areas of activity: education and research.

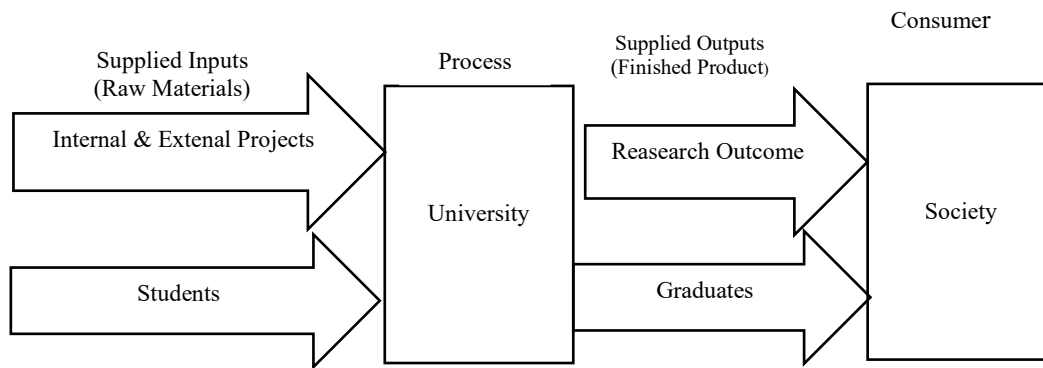


Figure 1. The overview of university supply chain

The X training centre is an institution that has the task of increasing the competency of vocational teachers in Indonesia. Like a university, the X training centre is a training institution so that the supply chain of training in the X training centre can be described in Figure 2.

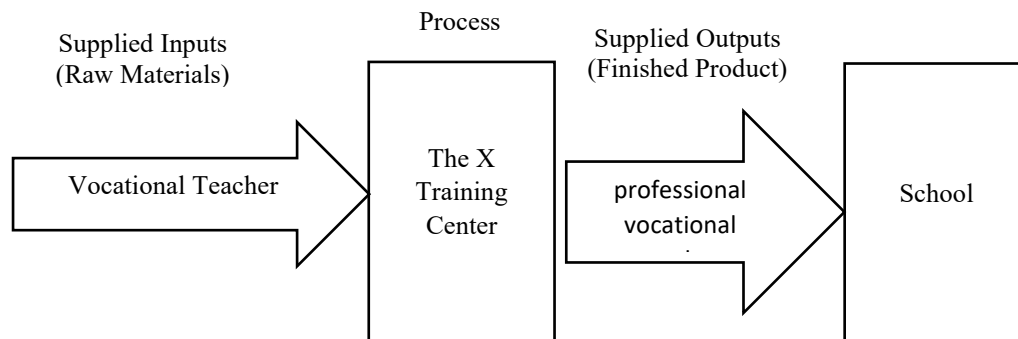


Figure 2. The X training centre supply chain.

According to the concept of three decision levels in SCM, this concept would be adopted in higher education (Harris 1998). In educational management, three decision levels, as illustrated in Figure 1 are involved in the process of the university: Phase 1: Strategic Level Phase 2: Planning Level Phase 3: Operating Level, the decision level shown in Figure 3.

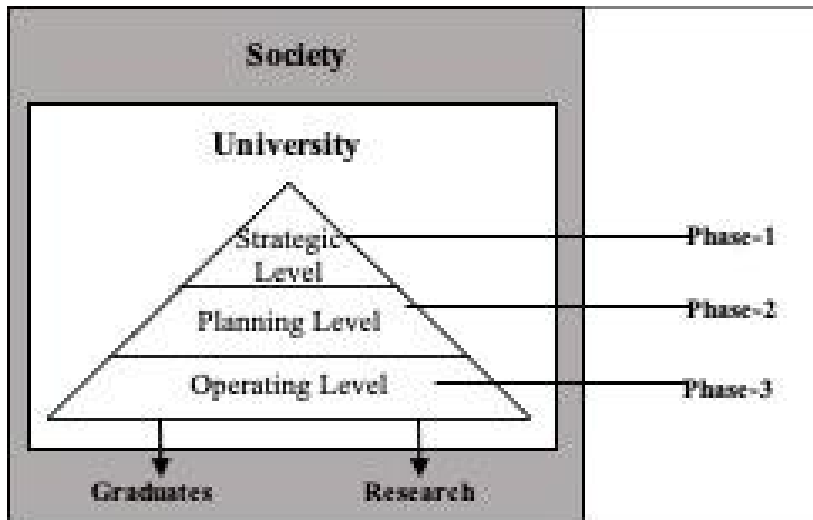


Figure 3. Decision level for university

In educational management for the universities four aspects including programs establishment, university culture, faculty capabilities, and facilities are considered for education development. The final outcomes from the university, i.e. quality graduates are delivered to the society. Adapted from previous research Habib and Jungthirapanich (2010), this study has adjusted the variables to be:

Programs Establishment (PE)	: Establish competency improvement programs for vocational teachers for educational development
Culture (BC)	: Management by objectives (MBO), good governance and academic
Capabilities (BCA)	: Training and service system (academic and non-academic services)
Facilities (FA)	: Academic supportive facilities, facilities quality assessment etc.

2.3. Teacher Educational Development

Competence is the combination of knowledge, skill, values and attitudes that is reflected in human's thought and action. McAshan (1981) stated that competence is knowledge, skill, and ability possessed by someone that has become part of himself so that he can perform cognitive, affective, and psychomotor behaviours as well as possible. In line with this, further Finch and Curtis (1979) defines competence as the mastery of a task, skill, attitude and appreciation needed to support success. Competence is a set of knowledge, skill, and behaviour that should be possessed, internalized and mastered by teachers in carrying out their professional duties. While teacher competence according to *Regulation of Republic Indonesia Government Regulation* (2005) includes Pedagogic Competence, Personality Competence, Professional Competence and Social Competence.

3. Research Methodology

3.1. Data Source

The data of this study was obtained from X Training Centre in 2018. The data includes the factors affecting the variables and indicators of education development. In this research respondents consisted of 11 structural officials/strategic level (SL), 40 instructors/planning level (PL) and 100 teacher training participants/operating level (OP).

3.2. Hypotheses

In revised ITESCM model by Habib and Bishwajit (2012), the authors represent five models in this section. From the research model, the following hypotheses are established as shown in Figure 4.

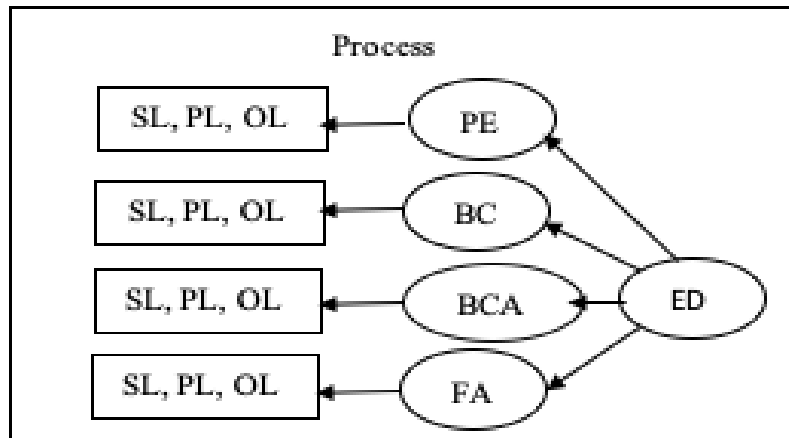


Figure 4. Relationship of research variables to the supply chain process at the X training centre.

There are 5 observed variables of this study:

ED = Education Development as Endogenous Variable
 PE = Program establishment as Exogen Variable
 BC = Culture as Exogen Variable
 BCA = Capabilities as Exogen Variable
 FA = Facilities as Exogen Variable

Three decision making levels:

SL = Strategic Level
 PL = Planning Level
 OL = Operating Level

From the research model, the following hypotheses are established:

- H1 : The effect of Program establishment on Education Development partially to the three decision making levels (Strategic Level, Planning Level, Operating Level).
- H2 : The effect Culture on Education Development partially to the three-decision making levels (Strategic Level, Planning Level, Operating Level).
- H3 : The effect of Capabilities on Education Development partially to the three-decision making levels (Strategic Level, Planning Level, Operating Level).
- H4 : The effect of Facilities on Education Development partially to the three decision making levels (Strategic Level, Planning Level, Operating Level).
- H5 : The effect of program establishment, culture, capabilities, facilities simultaneously on education development to the three decision making levels (Strategic Level, Planning Level, Operating Level).

