

Analysis of Structural Equation Modeling as a Measuring Tool for Educational Management Research

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Abstract

In management education and psychology there are certain concepts that cannot be well defined and then various discussions arise about the true meaning of the concept. Concepts such as management intelligence, personality, attitudes, interests, ambitions, social prejudice and social status are hypothetical constructs that are not available in operational methods that can directly measure them. Concepts such as intelligence, personality, attitudes, interests, ambitions, social prejudice, social status are hypothetical constructs that are not available operational methods that can directly measure them. This study aims to determine the background of the use of Structural Equation Modeling (SEM), understanding SEM, basic concepts of SEM: constructs, manifest variables, validity, reliability, factor analysis, polycoric correlation, causal relationships, LISREL: Linear Structural Relationship, SEM procedures : definition of variance and covariance, model specifications, model identification, model estimation, model formation, model compatibility test, model specification, LISREL program output. Symbols in SEM and SEM mathematical equations. The method used during this study took place, namely using a literature study method which functions so that in research, researchers continue to add insight.

Keywords: Management, Structural Equation Modeling, LISREL

1. Introduction

In management education and psychology there are certain concepts that cannot be well defined and then various discussions arise about the true meaning of the concept. Concepts such as management intelligence, personality, attitudes, interests, ambitions, social prejudice and social status are hypothetical constructs that are not available in operational methods that can directly measure them. thus the management of education will be more productive [1].

This concept is called a latent variable. Because it cannot be observed directly, then to explain the latent variables used other variables that are manifestations or manifestations of these latent variables, namely what are referred to as observed variables that can be observed or measured empirically and are often referred to as indicators of the measure of latent variables [2] or manifest variable.

Intelligence Quotien (IQ), is the value obtained from an intelligence test tool [3] or with another definition of intelligence or IQ a concept in psychology and education which is an example of a latent variable. People cannot measure it directly, but can make measurements through its manifestations, namely variables that are assumed to be the embodiment of IQ.

The measured scores on the observed variables, namely numerical, verbal, mechanical and spatial abilities are a reflection of a person's high and low IQ. If the measurement results show that a person has a high score on observed variables (numerical, verbal, mechanical and spatial) then this can be used as an indication that a person's IQ is high, and vice versa.

The situation above will be more complex if the researcher does not only do a single analysis of one latent variable, but looks for relations between latent variables. Or researchers try to find the best understanding of the relationship between two latent variables by trying to solve them through the third, fourth, and so on. Also if researchers are not just looking for relationships but want to see a causal relationship of various latent variables, where researchers use an approach known as causal models.

A researcher in HRD seeks to express the pattern of influence between management job satisfaction and management productivity levels. HRD researchers have an assumption or conjecture that employee job satisfaction will have a significant effect on work productivity. The next thing is how the HRD researchers measure the level of satisfaction of employees who work in the management and productivity in working. Is employee satisfaction and productivity which is a construct can be measured directly.

Job satisfaction or job satisfaction creates a work atmosphere that is positively correlated with the high performance of employees in the organization. Job satisfaction and psychological distress of one another have a negative correlation [4]. and can be interpreted in salary satisfaction, satisfaction from any aspect, especially management work. But according to Panjaitan, M. (2018). Productivity is the ratio between input and output with a focus on attention to the output produced by a process, usually a combination can be used to produce a certain level of output [5]

In statistical techniques we know what is called Structural Equation Modeling, then abbreviated as SEM. SEM is a statistical technique that is able to analyze the pattern of the relationship between latent extracts and indicators, latent extract with one another, and direct measurement errors.

From the explanation above, the author intends to provide an understanding of research management, so that it can be used as a measurement tool in management education. With this the author takes the title of the research "Analysis of Structural Equation Modeling as a Measure Tool for Educational Management Research"

2. Research Methods

At the time this management research took place researchers used the Library Study method which has a definition of a method used to collect relevant information in accordance with the topics and problems that are the object of research [6]

Or another understanding According to Rahardja, U (2009), Literature Review is written material both in the form of books and sources from previous research, discussing the subject matter of journals or scientific works with topics to be researched that are relevant to previous research topics or those that already exist. Because in previous studies there have been many scientific studies that conducted research on credit memo features to minimize deposits and uncollectible accounts [7] Basically this research method is a way to collect data or information needed which will then be analyzed [8]. which can be used to discuss existing problems [9] and with the existence of research methods researchers can collect information or data and conduct an investigation of the information that has been obtained [10]. The following are some literature studies related to this management research:

