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Modeling Reflective Constructs in Generalized Structure Component Analysis: An Application to Service Quality and Customer Satisfaction in UniSZA Library

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This paper will discuss the estimation of the novel method as a Generalized Structure Component Analysis (GSCA) with first order constructs. Existing research has primarily focused on a reflective construct. This study will use an established model on Parasuraman service quality theory applied to UniSZA library. The estimated model examines the impact of quality of services on customer satisfaction in UniSZA library. The data was obtained through online questionnaires from a sample of 1,043 valid responses. The findings from the GSCA method shows that the measurement and structural model is adequate for composite based SEM. Several recommendations have been provided. Since most of the previous research has focused on composite based SEM, this paper provides useful guidelines for researchers to apply the GSCA method as an alternative to PLS-SEM.

Key words: *Service Quality, Customer Satisfaction, Generalized Structure Component Analysis, Partial Least Squares Structural Equation Modelling, composite method.*

Introduction

Structural Equation Modeling (SEM) has become a method of choice for analyzing complex models with large sample sizes in several research fields, including management (Afthanorhan et al., 2018; Aziz et al., 2015), marketing (Al-mhasnah et al., 2018; Zainol et al., 2019), tourism (Awang et al., 2015; Afthanorhan, Awang, & Fazella, 2017), and education (Afthanorhan et al., 2019; Albasu & Nyameh, 2017; Aldulaimi, 2018; Alhassan & Anya, 2017; Altunkaya & Ates, 2018; Ang etal. 2018; Anthony et al. 2017; Ariani, 2017). The SEM methods were introduced in 1960 to estimating the inter-relationships between multiple observed and latent variables while also considering measurement errors. The two methods were conceptually distinguished for different purposes: common factor and composite based SEM (Rigdon et al., 2017; Hwang et al., 2019). In common factor-based SEM, unobserved constructs exist as the independent variable for observed variables. In contrast, the composite based SEM applies unobserved constructs as the dependent variable for observed variables which follows the principle of the multivariate statistical technique such as canonical correlations and principle component analysis (Pearson 1901; Horst, 1961).

When applying SEM methods, researchers must decide whether to use common factor or composite based SEM. The common factor-based SEM is often referred to as covariance-based analysis (CBSEM) that exemplified in IBM-SPSS-AMOS, Mplus, Lisrel, Lavaan, JASP, and EQS software. For composite based SEM, several methods have been recognized in multivariate analysis, such as partial least squares, structural equation modelling (PLS-SEM), generalized structure component analysis (GSCA), regression on sum scores, consistent PLS, and Factor based PLS. PLS-SEM and GSCA are well developed to composite based SEM since this method has gained massive attention during the last 15 years, especially in business management (Aziz et al., 2019). This method has also penetrated the research of other scientific fields such as medicine, environmental, agriculture, and engineering. To date, there are several software programs that have implement the composite based SEM such as SmartPLS 3.0, Warp PLS 6.0, ADANCO 2.0, and Gesca 2.0.

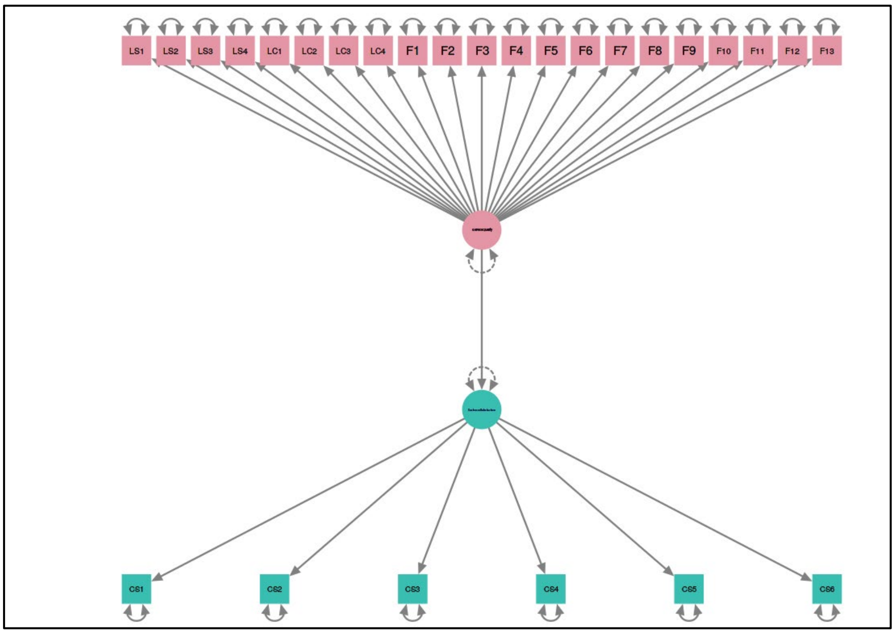
The common factor-based SEM is the confirmatory method that is only relevant for replication studies (apply the existing model into a new domain), modified the established model, behavioural construct, and for the comparison purposes. The composites-based SEM focuses on an exploratory method that is suitable for prediction (aiming to maximize the total variance of endogenous construct), the development of new models from lack of evidences, and design construct. Although some scholars argue the capability of composite based SEM, others view them as complementary rather than competing statistical methods.