3.3 Data Analysis

There are five latent variables in this study, they are Program Establishment, Culture, Capabilities, Facilities and Education Development. Each latent variable was measured by observed variable/ indicator. For SEM analysis, a series of relevant quantitative analysis was done using Partial Least Square Structural Equation Modelling (PLS-SEM). There are two types of models in structural equation modelling which are outer model and inner model (Wijaya 2012). The measurement model explains the proportion of variance from each manifest variable. The more dominant indicator in the formation of latent variable was found through the measurement model. After the measurement model elaboration of each latent variable, the structural model was described examining the effect of each exogenous latent variable toward the endogenous latent variable.

4. Result and Discussion

4.1. Descriptive Analysis

4.1.1. Respondent's Profile

Respondent characteristics are used to determine the diversity of respondents based on occupation. This is expected to provide a fairly clear picture of the condition of the respondent and its relation to the problems and objectives of this study. The diversity of respondents by occupation can be shown in Table 1 below:

Table 1. Respondents by occupation.

Occupation	Amount	Percentage
Structural officials	11	7.28%
Lecture	40	26.49%
Teacher	100	66.23%
Total	151	100 %

Based on the occupation characteristics of the respondents in Table 1, it can be seen that respondents who work as structural officials in X training centre are 11 people with a percentage of 7.28%, respondents who work as lecture as many as 40 people with presentations of 26.49% and respondents who work as teachers as many as 87 people with a percentage of 66.23%. Most of the respondents are respondents who work as teachers because they are in accordance with research, namely education development for teachers.

4.1.2. Variable Description

The scoring technique used in the research questionnaire was the Likert scale technique (Sugiono 2013), to make it easier to interpret the variables being studied, categorization of the survey results was carried out. the survey results on each statement item are categorized into five categories: very good, good, sufficient, not good and very not good with the following calculation:

- Maximum Index Value = Highest scale = 5
- Minimum Index Value = Lowest scale = 1
- Interval Distance = [maximum value - minimum value]: 5, = (5 - 1) : 5 = 0.8

Criteria obtained as in the Table 2.

Table 2. Categorization of respondents' response scores

Average Index			Category
4.21	-	5.00	Very Good
3.41	-	4.20	Good
2.61	-	3.40	Sufficient
1.81	-	2.60	Not Good
1.00	-	1.80	Very Not Good

In this study the variables are further divided into several dimensions and indicators: Program Establishment variable is measured by three indicators, Culture variable is measured with five dimensions consisting of seven indicators, Capabilities variable is measured by two dimensions consisting of five indicators, Facilities variable is measured by four dimensions consisting of eleven indicators and Education Development variable is measured by four dimensions consisting of fourteen indicators. A summary of the results of the survey of the five variables can be seen in the Table 3.

Table 3. Recapitulation of respondents' responses to the research variables

Variables	Total Score	Score Average	Category
Program Establishment	1,377	3.04	Sufficient
Culture	3,803	3.60	Good
Capabilities	2,404	3.18	Sufficient
Facilities	6,647	4.00	Good
Education Development	7,888	3.73	Good

4.2. PLS Analysis

SEM uses PLS consisting of three components (Monecke and Leisch 2012), namely structural models, measurement models and weighting schemes. This third part is a special feature of SEM with PLS and is not present in SEM which is covariant based. The model is described as Figure 5.

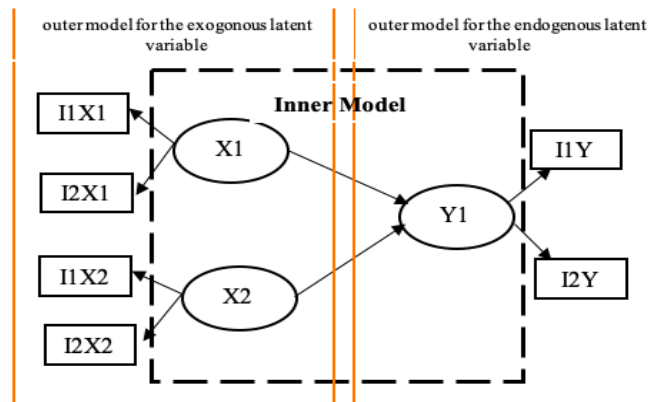


Figure 5. SEM PLS Model

SEM using PLS only allows a recursive variable relationship model (Kline 2001). This is the same as the path analysis model (path analysis) is not the same as the covariance-based SEM which also allows the occurrence of non-recursive relationships (reciprocity). In the structural model, which is also called the inner model, all latent variables are related to one another based on the theory of substance. Latent variables are divided into two, namely exogenous and endogenous (Hair et al. 2011). Exogenous latent variables are causal variables or variables without preceding other variables with arrows going to other variables (endogenous latent variables).

