
The Utilization Management of Path Analysis Methods to Improve Quality in Writing Research Reports at Higher Education

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Abstract

In writing a research report requires good management, starting from the start to the end pages must be neatly arranged in accordance with existing rules. In managing the research report method, a researcher can use a variety of methods available, tailored to what he studies. This study discusses the introduction of path analysis, the notion of path analysis, which is a method for studying the direct effects or indirect effects of hypothesized variables as the causes of the effects of variables needed in research, characteristics of path analysis and terms in path analysis . There are 2 (two) completion of path analysis, namely with simple correlation, completion of path analysis with linear regression. Literary research research methods were used in this study to add insight to researchers regarding writing management. With this research, it is expected to be able to help students who are compiling reports in higher education, and can improve the quality of management of research reports using path analysis methods.

Keywords: Path Analysis Methods, Management, Writing, Research Reports.

1. Introduction

Research is a scientific management to solve a problem and to penetrate the boundaries of human ignorance [1-2]. Research activities by collecting, managing and processing the facts so that the facts can be communicated by the researcher and the results can be enjoyed and used for the benefit of humans [3]. In general, management analysis of research in educational research is faced with a double-factor problem, because the problems in education can be said to be impossible to explain by simply using a bivariate analysis model, which only uses a single factor [4]. Moreover, problems that are of a very personal nature, such as student achievement, economic status of parents of students and other factors, are in fact influenced by many things that are interrelated with other factors so that they are multi-faceted [5].

For example student achievement was influenced by the potential of children, and this potential is also influenced by the IQ level of children, and IQ is also influenced by economic status, and so on when traced again the economy is still influenced by other factors [6]. Therefore, educational researchers and social researchers become familiar with the method known as multivariate analysis. Multivariate analysis is a statistical technique that focuses, manages and makes clear the structure of simultaneous relationships between three or more variables or phenomena [7]. In conducting multivariate analysis management, researchers are often preoccupied with several possibilities that can occur in relationships between various variables.

For us, the question arises, especially when the relationship that seems real then proves to be only pseudo, periodic, because the related variables are each influenced by other variables, which are not included in the analysis framework [8-9]. Example: the relationship between dress style and food consumption. We often see many young people, especially girls in short pants, walking around while eating ice cream. What is the real relationship between the style of dressing "shorts" with the consumption of "ice cream" food? If we pay attention to environmental conditions, then it turns out that the relationship between the two arises because of other forgotten variables [10]. Namely, "air (season) hot". Hot air encourages people to walk in short pants to reduce the feeling of stuffiness and make people feel like they want to drink.

The second question questions the fairness of the relationship. Let us consider the example of the relationship between education and one's rank. Education is generally related to management capabilities and skills [11]. So it is only natural that highly educated people occupy high positions, while those with low education occupy low positions. It turns out that if we look further, those with high positions besides being highly educated also have work experience management [12-14]. Thus the relationship between education and rank can change or increase due to experience factors.

The third question concerns direction and sequence. To be clear, we note the example of the relationship between the social degree of the father and the position of his child. Can we today follow the old mindset that children must uphold the degree of parents? or vice versa, we follow the theory of socialization and environmental influences, namely that the degree of parents especially the social degree of the father influences the ideals and degrees to be achieved by their children? These kinds of difficulties encourage educational researchers and social researchers to find ways, management or new methods to make analysis more precisely [15]. One new method in multivariate analysis that is considered efficient and effective to overcome various relationship problems is path analysis, which can freely be translated into path analysis. It is hoped that this new method, namely path analysis, can add insight to researchers who conduct research and research reports, especially in higher education [16].

2. Research Method

The path analysis technique was first developed by Sewell Wright in the 1930s. This technique is used to test the plausibility of a causal relationship between one variable and another in a non-experimental condition. The path analysis method is a method that examines the effects (effects) directly or indirectly of the variables hypothesized as a result of the effect of treatment on these variables [17]. Path analysis is not a method of finding cause and effect, but a method that is applied to a causal model formulated by researchers on the basic and theoretical knowledge developed [18].

