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Structural Equation Modelling: Confirmatory Factor Analysis To Construct Measurement Model & Mediator Check Among Formed Factors.

Loshini Thiruchelvam [1] & Sabri Ahmad [2]
Department of Mathematics, Faculty of Science and Technology, Universiti Malaysia Terengganu, Malaysia
losht_88@yahoo.com[1] & sba@umt.edu.my[2]

Abstract
The study aimed to build a measurement model, to describe satisfaction of students towards the quality of service provided at their hostel. A measurement model out of the hypothesized SERVPERF Model, was build for this purpose, using Confirmatory Factor Analysis. A number of 313 respondents were used in this data set. Study found that the hypothesized model with some modifications fits the data well. As the hypothesized model fits the data well, study was also done to investigate if the Working Style factor act as a mediator for the relationship of Empathy factor towards Tangible factor in the modified SERVPERF Model. Study found that Working Style factor act as a partial mediator for this relationship.
Keywords: Measurement Model, Confirmatory Factor Analysis, SERVPERF Model, Mediator, Working Style, Empathy, Tangible

1.0 Introduction

Quality matter is an important aspect in both the government and private organizations. Only if good quality of service is provided, then the customers will be satisfied. According to Othman (2006), government organizations in Malaysia assume that the service they provide, should meet the standard set and clients should be satisfied with their service.

On the other hand, satisfaction can be defined as the assessment of customers towards the service they received. According to Tse & Wilton (1988), satisfaction is the result of comparison between the service that customers expected with the service they receive at real. If the service they receive is better than the one they expected, then customers are said to be satisfied and vice versa.

There are few type of models that can be used to measure customer satisfaction. Among them is the (Service Performance) SERVPERF model by Cronin & Taylor (1992). The SERVPERF model has five dimensions, namely Tangible, Responsive, Assurance, Reliability and Empathy.

However, different area of service will have different service quality to be met. This is because aspects of customers satisfaction differs for each area of service (Culliberg & Rojsek, 2010). Therefore, the SERVPERF Model for this students satisfaction is estimated not to be the same with original SERVPERF Model, as proposed by Cronin & Taylor (1992). Based on an earlier analysis using Exploratory Factor Analysis, it is hypothesized that the SERVPERF Model has three main factors, named Tangible, Working Style and Empathy.

2.0 Literature Review

Abdullah et al. (2012) carried out a research to confirm the number of dimensions for SERVPERF Model in the Aviation Sector of Malaysia, and to identify factors which are considered important by the customers. Study uses the two-phase Structural Equation Modeling, with the first phase was on constructing a measurement model that

fits the data well. In the second phase, the measurement model was used to build a second-level measurement model, and used to identify factors which are considered important to the customers. Both the analysis used Maximum Likelihood estimation as the estimation method. Study found that Reliability dimension is the most important, followed by Tangible and Assurance dimensions. Responsiveness and Empathy dimensions were found not to be considered important by the customers.

Prabaharan et al. (2008) carried out a research to identify tourists' satisfaction towards the quality of tourism service provided to them. Research was carried out within the tourism sector in Kerala, India, using the SERVPERF Model with some modifications. This model had six dimensions, named Tangible, Responsiveness, Reliability, Product Service, Assurance and Responsibility Towards Service Provided. A measurement model was first build to describe the opinion of tourists, and the model was then used to build up the Structural Model. Two separate structural models for domestic and international tourists were built to identify if any of the dimension act as mediator and influences the other dimension, contributing to the most for satisfaction of tourists. Based on previous studies, it was hypothesized that, Tangible dimension act as the mediator for the domestic tourists model, whereas, Responsiveness dimension act as the mediator for the international tourists model. The analysis made in this study found the hypothesized model fits the data well. Therefore, it was suggested that the tourism department should use these two different models for both the domestic and international tourists, separately.

Ro (2012) carried out a study named Effect of Mediator and Moderator Factors towards the On-Going Research of Hostel Industry. Their study was consolidated by writings of Baron & Kenny (1986), where they discussed that mediators and moderators are the third factor which increases the influence of independent variable towards the dependent variable. According to them, neglecting these factors will affect the accuracy of result gained, as these factors if found to have significance relationship, will contribute some variance to the dependent variable.

