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Internal Consistency Reliability Of Instruments Measuring Students Satisfaction As An Internal Customer (Application Of Factor Analysis)

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Abstract

Reliability is consistency of the instrument in measurement whatever it measures. There are different methods available for estimating internal consistency reliability base on a single administration of a given assessment. Measures of internal consistency are a popular set of assessments with Cronbach's alpha (α) being the most favored. Two other measures of internal consistency, such as theta (Θ) and omega (Ω). Each of three measures and its computation is described using instrument for measuring students' satisfaction as internal customer. Students' satisfaction is the level of a student's felt state resulting from comparing a product's perceived performance (outcome) in relations to the student's expectation. The purpose of this study to answer which of the three measures a highest one? The research was survey research using simple random sampling methods. The instrument was based on the definition above and it was tried out to 103 Post Graduate students' State University of Jakarta (Universitas Negeri Jakarta). Because alpha (α) is a lower bound reliability assessment so this research the following holds $\alpha < \Theta < \Omega$ for this instrument. It can be concluded that the questionnaire measuring students' satisfaction has appropriate internal consistency reliability. Further try out is still needed to standardize the instrument.

Key words: internal consistency reliability α, Θ, and Ω, students' satisfaction as an internal customer

I. INTRODUCTION

According to Naga (1992) for the measurement of education and psychology includes several things. First, measure the latent trait is invisible on the respondent. Second, to measure the latent trait is given a stimulus in the form of questionnaire respondents or the proper gauge. Third, the stimulus responded to by the respondent in the expectation of correct responses reflects the latent trait to measure. Fourth, the response was scored and can be interpreted adequately. Then, question the extent to which scores obtained can be appropriately reflect latent traits to be measured? Are the instruments used as the stimulus was correctly able to reveal the hidden features of the invisible? The second question regarding the validity. Being associated with reliability, whether the responses given by participants was unreliable to be used as material for the scoring of psychological attributes that?