1. This research was conducted by Purwanto, H., & Firmansyah, D. (2018) entitled "APPLICATION OF STRUCTURAL EQUATION MODELING (SEM) MEDODOLOGY FOR ANALYSIS OF THE EFFECT OF EMPLOYEE INFORMATION SYSTEMS ON HUMAN RESOURCES PLANNING (CASE STUDY: ENERGY DEPARTMENT AND MINERAL RESOURCES, WEST JAVA PROVINCE) "Explained that the Structural Equation Modeling methodology is expected to be more optimal in analyzing the effect of personnel information systems on human resource planning assisted with Lisrel 8.80

application. It also has a less significant value on employee training indicators, namely getting a 0.032 loading value which means the indicator is not significant because the value of the loading factor is good which is > 0.50 . Likewise, the t value of the statistics only gets a value of 0.32, the employee training indicator is not fit because the fit value must be > 1.96 . [11]

2. This research was conducted by Budiman, A. S. (2018). entitled "ANALYSIS OF REGIONAL GOVERNMENT WEBSITE AND ITS EFFECT IN THE IMPLEMENTATION OF E-GOVERNMENT FOR RURAL COMMUNITIES IN INDONESIA" which explains that the understanding of Structural Equation Modeling (SEM) is a second generation multivariate analysis technique that allows researchers to test and estimate simultaneously the relationship between several independent latent variables and dependent variabelaten [12]
3. This research was conducted by Bahri, S., Abrar, A. I. P., & Angriani, A. D. (2017). with the title "COMPARISON OF DEDUCTIVE AND INDUCTIVE METHODS ON MATHEMATICAL LEARNING OUTCOMES REVIEWED FROM STUDENT LEARNING MOTIVATION" This study aims to find out the description of learning outcomes, the instruments used in this study are learning outcomes tests and questionnaires and reliability tests produce a reliable measurement. [13]
4. This research was conducted by Pidarta, M. (2016) entitled "Educational Management in the Era of Globalization." This study explains that education management in this era of globalization so that educational institutions can succeed more than in this era of globalization. Education management has such great benefits that it provides opportunities for education personnel to take part in making decisions within the limits of ability. [14]
5. This research was conducted by Anwar, M. (2018) with the title "Application of Emotional Spiritual Quotient (ESQ) Based Education and Training in Manado Religious Training Center" which explains that IQ is a measure of one's intellectual ability, analysis, logic and ratio. Thus, this is related to speaking skills, awareness of space, awareness of something that appears, and mastery of mathematics. IQ measures our speed to learn new things, focuses on various tasks and exercises, saves and binds back objective information, engages in thought processes, works with numbers, thinks abstractly and analyzes, and solves problems by applying existing knowledge. If our IQ is high, the average number is 100, we have very good capital to pass all the tests brilliantly, and (not coincidence) achieve good scores in the IQ test [15].
6. This research was conducted by Prawiradisastra, M. I. B., Ma'arif, M. S., & Kuswanto, S. (2018). entitled "The effectiveness of sharia Sacrifice socialization through collocation program in the iPb from the Ministry of Religion" in this study using Structural Aquation Modeling as an analysis of data processing while for processing data from SEM itself using Lisrel which aims to conclude that Dramaga BNI Bank employees notifying about the service schedule, Bank BNI employees of the Dramaga branch provided services quickly, employees of the Bank BNI Dramaga branch provided appropriate services, I received a socialization of the collocation program while transacting in BNI Conventional, Dramaga branch BNI employees provided detailed explanations of the socialization of the collocation program in Conventional BNI. The most dominant variable forming the responsiveness variable is the Bank BNI employee Dramaga branch providing appropriate service [16].

From 6 (six) literature studies, it can be concluded that in this era of globalization, analysis of structural equation modeling is needed which is processed with literature which aims to be a measuring tool for intelligence or IQ in education management which contains informative information about the results of measurement of abilities that owned by someone.