Reflecting on the increasing number of publications that apply the composite based SEM, it is evident that there is no study in library settings that utilize the GSCA method, although it was more informative than the PLS-SEM (Hwang & Takane, 2014) when assessing the measurement model. PLS-SEM does not rely on stringent assumption as a common factor. Base SEM applied as the normal distributed data (using the maximum likelihood estimator) can avoid improper solutions and non-convergence of parameter estimates (indicator loading and construct correlation greater than 1.0 and Heywood cases). This is because it replaces factors by linear composites of observed variables per construct. The same applies to GSCA, but it is more effective as it can permit the constraint paths (between constructs) and manifest variables (between construct and items) simultaneously (Hwang, Takane, & Tennenhaus, 2015). Additionally, in GSCA, the extended constraint (when uncorrelated pair variables) and unconstraint approach (when pair correlated variables) is applicable to multi-group analysis (moderation analysis), which avoids the drawback of PLS-SEM (Hwang, Takane, & Jung, 2017). For these reasons, it would be helpful to extend the GSCA capabilities into library research as addressed in this study. More importantly, this study provides insights for researchers who conceptualize and operationalize their research model to composite based SEM methods.

Empirical Example

To better illustrate how to model and assess the reflective first order construct using the GSCA method, this research paper uses a model grounded on Parasuraman's service quality (1985) applied to UniSZA library. This theory posits that the level of customer satisfaction is influenced by the prominent construct called service quality which is measured by 23 items. The model used in this study is aims to examines the strength of service quality that has an impact on customer satisfaction. Based on a literature reviews (not the focus of this study), one research hypothesis was proposed as depicted in Figure 1.

Figure 1. Research framework



Service quality construct was conceptualized as an exogenous construct (independent construct). Indeed, the previous literature proves that there are at least five dimensions that should be composed in the service quality construct and have typically included responsiveness, reliability, tangible, empathy and assurance. The current study considers all items from each dimension into the service quality. The implementation of second-order construct was not the aim of this study when apply to GSCA method. Therefore, service quality construct was served as the first order construct by taking all items altogether.

the data used to test this model model was obtained by an online survey, using a convenience sampling (non-probability sampling). The questionnaire was validated by the experts in library research and a pilot test was conducted before proceeding with the field study. The pilot test was assessed by the analysis of exploratory factors to examine the number of items retain in the model and Cronbach Alpha for reliability purpose. From EFA results, 2 items from service quality construct were deleted due to poor loadings, whereas the reliability was satisfied. For the field study, a total of 1,043 valid responses were considered for further analysis using R programming. Figure 2 and Figure 3 provides the indicator loading and weight information for each construct in a research model.

Model Specification

The relationship between manifest variable and constructs is expressed as to whether the construct should be a reflective or a formative construct. The most common approaches when assessing the measurement model are specified as reflective measurement, indicators are assumed influenced by the latent variable (construct), i.e. dropping indicators from construct will not affect the underlying construct.

The researchers must decide whether to apply the reflective or formative construct as the misspecification of measurement model can lead to an invalid assessment of relationships in GSCA method. On the other hand, assessments for reflective constructs are not relevant for formative constructs. The reflective construct requires the test of Dillon-Goldstein (composite reliability). This includes the average variance extracted (AVE), discriminant validity, model of fit, indicator and weight results. On the contrary, these assessments cannot be implemented to formative constructs in which all indicators are assumed to form a latent variable (construct). In this study, the reflective measurement is imposed to all construct in a model (service quality and customer satisfaction).

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Figure 2. Indicator Loadings