Kerlinger (1990) says that what is meant by path analysis (path analysis) is an applied form of multi regression analysis. In this case a complex path diagram is used. By using it can be calculated the magnitude of the direct influence of the independent variables on a dependent variable. The effects are reflected in what is called the path coefficients which are actually the regression coefficients that have been standardized (ie). Although the analysis of this pathway has until now been and remains an important analytical and heuristic method, it is doubtful whether it will continue to be used to help test models to know congruence with the data obtained [19].

According to Pedhazur (1982), path analysis has been developed by Sewall Wright as a method for assessing the direct effects or indirect effects of variables hypothesized as causes of variable effects needed in the study. The thing that needs to be understood is that actually path analysis is not a method used to find causes, but it is used to find an explanation of the patterns of direct and indirect relations of a causal model compiled based on the theoretical considerations and knowledge of the researcher. So in general, path analysis procedures can be formulated as a coefficient estimation of a set of linear structural equations that describe cause and effect relationships that are hypothesized by researchers [20].

The main purpose of path analysis isa method of measurement the direct influence along each separate path in such a system and thus of finding the degree to which variation of a given effect is determined by each particular cause. The of method depend on the combination of knowledge of the degree of correlation among the variables in a system with such knowledge as may possessed of the causal relations (Maruyama, 1998). In the path diagram can be seen the direct and indirect effects of a variable to another variable. If between two variables there is a causal relationship then it must be determined in advance the direction of the relationship. Determination of the direction of this causal relationship is made on the basis of existing theory and knowledge [21]. The causal relationship between two variables that only have one direction or unidirectional is referred to as a model that has a recursive relationship, and if it has two directions it is called nonrecursive. In experimental research, researchers are interested in how to manipulate variables and how to observe in which manipulation is done on the effects of variations in the dependent variable.

In this case, to ensure that the variation of observed variables in the dependent variable is truly manipulated, research must also be able to control other relevant variables. One of the most powerful methods for controlling it is randomization. In terms of manipulation and randomization, researchers must feel they have a strong reason for trust in determining the types of treatment needed in an effort to produce changes (variations) in the dependent variable. Such a situation will have considerations that are more ambiguous if done in non-experimental studies because researchers cannot manipulate or conduct randomisations. As long as it is possible to use statistical control instead of randomization, researchers must be constantly prepared to deal with hidden difficulties which are the nature of interpretation in analyzing data from these non-experimental studies [22].

Correlation is not strong evidence that can be used to explain cause and effect. Likewise, there is no other index that can absolutely be used to explain the cause and effect, regardless of whether the index is obtained from experimental research data or non-experimental research. According to Pedhazur (1982), covariance or correlation between variables may be used to explain a cause and effect. According to him, an explanation scheme is not suitable to be used to explain data.

A completeness contained in this analysis is that the position of a researcher can determine whether the data is consistent with the explanatory scheme or not. If the data is not consistent with the explanatory model, then doubts will color the theory used in the study. However, the consistency of the data with the explanatory model, is not a strong proof of a theory that this is only a guide to that direction. In this case, maybe the data used is consistent with the causal models used. As commonly found in the model, that a consideration is needed. For example consider models that involve the following three variables:

$$(1) X \rightarrow Y \rightarrow Z \qquad (2) Y \rightarrow X \rightarrow Z$$

The first model states that X affects Y. otherwise Y affects Z. The second model states that Y affects X, so X affects Z. Correlations between the three observed variables may be consistent with both models, and this allows that X precedes Y in the order of time . If this is the case, researchers can reject model 2 in that model. Then it is necessary to determine the analytical method used to formulate a theoretical model that can be maintained by researchers. One of these methods is path analysis. The following study is not intended to weaken other analyzes, but rather to introduce to the reader some basic principles and the application of path analysis in educational research and other social research.