4.2.1. Outer Model Test Result

The evaluation of outer model includes individual convergent validity (from outer loading value), average variance extracted (AVE), discriminant validity and composite reliability. There are four exogenous latent variables in this study, namely Program Establishment, which was measured through three indicators, Culture which was measured through five dimensions consisting of seven indicators, Capabilities which was measured through two dimensions and five indicators, Facilities which was measured through four dimensions consisting of eleven indicators. There is one endogenous latent variable named Education Development which was measured through four dimensions comprising fourteen indicators. The Confirmatory factor analysis (CFA) measurement model test result using second order method in each research variable is in the following descriptions.

a. Convergent Validity Test

Convergent Validity from the measurement model with reflexive indicator was measured based on the correlation between score item and construct score. If the loading factor has fulfilled the convergent validity requirement by having a value of more than 0.5, then all indicators are valid. Aside from factor loading value, Average Variance Extracted (AVE) also determines the convergent validity. AVE is valid with the value of more than 0.5. Table 9 is a recapitulation of the measurement model test results with the first order method of the Program Establishment variable. Table 10 is a recapitulation of the measurement model test results with the first order method of the Culture variable.

Table 9. Convergent validity test for program establishment variable.

Latent Variable	Indicator	Loading Factor	t-statistic	AVE	Result
Training Program	PE1	0.932	94.454	0.869	Valid
	PE2	0.935	81.769		Valid
	PE3	0.930	83.245		Valid

Table 10. Convergent validity test for culture variable.

Latent Variable	Indicator	Loading Factor	t-statistic	AVE	Result
<i>First Order</i>					
Work Culture	BC1.1	0.903	52.639	0.839	Valid
	BC1.2	0.928	89.379		Valid
Work Ethic	BC2.1	0.868	42.809	0.836	Valid
	BC2.2	0.878	46.703		Valid
Togetherness	BC3.1	1.000	-	1.000	Valid
Creativity	BC4.1	1.000	-	1.000	Valid
Innovation	BC5.1	1.000	-	1.000	Valid
<i>Second Order</i>					
Culture	BC1	0.870	27.557	0.718	Valid
	BC2	0.955	124.174		Valid
	BC3	0.896	60.830		Valid
	BC4	0.796	21.938		Valid
	BC5	0.697	15.463		Valid

Table 11 is a recapitulation of the measurement model test results with the first order method of the Capabilities variable.
 Table 12 is a recapitulation of the measurement model test results with the first order method of the Facilities variable.

Table 11. Convergent validity test for capabilities variable.

Latent Variable	Indicator	Loading Factor	t-statistic	AVE	Result
First Order					
Training System	BCA1.1	0.882	47.294	0.713	Valid
	BCA1.2	0.862	33.928		Valid
	BCA1.3	0.786	27.016		Valid
Service	BCA2.1	0.897	59.620	0.776	Valid
	BCA2.2	0.864	30.699		Valid
First Order					
Capabilities (X3)	BCA1	0.957	126.442	0.878	Valid
	BCA2	0.917	65.711		Valid

Table 12. Convergent validity test for facilities variable

Latent Variable	Indicator	Loading Factor	t-statistic	AVE	Result
First Order					
Learning Facilities	FA1.1	0.940	59.914	0.888	Valid
	FA1.2	0.944	71.699		Valid
Practice Facilities	FA2.1	0.859	24.960	0.732	Valid
	FA2.2	0.902	43.968		Valid
	FA2.3	0.803	15.087		Valid
Accommodation	FA3.1	0.775	19.888	0.721	Valid
	FA3.2	0.869	37.784		Valid
	FA3.3	0.899	57.042		Valid
Logistics	FA4.1	0.890	40.958	0.807	Valid
	FA4.2	0.915	59.258		Valid
	FA4.3	0.889	41.626		Valid
Second Order					
Facilities (X4)	FA1	0.788	26.454	0.712	Valid
	FA2	0.818	25.550		Valid
	FA3	0.929	78.386		Valid
	FA4	0.834	35.009		Valid

b. Reliability Test

The evaluation of reliability construct was measured through composite reliability. Each construct is reliable if having composite reliability of more than 0.70. Table 14 shows that each construct has a composite reliability (CR) value greater than 0.7, which is reliable. This shows that each indicator has consistency in measuring the construct. Table 15 shows that each construct has a composite reliability (CR) value greater than 0.7, which is reliable. This shows that each indicator has consistency in measuring the construct.