Gao et al. (2008) carried out a study entitled Usage of Not-Normalized Data in Structural Equation Modeling. Study discussed that moderately not-normal data is still can be analyzed with this method. To proof, study used three different data set, with the first data set used all the respondents. Second model had the same data set with first model, but removed six respondents that were found to be serious outliers (where the vector of respondent is very far away from the mean vector of the sample data). In the third model, a number of 17% respondents that were found to be outlier (the vector of respondent is different with the mean vector of the sample data) had been removed. Normality test was done and the value of Multivariate Kurtosis and the Critical Value of Kurtosis were analyzed. It were found that the multivariate kurtosis and critical value of kurtosis for each model were;101.61 and 101.29 for first model, 28.76 and 28.56 for second model while third model has a value of 2.06 and 1.97 respectively. Therefore, it can be concluded that the first model is said to be severe non-normal multivariate, moderate non-normal for second model and multivariate normal for the third model. Second model was chosen as the best among three as the moderate normality condition is acceptable and does not affect the significance test and accuracy of the model formed. The minimum number of respondents being removed also assure that the data set represents the overall respondents well. The usage of moderately non-normal model is also been supported by writing of Lei & Lomax (2005) who stated the moderately non-normal condition will not cause any negative effect to the model formed.

Boon, Y. & Mat, N. (2010) carried out a study to investigate the satisfaction level of students at college 9, at

UTM Skudai, towards the service provided by the hostel management. Study was carried involving 280 respondents, with quantitative measurement. Three types of models were used to measure the satisfaction towards the service quality which are the SERVQUAL (service quality) model, SERVPERF (service performance) model and the Kano model. Findings showed that students are satisfied with all the criteria, accept for the quality of food prepared at the cafeteria.

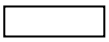
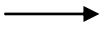
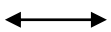
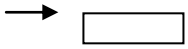
3.0 Methadology

Study uses primary data which was collected using survey forms. Survey was carried out on 313 respondents, which were selected randomly. This number of respondents fulfilled the Krejie and Morgan's rule of thumb for random sampling.

The hypothesized SERVPERF Model used, is analyzed using the Structural Equation Modeling (SEM) method. SEM method uses hypothesis testing approach to authenticate the theory being investigated. It solves all the equations forming the model simultaneously and conclude whether the formed model, fits the data well or not. That is, whether the theory which based the model is true or not for the research sample.

The SEM Model is based on two variables, namely the exogenous factor and the endogenous factor. Exogenous factor is the independent variable, which is the factor for some other factor. This factor might form by the latent construct or by indicator variables. On the other hand, endogenous factor is the dependent variable, which might also form by the latent construct or by indicator variables. Table 1 describes the symbols used in this SEM method, with their respective explanations.

Table 1: Symbols and Explanations in SEM

Name	Symbol	Explanation
(latent construct)		η_i for dependent variables and ξ_i for independent variables
Indicator Variables		y_i for dependent variable and x_i for independent variable
regression coefficient		$-\gamma_i$ for the impact of relationship between two indicators $-\beta_i$ for the impact of relationship between two latent construct and for the impact of relationship between an indicator and latent construct
correlation/covariance relationship		φ_i for structural model and Φ_i for measurement model
error estimation for indicator		δ_i for measurement model and ϵ_i for structural model
error estimation for latent construct		θ_i (only used for endogenous factor)

Mediator Effect

Mediator effect occurs when there is a third factor, influencing the relationship between two other factors. This mediator effect is analyzed when there is strong, significance relationship between two factors. Mediator effect test is done to ensure if the strong relationship is caused by a third factor. Diagram 1 below explains the Mediator Effect.

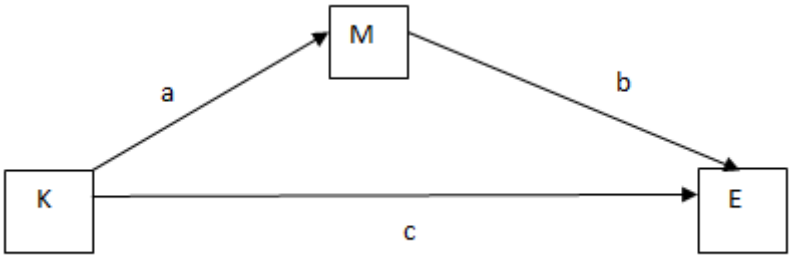


Diagram 1: Relationship of Mediator Effect

Earlier, it was found that there is a significance relationship between K and E factors, with a high regression coefficient for the path c (direct effect for K factor towards E factor). Therefore, study suggests that there might be a third factor which is the reason for this strong relationship. This will suggest a new indirect effect for K factor relationship towards E factor, that is the path a and b. However, this mediator effect is not always same for all condition, and it can be categorized into three groups.