3. Results and Analysis

Structural Equation Modeling (SEM) is an increasingly popular statistical analysis tool for this goddess. in social sciences and management education there are many variables such as one's motivation, commitment, customer loyalty and others, which are categorized as latent variables [17]. As time goes by there are developments regarding this, namely SEM analysis becomes easier with the help of software, namely with LISREL

The basis of processing with LISREL can be done in four ways, namely the pre-project, simplistic project, LISREL project, or path diagram. We limit data processing with the simplistic project method that allows us to solve simple problems within the scope of educational and psychological management research. Second, SEM analysis uses Smart PLS software. Smart PLS is an alternative method of SEM analysis using PLS (Partial Least Square).

1. Basic Concepts

Unlike the examples mentioned above, one of the main problems in social research, psychology and management of education is how to measure an object to obtain accurate and informative data so that decisions can be made that are right and can be entrusted. The success of a management process can be seen from education and psychology management well [18].

The method of measuring an object, for example a child's weight, in the exact plane can use a scale, where the clock indicates the child's weight. But in the field of psychology and management education, the concept of measurement is sometimes not something that can be measured physically or materially. For example, aspects of personality, one's self-confidence, intelligence, productivity, loyalty, etc. In practice, social researchers, psychology and education management develop a dimension that is used to measure an object of observation. These dimensions should be a good measurement tool and able to provide correct information, both logically and theoretically. These dimensions are measuring instruments that meet the criteria of valid, reliable, practical, and economical.

1.1. Extract

Extract is a process or event from an observation that is formulated in a conceptual form and requires indicators to clarify it, such as the extraction of loyalty. Loyalty as a construct is defined as the embodiment of psychological phenomena displayed by a customer or buyer by remaining loyal, consistent and continuous, accompanied by feelings of satisfaction to keep buying at a particular store or place. In the practice of questionnaire-based research, a construct is defined as a hypothesis of the problem to be examined.

1.2 Manifest Variables

In the questionnaire format, the manifest variable is the question items of each hypothesized variable. Latent extract cannot be measured directly and requires indicators to measure it. These indicators are called manifest variables.

1.3 Validity

According to Rahmadianto, A. W., Harini, C., & Mukeri, M. (2018), Validity is a measure that shows the levels of validity or validity [19]. A dimension or indicator is said to be valid if the indicator is able to achieve the measurement goal of latent extract correctly for education management. An indicator that measures latent A A must be an indicator that ultimately provides information / describes latent extract A. In practice, errors in the accuracy of measurements, both exact and social, psychology and management of education are still found. The error can be either overestimate or underestimated. These mistakes are what we are familiar with measurement error.

1.4 Reliability

Reliability is the achievement of beauty in each measurement [20]. Reliability is a translation of the word reliability derived from the word rely and ability. Reliability can be interpreted as trust, reliability, or consistency. The results of a measurement can be trusted if in

several times the measurement of the same budget is obtained relatively the same results, meaning that it has good measurement consistency. Conversely, if a different result is obtained with the same subject, then it is said to be inconsistent. We can conclude that a reliable measuring instrument is a measuring instrument that has a high level of reliability. Empirically, the high and low reliability is indicated by a number called the reliability coefficient.

1.5. Factor Analysis

With factor analysis, it is possible to examine interrelationship between many variable numbers and explain them according to dimensions. The analysis factor is used when a researcher attempts to understand the interrelation structure between variables in a data set. In factor analysis, there are two main approaches, namely, exploratory factor analysis and confirmatory factor analysis.

We use the exploratory factor analysis if the number of factors that will be formed is not determined in advance. Conversely, confirmatory factor analysis is used if the factors formed have been determined in advance. In its application, SEM uses confirmatory factor analysis. The basic assumption that must be underlined in factor analysis is that the variables analyzed are related or interrelated. This is because factor analysis seeks to find similarities in the dimensions underlying these variables.

1.6 Polychoric Correlation

Polychoric correlation is a measure of association used as a substitute for product correlation when the two variables are ordinal measurements with three or more categories. If the scale of the data used in the study is ordinal, then to measure the relationship of two variables used polychoric correlation. Conversely, product moment correlation or Pearson correlation is used when the data scale is interval.

1.7. Causal Relations

A causal relationship is a causal relationship. So here there are independent variables (influencing variables) and dependents (influenced) [21]. The relationship between two or more variables in which a researcher clearly defines that one variable will be the cause for another variable or affect another variable. For example, X1 and X2 are hypothesized to affect Y. The relation X1 to Y or X2 to Y is called a causal relationship.