Table 14. Composite reliability test for program establishment variable.

	Cronbach's Alpha	Composite Reliability	Result
PE	0.925	0.952	Reliable

Table 15. Composite reliability test for culture variable.

	Cronbach's Alpha	Composite Reliability	Result
BC1	0.808	0.912	Reliable
BC2	0.803	0.911	Reliable
BC3	1.000	1.000	Reliable
BC4	1.000	1.000	Reliable
BC5	1.000	1.000	Reliable

Table 13 is a recapitulation of the measurement model test results with the first order method of the Program Establishment variable.

Table 13. Convergent validity test for education development variable.

Latent Variable	Indicator	Loading Factor	t-statistic	AVE	Result
First Order					
Pedagogic	ED1.1	0.926	51.147	0.858	Valid
	ED1.2	0.926	62.923		Valid
	ED1.3	0.927	60.258		Valid
Personality	ED2.1	0.899	33.270	0.887	Valid
	ED2.2	0.961	110.680		Valid
	ED2.3	0.965	122.882		Valid
Professional	ED3.1	0.885	49.423	0.667	Valid
	ED3.2	0.755	11.446		Valid
	ED3.3	0.820	16.557		Valid
	ED3.4	0.802	16.790		Valid
Social	ED4.1	0.918	59.142	0.662	Valid
	ED4.2	0.927	72.739		Valid
	ED4.3	0.671	7.849		Valid
	ED4.4	0.703	14.405		Valid
Second Order					
Education Development	ED1	0.792	21.983	0.650	Valid
	ED2	0.824	27.976		Valid
	ED3	0.827	29.085		Valid
	ED4	0.781	16.245		Valid

Table 16 shows that each construct has a composite reliability (CR) value greater than 0.7, which is reliable. This shows that each indicator has consistency in measuring the construct. Table 17 shows that each construct has a composite reliability (CR) value greater than 0.7, which is reliable. This shows that each indicator has consistency in measuring the construct. Table 18 shows that each construct has a composite reliability (CR) value greater than 0.7, which is reliable. This shows that each indicator has consistency in measuring the construct.

Table 16. Composite reliability test for capabilities variable.

	Cronbach's Alpha	Composite Reliability	Result
BCA1	0.797	0.881	Reliable
BCA2	0.712	0.874	Reliable

Table 17. Composite reliability test for facilities variable.

	Cronbach's Alpha	Composite Reliability	Result
FA1	0.873	0.940	Reliable
FA2	0.816	0.891	Reliable
FA3	0.804	0.886	Reliable
FA4	0.880	0.926	Reliable

Table 18. Composite reliability test for education development variable.

	Cronbach's Alpha	Composite Reliability	Result
ED1	0.918	0.948	Reliable
ED2	0.936	0.959	Reliable
ED3	0.833	0.889	Reliable
ED4	0.827	0.884	Reliable

4.2.2. Structural Model Test (Inner Model)

Structural model connects exogenous latent variables and endogenous latent variables or the relationship among endogenous variables (Chin 1998). In this study the structural model is related to five hypotheses inferring causality relationship among latent variables. Following are the result of full structural model from the three decision making levels (Strategic Level, Planning Level, Operating Level). The hypotheses of this study are shown in this following Figure 6.