First category is, no mediation effect. This condition occurs when the regression coefficient between the two factors c, remains significance and the value does not change even with the existence of M factor. M factor is said not to give effect for the relationship between the two factors.

Second category is, partial mediation effect. This condition occurs when the regression coefficient between the two factors c, remains significance, but the value decreased with the existence of M factor. M factor is said to give partial effect for the relationship between the two factors.

Third category is, full mediation effect. This condition occurs when the regression coefficient between the two factors c, becomes zero with the existence of M factor. M factor is said to give full effect for the relationship between the two factors.

4.0 Findings and Data Analysis

Constructing the Measurement Model

Two assumptions should be met to conclude the data set is suitable to be used for Structural Equation Modeling. They are, data set should be multivariate normal and continuous. Assumption of Continuous is fulfilled by using the continuous scale in the survey forms. It was also found the data set is moderately multivariate normal and acceptable for the Structural Equation Modeling. This result of multivariate normal test is shown in Table 2.

Table 2: Test of Multivariate Normality

Variable	Minimum Value	Maximum Value	Skewness	Critical Value of Skewness	Kurtosis	Critical Value of Kurtosis
18	1.00	7.00	0.119	0.86	0.105	0.377
19	1.00	7.00	0.124	0.894	0.111	0.402
20	1.00	7.00	0.036	0.259	0.240	0.865
21	1.00	7.00	-0.082	-0.588	0.309	1.113
22	1.00	7.00	0.024	0.175	0.116	0.418
5	1.00	7.00	0.044	0.316	0.459	1.655
6	1.00	7.00	0.086	0.619	0.306	1.102
7	1.00	7.00	-0.02	-0.147	0.053	0.191
8	1.00	7.00	-0.033	-0.235	-0.013	-0.045
9	1.00	7.00	-0.052	0.378	0.181	0.654
11	1.00	7.00	0.143	1.033	0.267	0.962
12	1.00	7.00	0.209	1.507	0.324	1.167
13	1.00	7.00	0.196	1.414	0.408	1.472
1	1.00	7.00	-0.004	-0.027	0.379	1.368
2	1.00	7.00	-0.038	-0.275	0.116	0.417
Multivariate					**49.600**	**19.397**

Next, Confirmatory Factor Analysis was carried out on the hypothesized SERVPERF Model. Figure 1 below shows the hypothesized model, having Tangible, Working Style and Empathy factors.

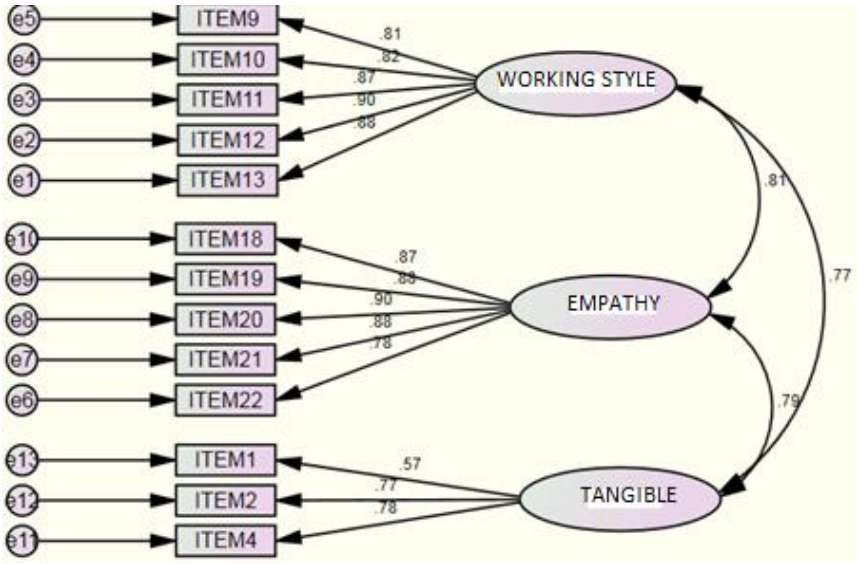


Fig. 1: Measurement Model with Three Dimensions

Testing of the above Measurement Model is based on the hypothesis of:

H_0: Model fits the data.