1.8. Data Scale

There are 4 (four) scales of data in statistics, namely nominal data scales (data scale categories or attributes). Example: gender data, color, choice yes or no, and so on. On a nominal scale, data can only be distinguished based on its physical nature. For example, gender data: there will only be men and women; or color data, namely red, green, and white. The numbers given in nominal scale, for example 1 for men and 0 for women do not make that 1 is greater than 0. The number given is only as a label.

Ordinal scale (rank or level data), such as education level or position level. In the level of education, there are elementary, middle, high school, bachelor (education management). Numbers given for ordinal scales show the rank value of an object, for example 1 = SD, 2 = Middle School, 3 = High School, and 4 = Bachelor. The interval scale is a number given to a set of objects that have ordinal size properties and added another property that is the same distance in the interval meter showing the same distance from the measured feature or object. In social research, the scale of nature is usually assumed to be interval scale. Scale ratio is a measure that includes all the above sizes plus one more trait, namely a scale that gives an explanation of the absolute value of the object being measured. The size ratio has a zero point, so the size of this ratio can be multiplied or divided. Numbers on the ratio scale indicate the true value of the object being measured. Examples of size ratios: weight scales, height, etc.

1.9 Questionnaire Design

The questionnaire is a set of systematic questions and logically related to the research problems posed by researchers including into management research. There are four core components in a questionnaire, namely: 1. The existence of a subject, namely an individual or an institution conducting research. 2. There are invitations, namely requests from researchers to fill the active and objective events of the available questions. 3. There are instructions, namely procedures or directives / instructions in filling out the questionnaire. 4. The existence of questions, namely the existence of questions or questions that are asked by respondents to fill it out and the availability of a place or column to fill it out.

2. LISREL (Linear Structural Relationship)

LISREL is software that helps process data from the analysis of Structural Equation Modeling [22]. LISREL is the only sophisticated SEM program and can estimate SEM problems that are almost impossible for other SEM programs. LISREL consists of two important parts, namely 1) structural equation models (the structural equation model) and 2) the measurement model.

In addition, in the process of delivering fast, efficient information [23], the existence of accurate information is indeed needed especially for everyday life, because accurate information can be an assessment and will affect the recipient of that information [24], needed in various aspects for example the form of presentation of information, so that information can be effective and easy to understand [25]. so with LISREL at the moment LISREL is perceived as presenting a very informative SEM program information, so that it can provide accurate, precise and reliable information [26] in producing statistical test results so that modification of the model and the cause of the goodness of fit model can be easily overcome . And in order to solve existing problems [27]

Latent dependent variables or endogenous variables are given symbols (η), while latent independent variables or exogenous variables are given symbols (ξ). The structural equation models in LISREL are as follows:

$$B\eta = \Gamma\xi + \zeta$$

Where,

- | | | |
|------------------|---|--|
| B (Beta) | : | Is a coefficient matrix that describes the effect of endogenous variables on endogenous variables (η) towards endogenous variables (η) |
| η (eta) | : | A vector of endogenous latent variables. |
| Γ (gamma) | : | Is a coefficient matrix that describes the effect of an exogenous variable on endogenous variables. (ξ) towards endogenous variables (η). |
| ξ (xi) | : | Vector is an exogenous variable. |
| ζ (zeta) | : | Is a residual vector that knows an error in the equation. |

Structural equations must be observed from a regression point of view. At first it must be identified first through a very rigorous theoretical study of the model and its variables. Suppose we have 3 latent variables; which consists of 2 exogenous variables namely Alienation (Alienation) and feelings of inferiority (inferiority complex) and 1 endogenous variable namely social prejudice (Social prejudice). The alienation variable is measured through 2 manifest variables which are indicators of the exogenous latent variable of variance, which is measured by the scale of anomia (Anomia Scale) and the scale of Powerlessness Scale.

Thus we have 4 observed independent variables, namely 1) the level of anomia, 2) the level of helplessness, 3) self-esteem and 4) self-concept; x_1 , x_2 , x_3 , x_4 . The four times four correlation matrix is calculated and a factor analysis is performed on it, so there will be found

two factors, namely Alienation factor 1 and complex inferiority factor 2. The lambda x x matrix will contain charge-load factors: 11, 21, 32, 42 [28].