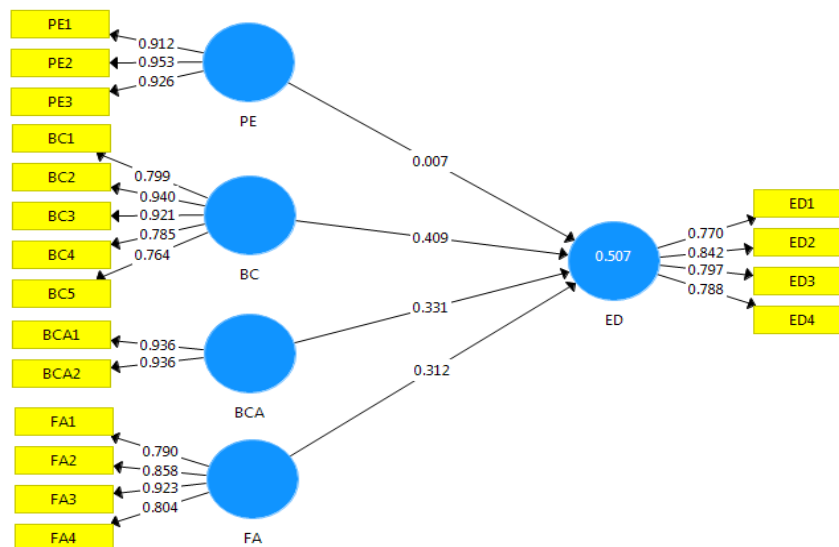


Figure 6. The results of the full Structural models (Standardized) Strategic Level, Planning Level, Operating Level.

Based on the test result, each standardized coefficient (Path) among variables shows positive result. Bootstrapping method was used in order to find out the significance of the relationship between variables, as shown in Figure 7.

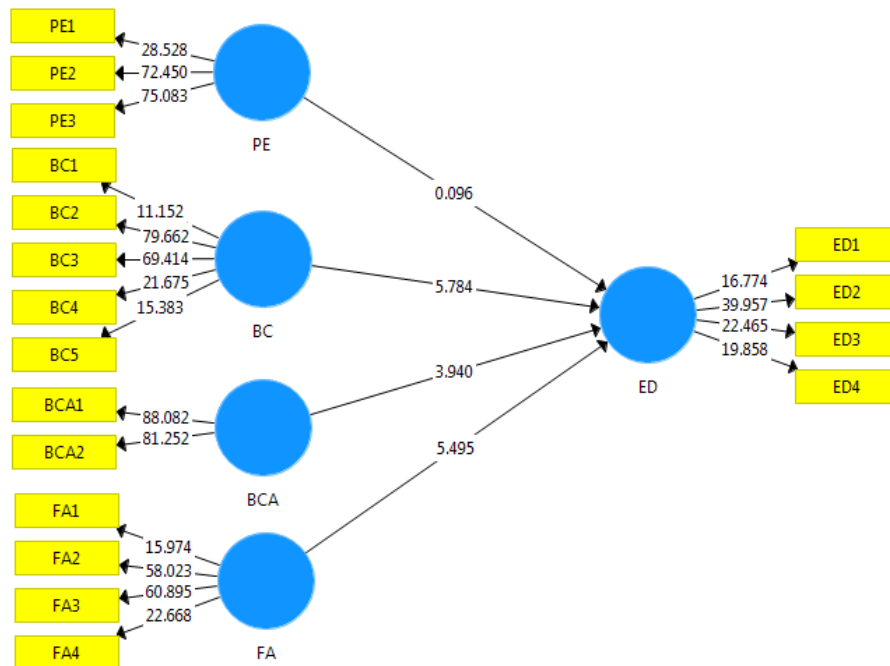


Figure 7. Structural full model results (bootstrapping).

The following summarizes the results of the structural model estimation of the relationship between latent variables through the Path coefficient test (path coefficient) described in Table 19.

Table 19. Summary of estimation results of path coefficient and statistical test.

Relationship	Path Coefficient	t-statistic	p-value	R-square partial	R-square simultaneous
PE -> ED	0.007	0.096	0.925	0.002	0.507
BC -> ED	0.409	5.784	0.000	0.191	
BCA -> ED	0.331	3.940	0.002	0.151	
FA -> ED	0.312	5.495	0.000	0.164	

Through the recapitulation results in the table above it can be seen that the Program Establishment variables (PE), Culture (BC), Capabilities (BCA), facilities (FA) have a 50.7% influence on Education Development (ED), while the remaining 49.3% is influenced by other variables besides the 4 independent variables. Judging from the value of the path coefficient, the most dominant variable sequentially in influencing Education Development is Culture (BC) with a path coefficient of 0.409 (19.1%), then Capabilities (BCA) with a path coefficient of 0.331 (15.1%) , then facilities (FA) with a path coefficient of 0.312 (16.4%) and finally the Program Establishment (PE) with a path coefficient of 0.007 (0.2%).