H_a: Model does not fit the data

The testing is based on the validity and fitting of the model. The validity of the model is based on four sub-tests which are the convergent validity, discriminate validity, nomological validity and face validity. The calculation for the convergent validity and discriminate validity are as follow:

Value of VE of each factor:

Value of VE for Working Style factor: $= \frac{0.81^2+0.82^2+0.87^2+0.9^2+0.88^2}{5} = 0.73$

Value of VE for Empathy factor: $= \frac{0.87^2+0.88^2+0.9^2+0.88^2+0.78^2}{5} = 0.74$

Value of VE for Tangible factor: = $\frac{0.57^2+0.77^2+0.78^2}{3} = 0.51$

As all the factors have the VE (Variance Extracted) value higher than 0.5, therefore all the factors obey the convergent validity condition.

Values for the discriminate validity are as follow:

Value of Variance being Extracted between the Working Style and Empathy Factors:

$$= \frac{0.81^2 + 0.82^2 + 0.87^2 + 0.9^2 + 0.88^2 + 0.87^2 + 0.88^2 + 0.9^2 + 0.88^2 + 0.78^2}{10}$$

$$= 0.7394$$

Value of Correlation Squared for the Working Style and Empathy Factors:

$$= 0.81^2 = 0.6561$$

Value of Variance being Extracted between the Working Style and Tangible Factors:

$$= \frac{0.81^2 + 0.82^2 + 0.87^2 + 0.9^2 + 0.88^2 + 0.57^2 + 0.77^2 + 0.78^2}{8} = 0.6495$$

Value of Correlation Squared for the Working Style and tangible Factors:

$$= 0.77^2 = 0.5929$$

Value of Variance being Extracted between the Empathy and Tangible Factor:

$$= \frac{0.87^2 + 0.88^2 + 0.9^2 + 0.88^2 + 0.78^2 + 0.57^2 + 0.77^2 + 0.78^2}{8} = 0.6563$$

Value of Correlation Squared for the Working Style and tangible Factors:

$$= 0.79^2 = 0.6241$$

It was found that all factors obey the discriminate validity as all the factors have Variance Extracted (VE) higher than the value squared correlations. Therefore, it can be concluded that all the factors obey the discriminate validity condition.

All the factors are also obeyed the nomological validity as the inter-correlation between each two factors is below 0.85. Face validity condition is also obeyed as the modified SERVPERF Model had high inter-correlation between factors, as hypothesized based on previous studies.

As all the four sub-test for the construct validity is fulfilled, the modified SERVPERF Model being used, obeys the construct validity condition.

The next step is to ensure the model fits the data well. First, the model is checked if it has the ratio of chi-square to degree of freedom (CMIN/df) less than five. Second, is to ensure model obeys fitting indexes, which is categorized into three groups. The three groups named Absolute Fitness Index ~(eg: Goodness of Fit, GFI and Adjusted Goodness of Fit AGFI),~Incremental Fitness Index ~(eg: Comparative Fitness Index, CFI) and Parsimony Index~(eg: Root Mean Square Error, RMSEA and p-CLOSE). A model is considered good only if both the Absolute Fitness Index and Incremental Fitness Index has a minimum value of 0.90. On the other hand, the error estimation for the model, for example the RMSEA value should be 0.05 and below, whereas the p-CLOSE value which explains the probability of the model to have the RMSEA value, should have a minimum value of 0.80.

The statistical results gained from the fitting test are as Table 2 below:

Table 2: Statistical Analysis for the Measurement Model

Index	Value	Conclusion
(CMIN/DF)	5.090	Model fit is not achieved
Absolute Fitness Index		
-GFI	0.918	Model fit is achieved
-AGFI	0.879	Model fit is not achieved
Incremental Fitness Index		
-CFI	0.959	Model fit is achieved
Parsimony Index		
-PR	0.795	Model fit is not achieved
-RMSEA	0.085	Model fit is not achieved
-PCLOSE	0.000	Model fit is not achieved

From the above table, it can be concluded that the model is close to the data fit level, however data fit is not achieved yet. Therefore, this model is rejected, and a modification is done to the model.

H_0 is rejected; model does not fit the data.

Modification is carried out based on three bases. First, any indicators/variables with a loading value below 0.5 is removed. Second, if any two indicators have value of co-variance out of the range -2.5 and 2.5, one of the indicators should be removed. Third, any two errors of indicators/variables having high correlations (value of Modification Indexes above 10) should be added constraint (covariance) among them to reduce the correlation effect.

Figure 1 showed that all the indicators have loading value above 0.5, next Table 3 and Figure 2 shows the Modification Indices value and the Measurement Model after the modifications, respectively.