3. Results and Analysis

The characteristics of path analysis are the multivariate dependency data analysis method used to test the hypothesis of the asymmetry relationship that is built on the basis of certain theoretical studies, with the aim of knowing the direct and indirect effects of a set of causal variables on the resulting variable. Testing the hypothesis of an asymmetrical relationship that is built on the study of a particular theory means that what is tested is a model that explains the causal relationship between variables built on the study of certain theories. The causal relationship is explicitly formulated in the form of a directional hypothesis, both positive

and negative. According to Supardi (2012), there are several characteristics or requirements that must be met in path analysis, including:

1. Data for each variable is interval or ratio data.
2. The relationship between two variables is linear and additive.
3. The relationship between each of the two variables is recursive or one-way.
4. Residual or residual variables are not correlated with each other and not also with variables in the system.

According to Kusnendi (2005), there are two relationship patterns that can be expressed, namely the relationship pattern for management, predicting or predicting the Y response variable on the values of predictor variables X1, X2, ... Xk or relationship patterns that study the magnitude of the effect of variable X1, X2, ... Xk for a variable due to both direct, indirect and total influence. From the statistical study, it is known that for the purpose of forecasting or estimating the variable Y over X1, X2, ... Xk, the relationship pattern can be studied correctly through a regression model, while for management purposes studying the pattern of causal relationships then the right analysis knife is path analysis through structural models. Kadir (2015) explains the differences between regression models and path analysis, explained in the following table.

Table 1. The Comparison of Regression Models and Path Analysis Models

Aspect	Regression Model	Path Analysis Model
Purpose	Assess the direct effect and predict the value of the criterion variable Y on predictors X1, X2, X3 ... Xn.	Assess the pattern of causal relationships, direct influence and indirect influence.
Terminology	<i>Independent variable, dependent variable.</i>	Cause variable (exogenous), variable effect (endogenous).
Scale and data	Minimum matrix interval scale and raw data.	Minimum matrix interval scale and data in the form of raw scores.
Formulation of the problem	Do variables X1, X2, X3, ... Xn affect Y both partially and simultaneously.	Do variables X1, X2, X3, ... Xn directly and indirectly affect Y.
Relations between independent variables	Not studying the relationship between independent variables.	Study the relationship between IV.
Requirements for analysis	(1) Data on the estimated Y error for X is normally distributed and homogeneous. (2) The relationship of Independent variables and Dependent linear variables. (3) There is no multicollinearity between independent variables. (4) There is no autocorrelation (residual is independent).	Same with the regression model plus 2 conditions, (1) There is no direction of causality that is reversed or recursive. (2) All errors do not correlate with other errors and with variables in the model.

3.1 The Terms in Path Analysis

Lane model. The path model is a diagram that manages the relationship between independent variables, intermediaries and dependent. Relationship patterns are indicated by using arrows. Single arrows indicate a causal relationship between exogenous variables or intermediaries with one or more dependent variables. The arrows also connect errors (residual variables) with all endogenous variables respectively. Double arrows show correlation between pairs of exogenous variables.

The causal path for a given variable includes the first paths of the arrows leading to that variable and the two correlation paths of all endogenous variables correlated with other variables that have arrows towards the covariable already exists. The paths shown with arrows determine the degree of closeness of the relationship between variables.

Path coefficient or line weighting. Path coefficient is a standard regression coefficient or called "beta" which shows the direct influence of an independent variable on a dependent variable in a particular path model. Therefore, if a model has two or more causal variables, then the path coefficients are partial regression coefficients which show the magnitude of the management influence of one variable on another in a particular path model that controls the other two previous variables using standardized data or correlation matrix as input.

Latent variables can be defined as causal variables that cannot be observed directly (unobservable). Management of observations of these variables is observed through the manifest variable. The manifest variable is a measurable indicator variable that can be observed directly to measure latent variables. Example: latent variable motivation. Can not be observed directly, but through manifest variables (indicators) such as hard work, never give up, diligently, meticulously, and others.