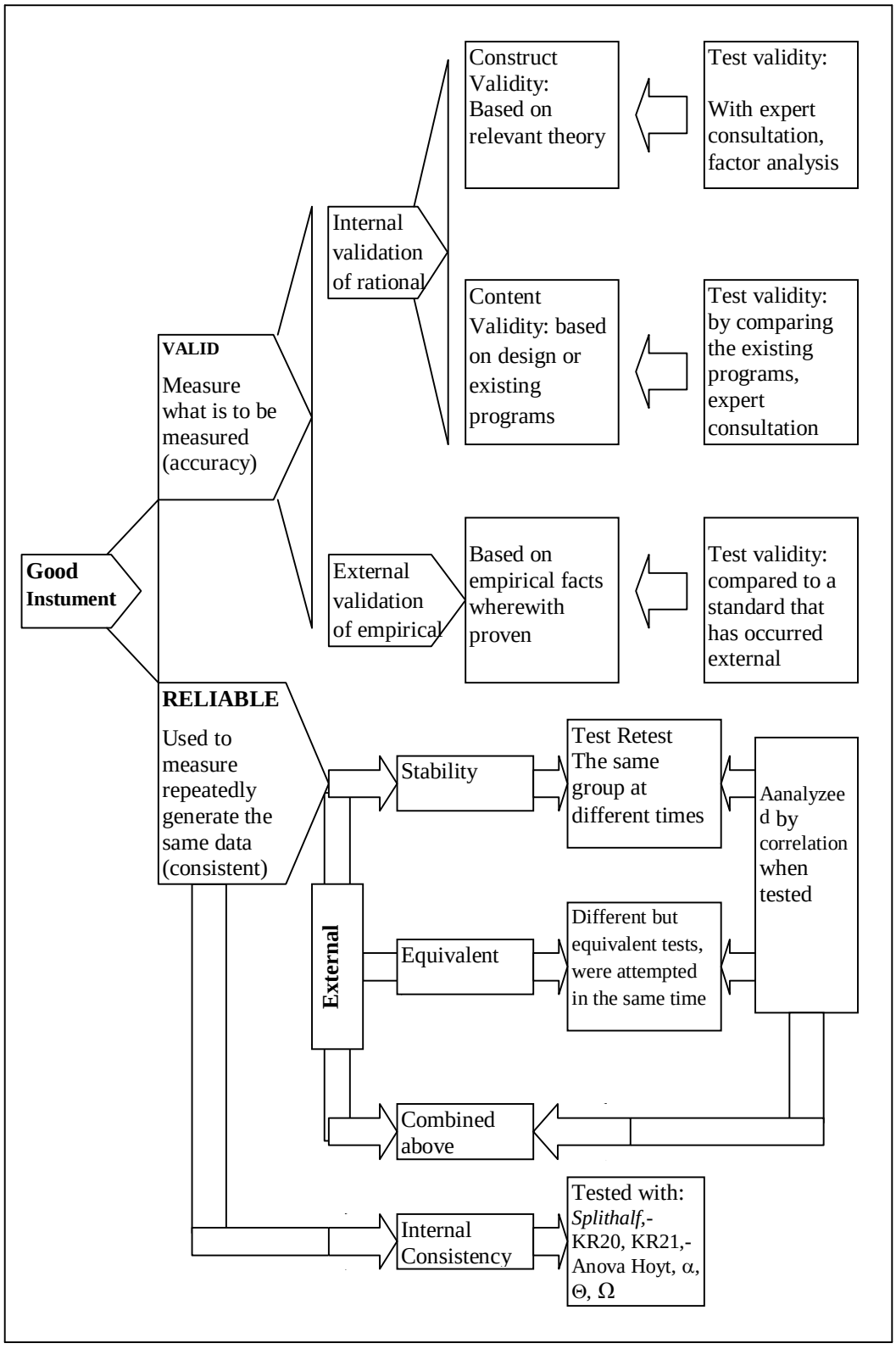

Figure 1. Scheme of Instruments and Methods Testing Validity and Reliability (Adapted from Sugiyono, 2002)

Furthermore, a good instrument and the way testing is shown by the schematic in Figure 1. From the schematic above shows that the internal consistency reliability of many ways to measure it. As an internal consistency reliability alpha, theta and omega for example. Which of the three that have the largest coefficients?

Reliability is the consistency of an instrument to measure something to be measured (Wirsma, 1986). Reliability indicates the extent to which measurement results can be trusted with such a device. Therefore, reliability is an index showing the extent to which a measure is reliable or unreliable. When an instrument is used repeatedly to measure the same phenomenome and the results obtained are relatively stable or consistent, then the instrument is reliable. In other words it is the same expected outcome measurement when the measurement was repeated.

In general, the measurement of affective characteristics provide reliability coefficient lower than the measurement of cognitive domains, because the cognitive skills tend to be more stable than affective characteristics. According to Gable (1986) reliability coefficient of the cognitive instruments usually about 0.90 or greater, whereas the affective domain of instrument reliability coefficient of less than 0.70. Reliability coefficient on the level of 0.70 or more generally accepted as good reliability (Litwin, 1995). Meanwhile, according to Naga (1992) adequate reliability coefficient should be located above 0.75.

The instrument was given to a group of subjects once past a certain manner calculated reliability estimates, this is what is meant by the instrument's internal consistency reliability. The internal consistency reliability alpha formula is as follows:

$$\alpha = \left[\frac{k}{k-1}\right]\left[1-\frac{\sum s_i^2}{s_x^2}\right]$$

Description:

α = Reliability coefficient alpha

k = Number of items in the instrument

$\sum s_i^2$ = Amount of variance score items, and

s_x^2 = Variance of scores on all the item problem/question

However, when using the approach of the obtained formula intercorrelation items like it was written by Carmines and Zeller (1979) as follows:

$$\alpha = \left[\frac{k}{k-1}\right]\left[1-\frac{k}{2b}\right]$$

Description:

α = Reliability coefficient alpha

k = Number of items in the instrument

b = Number of items intercorrelation

Another item intercorrelation approach that is:

$$\alpha = \frac{k.\bar{b}}{1+(k-1)\bar{b}}$$

Description:

α = Reliability coefficient alpha

k = Number of items in the instrument

$\bar{b}$ = Average item intercorrelation

In addition to alpha was measured by using the formula above, in this study, also used theta reliability reasons: (1) internal consistency reliability theta relatively higher than the alpha and omega, or reliability ($\alpha < \Omega < \Theta$), for both reliability. The latter is a lower threshold of reliability and (2) theta reliability is a special case which is to maximize the alpha coefficient (Smith, 1998).