Table 3: Modification Indices

Covariance	Modification Indices	Changes of the Chi-Square Fitness
e14←→e15	52.283	0.114
e13←→e15	7.312	-0.041
e13←→e14	4.003	-0.030
e12←→e15	12.653	-0.058
e12←→e14	13.558	-0.058
e12←→e13	25.655	0.078
e11←→e15	5.289	-0.056
e11←→e14	20.752	-0.108
e11←→e12	21.279	0.112
e10←→TANGIBLE	5.470	0.072
e9←→e11	4.141	-0.057
e9←→e10	14.291	0.087
e8←→e9	14.573	0.080
e7←→EMPATHY	7.706	-0.051
e7←→e15	6.394	-0.050
e7←→e10	4.368	0.049
e6←→e13	13.298	-0.074
e6←→e11	6.083	0.077
e6←→e7	20.160	0.112
e5←→e9	4.396	-0.049
e4←→e10	10.146	-0.071
e4←→e8	4.102	-0.041
e4←→e7	8.348	-0.063
e4←→e5	24.581	0.113
e3←→EMPATHY	6.918	0.049
e3←→e10	10.192	-0.076
e3←→e9	7.428	-0.062
e3←→e8	7.136	-0.058
e3←→e5	4.947	0.054
e3←→e4	36.432	0.133

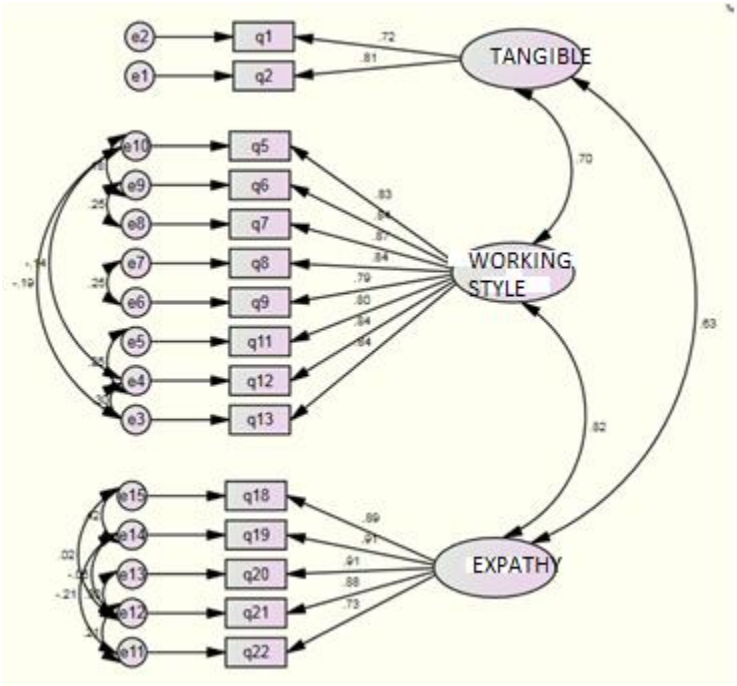


Figure 2: Measurement Model after Modification

The statistics values for the Measurement Model after modifications are shown in Table 4 below.

Table 4: Statistical Analysis for the Measurement Model

Index	Value	Conclusion
(CMIN/DF)	1.554	Model fit is achieved
Absolute Fitness Index		
-GFI	0.954	Model fit is achieved
-AGFI	0.925	Model fit is achieved
Incremental Fitness Index		
-CFI	0.991	Model fit is achieved
Parsimony Index		
-PR	0.705	Model fit is closely to be achieved
-RMSEA	0.042	Model fit is achieved
-PCLOSE	0.800	Model fit is achieved

Based on the results of Table 4, it can be concluded that the Measurement Model after modification, as in Figure 2 fits the data and could explain the data well. Therefore,
hypothesis H_0 is accepted, that is model fits the data.

Analysis on Presence of Mediator

Previous studies suggest that there is a strong relationship for Empathy factor towards Tangible factor. That is the concern and caring attitudes among the hostel staffs caused a good improvement on the quality of facilities, equipments and environment at the hostel. Therefore, researcher would like to investigate if there is a third factor

influences this strong relationship between these Empathy and Tangible factors. Based on previous studies, it is hypothesized that Working Style factor act as the mediator and contributes as an indirect effect towards the relationship. That is, the concern and caring attitudes among the hostel staffs (Empathy) caused them to work harder and faster and always have an attitude to help the students (Working Style). This will then cause the quality of facilities, equipments and environment provided to be even better (Tangible).