Exogenous and Endogenous Variables. Theoretically variables can be defined as attributes of a person or object, which have variations between one person and another or one object with another object (Sugiyono, 2006). Variables can also be attributes from scientific fields or certain activities. In a causal model, it must be distinguished between exogenous and endogenous variables. Exogenous variables are variables whose variability is assumed to be determined by causes that are outside the model. While endogenous variables are variables whose variations can be explained by exogenous and endogenous variables that are in the system. Endogenous variables are treated as dependent variables in a set of certain variables which may also be conceptualized as independent variables in relation to other variables. Added by Hasan (2002) that besides there are exogenous and endogenous variables there is still one more variable, namely the error variable. Exogenous variables are each variable that affects other variables and endogenous variables are each variable that has an influence from other variables.

There is rarely an attempt to explain the variability of an exogenous variable or that the difference is only the relationships between other exogenous variables. On the other hand, endogenous variables are a variation explained by the exogenous or endogenous variables contained in the system. The difference between the two types of variables is illustrated in Figure 1.

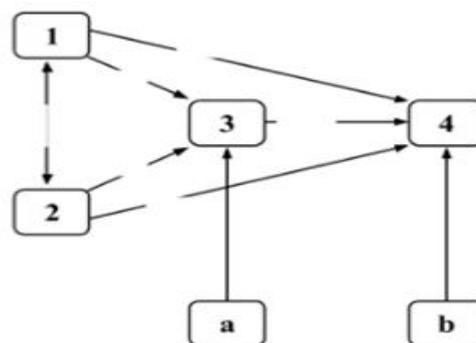


Figure 1. Search Analysis Scheme

In Figure 1 it appears that variables 1 and 2 are exogenous variables. Correlation between exogenous variables is indicated by the direction of the arrow, where researchers do not need to sort one variable into another. Consequently, the relationship between the residual fellow exogenous variables is not analyzed in the system. Variables 3, and 4 are endogenous variables. Here a direct connection occurs. The form of the relationship is not directly described from the variables taken as causes (independent variables) to the variables taken as a result (dependent variable). These two trajectories can be seen from variables 1 and 2 to 3 which state that variable 3 is dependent 1 and 2. Means that at one time a variable cannot be a cause and simultaneously as a result of other variables.

For example if variable 2 is taken as the cause of variable 3, then the possibility of variable 3 being the cause of variable 2 is impossible. Endogenous variables are treated as dependent variables in a group of variables which are also arranged as independent variables in the relationship of other variables. For example, variable 3 is taken as a dependent variable variable 1, and 2, and also as an independent variable in variable 4. This is an example of an indirect causal relationship. Because it is almost impossible to calculate the total variance of a variable, the variable residues are introduced to state the effects of the variables involved in the model. In Figure 1 a also appears, and b is variable residues, where it is assumed that the residues do not correlate with each other or with the preceding variables in the model. For example, a does not correlate with b and also does not correlate with variables 1 and 2.

3.2 The Path Analysis Assumptions

Like other parametric statistical analysis models, that adequate application of a statistical procedure for the benefit of testing hypotheses depends on how far the set of assumptions underlying the procedure qualify for the purpose of the analysis. The path analysis model is only suitable for data that meets the assumptions that apply to regression analysis, among others: First, the relationships between the variables in the model are linear, namely the assumption that all relationships between variables in the model are relationships that follow straight line, not curvilinear.

Second, the residuals that appear do not correlate with the variables that precede them in the model and also do not correlate among the variables themselves. The implication of this assumption is that all relevant variables must be involved in the system. Endogenous variables are arranged as linear combinations of other exogenous or endogenous variables in the system, accompanied by a residue. The exogenous variable is needed as a "giver". If exogenous variables are correlated with each other, the correlation is treated as a "giver" and the remainder is not analyzed.