The Θ formula put forward by the Armor as summarized by Yaffe (2000) has lowered the formula theta reliability as an analog of alpha following formula:

$$\Theta = \left[\frac{k}{k-1}\right]\left[1-\frac{1}{\lambda_1}\right]$$

Description:

Θ = Reliability coefficient theta

k = Number of items in the instrument

λ_1 = Value of the characteristic root (eigenvalue), the largest

Eigenvalue represents the amount of variance explained by each factor. For Θ coefficient data extracted using factor analysis by the method of Principal Component Analysis (PCA). Factor analysis is a complex set of mathematical procedures to analyze the mutual relationship between these variables and explain the mutual relationship in the form of a limited group of variables called factors. So the function of the factor analysis is to find new variables fewer than the number of original variables, for example from 10 (original) changed to only 2 or 3 variables a new variable that is not correlated with one another (does not happen multicollinearities). The new variable contains as much information contained in the original variables. Ω last formula as formulated by Carmines and Zeller (1979) as follows:

$$\Omega = 1 - \frac{k - \sum h_i}{k + 2b}$$

Description:

Ω = Reliability coefficient omega

k = Number of items in the instrument

$\sum h_i$ = Number of communality of all items

b = Number of item intercorrelation

Communality is the amount of variance contributed by a variable with all other variables in the analysis. Can also be called or the proportion of variance explained by the common factor or the magnitude of the contribution of a factor to the variance of the variables. For the coefficient data extracted using factor analysis method Common Factor Analysis (CFA), otherwise known as the method of Principal Axis Factoring (PAF). It turned out that factor analysis with a variety of methods are useful for calculating the internal consistency reliability and especially. Furthermore, here a brief discussion about the analysis of all factors.

Factor analysis can be used to test hypotheses about the existence of the constructs, or if there is no hypothesis in question to find the constructs in the group variables. According to a comprehensive definition of Reymond and Joreskog as abstracted by Stapleton, factor analysis is a general term used to describe a number of methods designed to analyze intercorrelation in a set of variables or objects [as the] construction of several variables hypothesis [or objects] are called factor (Stapleton, 1997).

Suryanto (1988) suggested that factor analysis is the study of the interdependence between variables, with the aim to find a new set of variables are fewer in number than the original variables and indicating which of the original variables as factors fellowship. The method is carried out with the help of computers to assess whether the various items in a survey have a togetherness within a factor or scale.

Factor analysis to analyze a number of variables from a measurement or observation which is based on the theory and reality and analyze intercorrelation (relations) between these variables to determine whether the variations seen in these variables based on a number of basic factors that fewer than the number of the existing variance the variables. So in principle, factor analysis is used to reduce the data, namely the process to summarize a number of variables into fewer and named as a factor.

As with other multivariate approaches, factor analysis based on assumptions about the role of a large amount of variance in a phenomenome. Also based on the squared

correlation coefficient, factor analysis can illustrate the magnitude of the contribution of variance were investigated and indirectly the role of covariance suggests the possibility that unknown or not investigated. Of the several techniques of factor analysis, there is a technique that assumes a number of common factors that form a matrix intercorrelation factors, pointing observed variables that form a relationship with a common factor as the factor pattern, and finally each variable has a residual or unique factors or also commonly called a factor special.

Exploratory factor analysis is used to explore the data in determining the amount or nature of the factors comprising covariance between variables when the researcher *a priori*, does not have enough state to form a hypothesis about a number of factors based on the data (Stapleton, 1997). Exploratory approach used to see how many factors needed to explain the relationship between a set of indicators by observing the amount of load factor, or to search for constructs in the group variables. This approach assumes the absence of theoretical knowledge that is used to perform the procedure in the extraction of factors. Therefore, extraction procedures are carried out solely based on empirical data and mathematical criteria. This approach is utilized as a tool to search for empirical relations to the theoretical factor.

Meanwhile, a confirmatory factor analysis model testing the theory as opposed to general testing methods such as exploratory factor analysis. Confirmatory approach is used to test whether a number of factors empirically derived according to the number of factors that have been developed in theory or test hypotheses about the existence of the construct. Also to answer the question whether the number of factors that have been successfully extracted can be used to explain the relationship between indicators significantly. Through this approach can be obtained confirmatory fit goodness of fit test is significant and can be used to estimate population parameters through statistical sampling. In general suitability of goodness of fit test is a test.