The test of this mediator effect is based on following hypotheses:

H_1: Empathy factor will have a significance relationship with the Tangible factor and its regression coefficient does not change even with the Working Style as the mediator between the two factors.

H_2: Empathy factor will have a significance relationship with the Tangible factor but its regression coefficient decreases with the Working Style as the mediator between the two factors.

H_3: Empathy factor will not have a significance relationship with the Tangible factor and its regression coefficient will become zero with the Working Style as the mediator between the two factors.

Diagram 3, 4 and Table 2 below shows the p-value and the regression coefficient in both the two conditions, with and without Working Style as the mediator.

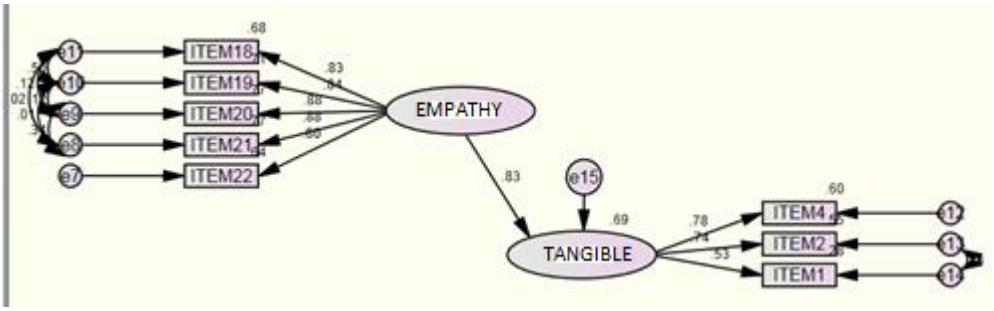


Diagram 3: Structural Model without Working Style as Mediator

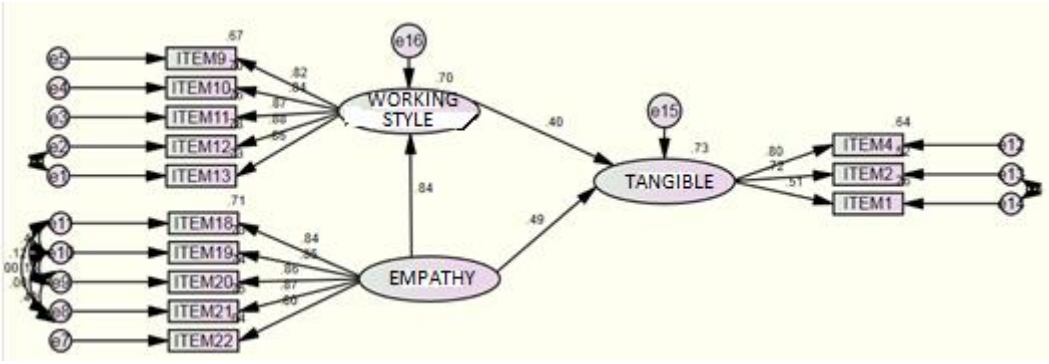


Diagram 4: Structural Model with Working Style as Mediator

Table 2: Mediator Effect on the Regression Coefficient and p-Value

Relationship	Direct Effect With Mediator	Direct Effect Without Mediator
Tangible←Empathy	0.49(***)	0.83(***)

Based on the above Diagrams and Table, it can be concluded that there is an indirect effect between Empathy and Tangible factors, with Working Style as the mediator. This is shown as the relationship between Empathy and Tangible factors is still significance with the existence of Working Style factor as the mediator. However,

the Working Style factor only act as a partial mediator, that is this factor could not explain the whole relationship between Tangible and Empathy factors. This is shown by the decrease (from 0.83 into 0.49) in the regression coefficient value with the existence of Working Style factor.

Therefore, hypotheses H_1 and H_3 are rejected, while hypothesis H_2 is accepted. Empathy factor have a significance relationship with Tangible factor, but the regression coefficient value decreases with the Working Style as a mediator between these two factors.

5.0 Conclusion

Referring to results of Table 4, it can be concluded that the respondents (students) assumed factors of Tangible, Working Style and Empathy as the factors influencing their satisfaction towards the quality of service provided at their hostel.

Based on the mediator presence analysis, it can be concluded that there is an indirect effect between Empathy and Tangible factors, with Working Style as the mediator. That is, the concern and caring attitudes among the hostel staffs (Empathy) caused them to work harder and faster and always have an attitude to help the students (Working Style). This will then cause the quality of facilities, equipments and environment provided to be even better (Tangible).

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