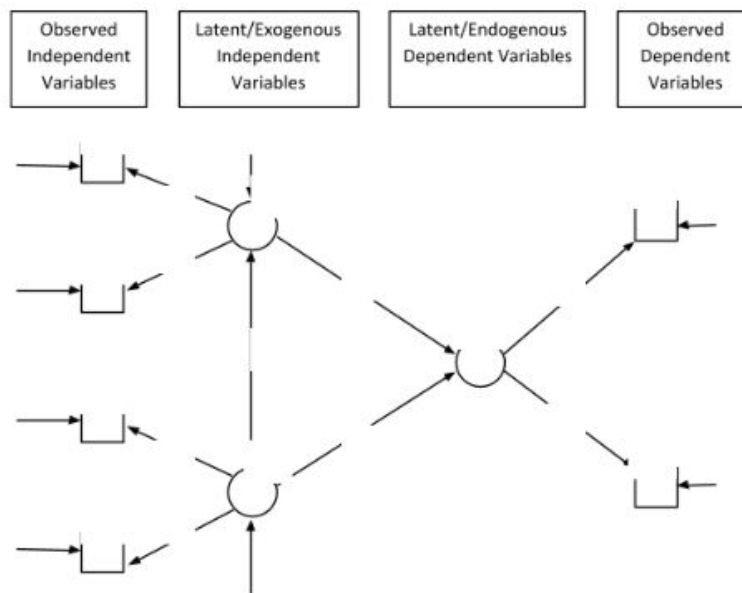


Figure 1. Theoretical Model of Relations between Variables. AN: Anomia, KB: Helplessness, HD: Self-Esteem, KD: Self-Concept, AL: Alienation, IF: Complex inferiority, PS: Social Prejudice, EM: Empathy and SE: Ethnic Stereotypes

In Figure 1. illustrates the research problem contained in the picture above can be expressed as a multivariate relation between independent variables (x) with dependent variables (y). The variable x reflects two factors, namely Alienation factor and Complex Inferiority factor, while y variable reflects 1 factor, Social Prejudice. Latent variables Alienation factors are measured by indicators or variables Anomia and Powerlessness. The latent variable Complex Inferential factors are measured through indicators or self-esteem and self-concept variables. Whereas the Social Prejudice latent variables are measured through indicators or variables of Empathy and Ethnic Stereotypes.

The working hypothesis proposed by referring to the theoretical model is that the alienation factor 1 and the complex factor of inferiority 2 both influence social prejudice. To test this hypothesis, the structural equation must be converted into a matrix so that it can be prepared for the implementation of the LISREL analysis. From the structural equation written above, the individual equations can be arranged as follows:

$$\eta = \gamma_1 \xi_1 + \gamma_2 \xi_2 + \zeta_1$$

So that the structural equation matrix form can be written as follows:

$$x = \Lambda x \xi + \delta$$

Parameters 1 and 2, namely gamma 1 and gamma 2, are the most important parts of this problem, because they estimate the effect of latent variables on alienation factor 1 and complex inferiority factor 2 on social prejudice.

While the equation of the measuring model, specifically used to see the relationship between variables that are not observed or latent with manifestation or observed variables. The equation used for the measurement model in y is:

$$y = \Lambda y \eta + \epsilon$$

Where,

y : is a measurement vector of the dependent variable.

Λy (*lamda y*) : is a coefficient matrix or loading y on latent dependent variables (η).

ϵ (*empson*) : is a measurement error vector on y .

For details on LISREL, the measurement equation on y is written in the form of a matrix as follows:

$$\begin{pmatrix} y_1 \\ y_2 \end{pmatrix} = \begin{pmatrix} \lambda_1 \\ \lambda_2 \end{pmatrix} \eta + \begin{pmatrix} \epsilon_1 \\ \epsilon_2 \end{pmatrix}$$

$$y = \Lambda y + \epsilon$$

While the measurement model on x is:

$$x = \Lambda x \xi + \delta$$

Where,

x : is a vector of independent variable measurements.

Λx (*lamda x*): is a coefficient matrix or loading x on latent independent variables (ξ). δ (*delta*) : is a measurement error vector on x .

For detailed LISREL, the measurement equation on x is written in the form of a matrix as follows:

$$\begin{pmatrix} x_1 & x_2 \\ x_3 & x_4 \end{pmatrix} = (\lambda_{11} \lambda_{21} 0 0 \quad 0 0 \lambda_{32} \lambda_{42}) (\xi_1 \xi_2) + \begin{pmatrix} \delta_1 & \delta_2 \\ \delta_3 & \delta_4 \end{pmatrix}$$

$$x = \Lambda x \xi + \delta$$

The two measurement equations x and y both express the relation between measured or observed variables, namely x and y , with latent variables or observed variables, namely x , and x together, also between y , and y based on the observed x and y variables.