This study focused primarily on internal consistency coefficient alpha (α), theta (Θ) and omega (Ω). Based on the three formulas above, the internal consistency reliability of which the largest or maximum? Therefore the internal consistent reliability coefficient because it is a lower threshold (Brennan, 2001; Knapp, 1991). then the next question: How is the internal consistency reliability of instruments measuring internal customer satisfaction as the students made up? The composition $\alpha < \Omega < \Theta$ (Smith, 1998) or $\alpha < \Theta < \Omega$ (Greene and Carmines, 1980)?

II. RESEARCH METHOD

The method used in this research is survey method. The survey used in data collection and not made treatment or conditioning on the variables studied, but only disclosed the fact on the basis of phenomenome that exist in students or other respondents. The survey sample in this study is a sample survey to things that are not tangible (intangible) that is when the survey involves the measurement of psychological or sociological constructs and comparing members of large populations where the variables can not be directly observed. Therefore, this study measures the psychological construct indirectly from the sample population, then clearly this study is called a sample survey of the things that are not real (sample survey of intangibles).

Instruments in the research scale is made of two columns with the details, for this first column is a reality (reality) or the facts and perceived by students to satisfy quality of service an a performance with five alternative answers ranging from very dissatisfied (VD) value of 1, not satisfied (NS) value of 2, neutral (N) value of 3, are satisfied (S) value of 4, and very satisfied (VS) score of 5. For the second column, expectations of students to institutions with a scale of five alternatives based on the level of student interest with answers ranging from very unimportant (VU) value of 1, not important (NI) value of 2, neutral (N) value of 3, it is important (I) value of 4, and very important (VI) value of 5.

Target population is all students State Unversity of Jakarta (Universitas Negeri Jakarta), while the entire student population is affordable Program Pasca Sarjana (Post Graduate Program) of UNJ, but sampled in this study were students of Education Evaluation Research Program, Post Graduate students' State University of Jakarta. Samples were taken by simple random sampling and of 200 instruments acquired or redeployed as many as 103.

III. RESULTS

Tryout for Performance Instruments

In this study the data processed using SPSS for Windows Version 17.0.0. Based on factor analysis, correlation matrix can be processed further when it meets the all requirements, because the item number 33 has only a smaller loading rotated 0.300 (<0.300) then the item is not included in the process. So initially there are 33 items then just 32 items or items that are processed and when using this program directly the obtained alpha reliability index = 0.951. Based on the computation of SPSS software, acquired the number item intercorrelation b = 188.437 (calculation not included in this

paper), with k = 32, coefficient reliability of alpha 0.857 is obtained (see calculation below). So $\alpha = \left[\frac{32}{32-1}\right]\left[1-\frac{32}{2(188.437)}\right] \rightarrow \alpha = 0.857$

Based on the computation of SPSS software, gained an average item intercorrelation $\bar{b} = 0.357$ (calculation not included in this paper), the coefficient reliability of alpha 0.947 is obtained (see calculation below). So $\alpha = \frac{(32)(0.357)}{1+(32-1)(0.357)} \rightarrow \alpha = 0.947$

For internal consistency reliability coefficient of theta, based on Table 1 is obtained $\lambda_1 = 13.174$. So $\Theta = \left[\frac{32}{32-1}\right]\left[1-\frac{1}{13.174}\right] \rightarrow \Theta = 0.954$

Table 1. Eigenvalue Based on Principal Component Analysis (PCA) of Performance Instruments

Item	Eigenvalue
1	13.174
2	2.525
3	1.559
.	.
.	.
.	.
29	0.124
30	0.114
31	0.096
32	0.079

Extraction Method: Principal Component Analysis

Internal reliability of omega coefficient is calculated using a factor analysis PAF method. Based on Table 2 is obtained as follows: $\sum h_1 = 19.499$, b as the number of items intercorreltaion $= 188.437$. So $\Omega = 1-\frac{32-19.499}{32+2(188.437)} \rightarrow \Omega = 0.969$

Table 2. Based on Principal Axis Factoring Communalities (PAF) of Performance Instruments

Item	Communality
1	0.380
2	0.307
3	0.553
4	0.622
5	0.540
7	0.625
8	0.483
9	0.801
11	0.560
12	0.722
13	0.782
14	0.590
15	0.637
16	0.659
17	0.588
18	0.768
19	0.535
20	0.619
21	0.723
22	0.467
23	0.644
24	0.518
25	0.596
26	0.785
27	0.683
28	0.569
29	0.495
30	0.600
31	0.723
32	0.803