Hypothesis test results are summarized in the Table 20.

1. The t-statistic value of Program Establishment variable on Education Development 0.096 is bigger than t-table 1.96 with p value 0.925. Since t-statistic 0.096 is smaller than 1.96 and p value 0.925 > 0.05, with margin of error 5% (two tail), H1 is rejected and H0 is accepted. This showed that there is no significant effect of Program Establishment on Education Development partially to the three decision making levels (Strategic Level, Planning Level, Operating Level).

2. The t-statistic value of Culture variable on Education Development is 5.784 with p value 0.000. Since t-statistic 5.784 is bigger than t-table 1.96 and p value $0.000 < 0.05$, with margin of error 5% (two tail), H_0 is rejected and H_2 is accepted. It can be inferred that there is a significant effect of Culture on Education Development partially to the three decision making levels (Strategic Level, Planning Level, Operating Level).
3. The t-statistic value of Capabilities variable on Education Development is 3.940 with p value 0.002. since t-statistic 3.940 is bigger than t-table 1.96 and p value $0.002 < 0.05$, with margin of error 5% (two tail), H_0 is rejected H_3 is accepted. Therefore, there is significant effect of Capabilities on Education Development partially to the three decision making levels (Strategic Level, Planning Level, Operating Level).
4. The t-statistic value of Facilities Variable on Education Development is 5.495 with p value 0.000. Since t-statistic 5.495 is bigger than t-table 1.96 and p value $0.000 < 0.05$, H_0 is rejected and H_4 is accepted. Therefore, there is a significant effect of on Education Development partially to the three decision making levels (Strategic Level, Planning Level, Operating Level).
5. F-count = 37.537 > F-table = 2.434. it can be implied that H_0 is rejected and H_5 is accepted. It can be concluded that there is a significant effect of program establishment, Culture, Capabilities and facilities simultaneously on education development to the three decision making levels (Strategic Level, Planning Level, Operating Level).

Table 20. Hypotheses testing results.

Relationship	Path Coefficient	t-statistic	p-value	Result
PE -> ED	0.007	0.096	0.925	Not Significant
BC -> ED	0.409	5.784	0.000	Significant
BCA -> ED	0.331	3.940	0.002	Significant
FA -> ED	0.312	5.495	0.000	Significant

Based on the results of the path analysis, using linear equations, the SEM PLS model for Education development is:
 Education Development (SL, PL, OL) = 0.007 Program Establishment + 0.409 Culture + 0.331 Capabilities + 0.312 Facilities.

5. Conclusion

The equation model obtained from the variance-based Fit model from Partial Least Square Structural Equation Modelling (PLS-SEM) as follows, Education development equation model partially to the three decision making levels (Strategic Level, Planning Level, Operating Level):

$$\text{Education Development (SL, PL, OL)} = 0.007 \text{ Program Establishment} + 0.409 \text{ Culture} + 0.331 \text{ Capabilities} + 0.312 \text{ Facilities}$$

1. At the strategic level, planning level and operating level partially tested, stating that Culture is a significant factor influencing education development. This means that the implementation of education and training at the X Training Centre to produce teachers with high competency strategic level, planning level and operating level must be able to create a good culture.
2. At the strategic level, planning level and operating level that are partially tested, states that Capabilities are a significant factor influencing education development. This means that the implementation of education and training at x training centre to produce teachers with high competency strategic level, planning level and operating level must be able to synergize in good capabilities.
3. At the strategic level, planning level and operating level partially tested, stating that facilities are a significant factor influencing education development. This means that the implementation of education and training at the X training centre to produce teachers with high competency at the strategic level, planning level and operating level must improve facilities in the implementation of education and training.
4. At the level of the strategic level, planning level and operating level tested by stating that the Program Establishment factors, Culture, Capabilities, facilities. This means that in the implementation of education and training in the X training centre to produce teachers with high competency, strategic level, planning level and operating level must increase the Program Establishment, Culture, Capabilities, and Facilities.

The problem studied in this study is limited, therefore it is suggested for the future researchers to develop more model, for instance by exploring other variables that may affect education development. Thus, it is expected to contribute to

teacher competence development. Future studies are expected to compare other variance-based methods with the same data to find out the most fit method. Lastly, mixed data scale can be used to see the extent of PLS parameter in overcoming cases with different data types.

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