If the null hypothesis states that there is no difference between the model and the data it turns out that it is not significant or cannot be rejected, then this means that there is no difference between the model and the data [29].

In phase I research, namely through critical review of curriculum vitae, there were 6 traits possessed by high achieving individuals; namely the nature of hard work, commitment, realistic, independent, disciplined and prestigious. The six traits found were used as endogenous variables in phase II research. While the hypothesis proposed for phase II research are: 1) Family background influences the formation of traits and then the traits will affect high achievers individuals, 2) School background influences the formation of traits and then the traits will affect high achievers individuals and 3) Structure of relationships between variables mentioned in the two hypotheses follow the theoretical model in the following figure.

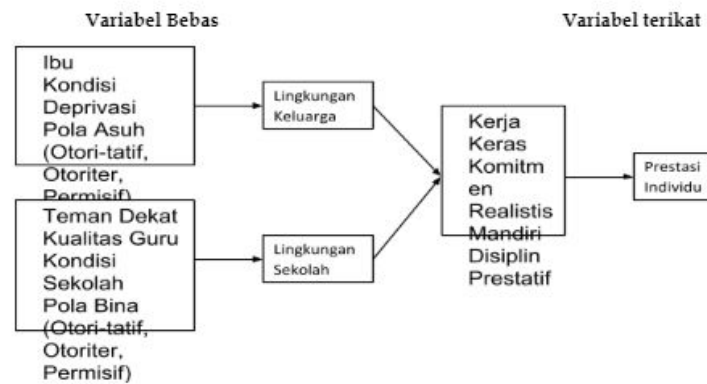


Figure 2. Theoretical Model of Relations between Variables

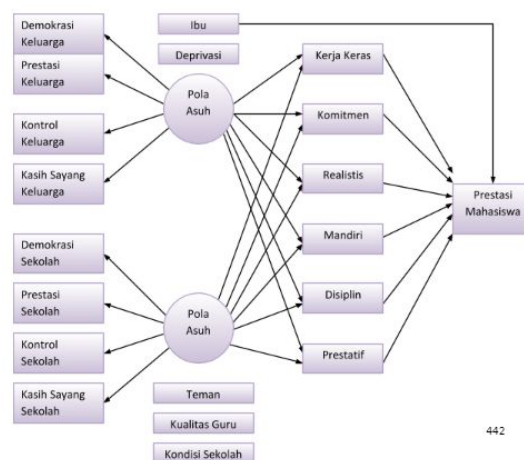


Figure 3. Model of Structural Relations Between Variables

In Figure 3, it is explained that Based on data analysis on 4 structural relations models between variables tested in the study, it was found that the chi-square coefficient was not significant, where in Model I it was obtained $\chi^2 = 83.40$ $p = 0.98$, Model II with $\chi^2 = 69.02$ $p = 1.00$, Model III has $\chi^2 = 73.44$ $p = 0.90$ and in Model IV is found $\chi^2 = 30.17$ $p = 0.1.00$. Because the 4 tested models proved to be insignificant, this means that the tested model is fit or the theoretical models proposed are no different from empirical data.

4. Conclusion

Structural Equation Modeling is a second generation multivariate analysis technique that combines factor analysis and path analysis allowing researchers to test and estimate the relationship between exogenous and endogenous multiple variables with multiple indicators simultaneously. LISREL is the statistical software for SEM analysis that is the most widely used. The basis of processing with LISREL can be done in four ways, namely the pre-project, simplic project, LISREL project, or path diagram.

In practice, social researchers, psychology and education management develop a dimension that is used to measure an object of observation. These dimensions should be a good measurement tool and able to provide correct information, both logically and theoretically. These dimensions are measuring instruments that meet the criteria of valid, reliable, practical, and economical. The basic concepts of SEM that are often used are extracts, manifest variables, validity, reliability, factor analysis, polycoric correlation, causal relationships. Whereas in SEM procedures include: definition of variance and covariance, model specifications, model

identification, model estimation, model formation, model compatibility test, model specification, LISREL program output.

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