Number of communality = 19.499

Extraction Method: Principal Axis Factoring

Tryout for Expectation Istruments

At try out the instrument of expectation is only 32 items that are processed and when using this program directly the obtained reliability index of alpha = 0.974.Based on the computation of SPSS software, acquired the number item intercorrelation $b = 268.876$ (calculation not included in this paper), with $k = 32$, coefficient reliability of alpha of 0.909 (calculation below). So $\alpha = \left[\frac{32}{32-1}\right]\left[1-\frac{32}{2(268.676)}\right] \rightarrow \alpha = 0.909$

Table 3. Eigenvalue Based on Principal Component Analysis (PCA) of Expectation Instruments

Item	Eigenvalue
1	17.882
2	1.720
3	1.197
.	.
.	.
.	.
29	0.102
30	0.099
31	0.077
32	0.048

Extraction Method: Principal Component Analysis

Table 4. Based on Principal Axis Factoring Communalities (PAF) of Expectations Instruments

Item	Communality
1	0.599
2	0.406
3	0.674
4	0.783
5	0.644
7	0.466
8	0.603
9	0.623
11	0.557
12	0.690
13	0.548

14	0.556
15	0.536
16	0.619
17	0.830
18	0.705
19	0.610
20	0.639
21	0.734
22	0.565
23	0.569
24	0.703
25	0.633
26	0.664
27	0.687
28	0.637
29	0.719
30	0.680
31	0.769
32	0.638

Number of communality = 20.475
Extraction Method: Principal Axis Factoring

Based on the computation of SPSS software, gained an average item intercorrelation $\bar{b} = 0,509$ (calculation not included in this paper), the coefficient reliability of alpha 0.971 is obtained. So $\alpha = \frac{(32)(0.509)}{1+(32-1)(0.509)} \rightarrow \alpha = 0.971$

For internal consistency reliability coefficient of theta, based on Table 3 is obtained $\lambda_1 = 17.882$. So $\Theta = \left[\frac{32}{32-1}\right]\left[1-\frac{1}{17.882}\right] \rightarrow \Theta = 0.975$

Internal reliability coefficient of omega is calculated using a factor analysis PAF method. Based on Table 4 is obtained as follows: $\sum h_i = 20.475 =$, b as the number item intercorrelation = 268.676. So $\Omega = 1 - \frac{32-20.475}{32+2(268.676)} \rightarrow \Omega = 0.980$

Of all the two try outs can be summarized as follows: (Table 5 below).

Table 5. Summary of Computational Results of Internal Consistency Reliability

Reliability Performance Expectation	Alpha (α)	*Alpha 1* (α)	*Alpha 2* (α)	*Theta* (Θ)	*Omega* (Ω)
	0.951	0.857	0.947	0.954	0.969
	0.974	0.909	0.971	0.975	0.980

IV. DISCUSSION

The higher the reliability coefficient, the closer the score with a score of actual observations, so the score observations can be used as a substitute for the real component score. The size of high or low reliability coefficient is not only determined by the value of the coefficient. Commentaries high and low value of the coefficient obtained by calculation, is determined also by the standards of the branch of science involved in that measurement. The higher the coefficient of reliability of an instrument, then the likelihood of errors that occur will be smaller if people make decisions based on the scores obtained in the instrument.

Interpretation of reliability coefficient is an evaluation of accuracy of test scores, not just consistency only. Also in interpreting the high reliability coefficient, there are at least two things that need to be understood, namely: (1) reliability is estimated using a group of subjects in a given situation will produce coefficients that are not the same as the estimate of such tests in other subject groups, and (2) reliability coefficient indicates the magnitude of inconsistency score is simply the result of measurement, rather than stating directly that causes inconsistency.

V. CONCLUSION AND SUGGESTION

Internal consistency reliability coefficient using the formula omega increases and higher when compared with the coefficient of Cronbach alpha or theta, and it was higher when compared to both (alpha and theta). In other words, the composition obtained internal consistency reliability coefficient as follows for the intrument measuring level of student satisfaction as an internal customer

Suggestions can be submitted are as follows:

1. The development of this instrument needs to be tested further by using modern measurement theory as item response theory (IRT). If necessary use a variety of other scales, e.g. semantic differential scale.
2. These instruments need to be tested by using a larger sample population and the wider setting and involve several provinces at once, also with the level and type of school or college tinngi different

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