Third, the assumption of normality is very important, especially for the benefit of management conclusions. In some observational variables tend to have a frequency whose position is in the center or in the middle of the distribution. Normal distribution is an important thing in statistics that is used as a reference to determine the size of the normality of a sample data distribution. Fourth, the assumption of homogeneity which is often also called homoscedasticity is when the scores of endogenous variables for each particular score on exogenous variables are always the same or almost the same (Goldstein, 1985).

Fifth, the path analysis model is suitable for variables that have interval or ratio scales and are less suitable for nominal or ordinal scale variables. If one of the variables in the specified model has an ordinal or nominal scale, then the correlation coefficient of the variable must be calculated by certain non-parametric statistical techniques. Then the resulting correlation coefficients are included in the correlation matrix that will be used in path analysis.

3.3 The Causal Relations in Path Analysis

In experimental research management researchers can manipulate treatment variables and then study their effects on the criterion variable. In order for the results obtained in the criterion variable to be believed to be caused by variables manipulated, the researcher needs to conduct control management conditionally on irrelevant variables. One way to do this control management is by randomization which can generally be done well through experimental

design and experimental units. By doing management manipulation and randomization, researchers feel more confident in making inferences about changes that occur in the criterion variable. In other words, researchers have created a cause in this case manipulation to obtain results. Thus, the causal relationship between the treatment variable and the criterion variable in the experimental study can be ascertained because there is an accompanying conditional control.

The situation is different in the management of non-experimental research, for example in associative research where manipulation of variables cannot be carried out and also can not be done conditionally as in experimental research. Therefore, in associative research, the way out is to take control statistically as a substitute for conditional control. However, statistical control must be interpreted carefully and carefully.

It should be realized that the causal relationship built on the concept of correlation or covariance as in path analysis techniques is not based on data but on the substance or scientific logic (knowledge, theory, experience, and logical-critical analysis). So only the theoretical framework is revealed to be a concept that will show a causal relationship. The function of data is to support or not support a causal (hypothetical) model. It is possible that the same data can be matched or consistent with more than one hypothetical model.

Broadly speaking the problem solving with path analysis can be solved through: (1) a simple correlation approach, and (2) a linear regression approach. To get reasonable results in testing the research model, researchers can simply follow the six steps that are often recommended by the compilers of the methodology demand book (Kelly 1973), among others: (a) building a causal model or scheme, (b) building interpersonal patterns variables in a sequence, (c) describe path diagrams, (d) calculate path coefficients for the base model, (e) test the goodness of fit with that basic model, and (f) make an interpretation of the results.

4. Conclusion

Path analysis is an applied form of multi regression analysis. In this case a complex path diagram is used. With management using it can be calculated the amount of direct influence of independent variables on a dependent variable. The effects are reflected in what is called the path coefficient which is actually a standardized regression coefficient. There are several properties or conditions that must be met in path analysis, namely: 1. Data for each variable is interval or ratio data. 2. The relationship between two variables is linear and additive. 3. The relationship between each of the two variables is recursive or one-way. 4. Residual or residual variables are not correlated with each other and not also with variables in the system. The path analysis model is only suitable for data that meets the assumptions that apply to regression analysis, including: 1. Relationships between variables in the model are linear. 2. The residuals that appear do not correlate with the variables that precede them in the model and also do not correlate among the variables themselves. 3. The assumption of normality is very important especially for the sake of drawing conclusions. In some observational variables tend to have a frequency whose position is in the center or in the middle of the distribution. 4. The assumption of homogeneity which is often also called homoscedasticity is that if the scores of endogenous variables for each particular score on exogenous variables are always the same or almost the same. 5. The path analysis model is suitable for variables that have interval or ratio scales and are less suitable for nominal or ordinal scale variables. Broadly speaking, solving problems with path analysis can be solved through: 1. Simple correlation approach. 2. Linear regression approach. Thus path analysis can improve the quality of management of scientific report writing in higher education.

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