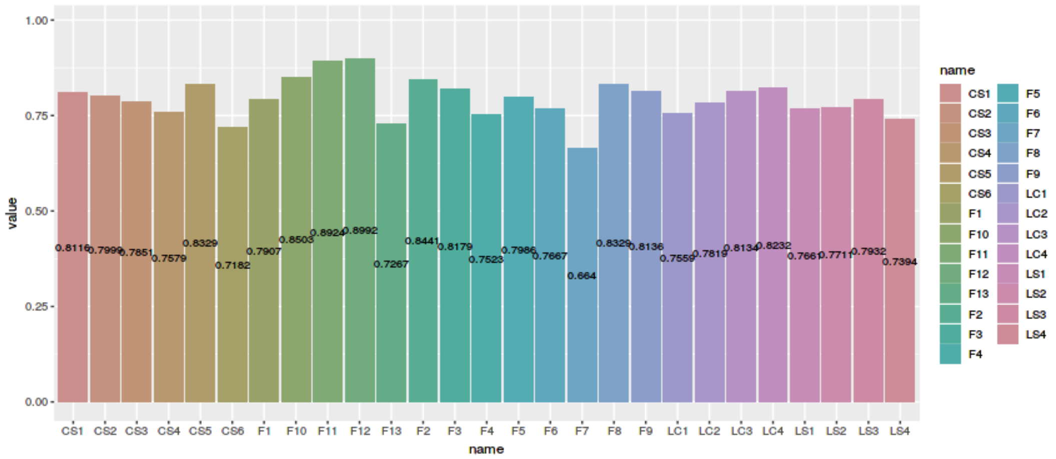
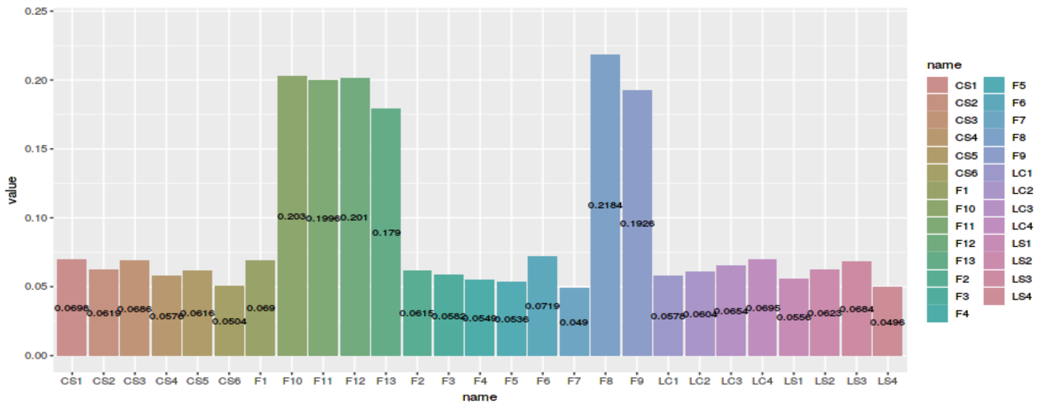


Figure 3. Indicator Weight



Model Assessment

A composite based SEM model has two components such as the structural model (inner estimates) and measurement model (outer estimates) which entails more than one optimization criterion for generating the parameter estimates. In GSCA, this novel method can construct a single optimization criterion for parameter estimates and thus allowing the GSCA yield an overall measure of fit. As such, four types of fit were introduced from GSCA method that are FIT, Adjusted FIT, GFI and SRMR. In PLS-SEM, only one fit index was introduced in measurement model. These two distinctions are caused by different estimators used. GSCA uses Alternating Least Squares (ALS) whereas PLS-SEM uses Ordinary Least Square (OLS). Both methods are alternative to confirmatory factor analysis.

Table 1: Model Fit

	Measure	SE	95% Lower Limit	95% Upper Limit
Fit	0.9143	0.026	0.5705	0.6708
Adjusted Fit	0.9084	0.0264	0.5639	0.6658
GFI	0.9991	0.0002	0.9966	0.9993
SRMR	0.063	0.007	0.0608	0.0882

Table 1 shows the model fit results generated from GSCA method. According to Hwang & Takane (2014), the overall fit in GSCA methods were measured by the total variance of the endogenous construct. The larger the fit values, the more variance permeated of the endogenous construct. In this case, the three fitness as FIT, Adjusted Fit, and GFI are greater than 0.90 which meet the threshold value (Hwang et al., 2019). Other than that, the SRMR yielded to examine the different values between empirical and implied of variance matrices. The lower the SRMR value, the higher accuracy of estimated model. The reasonable value for SRMR is lower than 0.08 (Afthanorhan et al., 2019).

Table 2: Reliability and Validity

	Cronbach Alpha	Dillon-Goldstein	Average Variance Extracted (AVE)
Service Quality	0.9679	0.9704	0.6104
Customer Satisfaction	0.9138	0.9336	0.7019

Table 2 presents the reliability and convergent validity results. These values derived from the strength of indicator loading. According to Hair et al. (2017), indicator loading below 0.40 should be immediately dropped from the model due to insignificant worth for assessing the corresponding construct. The indicator loading is suggested at least 0.70 to maintain in the model for further analysis. From this result, the Cronbach Alpha and Dillon-Goldstein method is satisfied (above 0.70). Meanwhile, the average variance extracted should be above 0.50. It implies that more than half of the total variation in construct has been explained. Subsequently, the discriminant validity is established as shown in Table 3.

Table 3: Discriminant Validity

	Service Quality	Customer Satisfaction
Service Quality	0.7813	
Customer Satisfaction	0.5523	0.8378

Discriminant validity is truly satisfied when the value of construct correlation (service quality and customer satisfaction) is lower than the diagonal values. This study applies Fornell & Larcker's approach to establish the discriminant validity rather than Heterotrait-Monotrait ratio

(HTMT) method. Some scholar argues the capabilities of the Fornell approach when applied to composite based SEM but no current research has focuses on the GSCA method. Therefore, the traditional approach is remains valid for GSCA.

Table 4: Path Estimates

	Estimate	**Standard Error**	**95% Lower Boundary**	**95% Upper Boundary**
Service Quality→ Customer Satisfaction	0.8868	0.0194	0.8496	0.9224

Finally, the standardized path coefficients and confidence intervals provide evidence of the structural model and allow the applied researchers to test the proposed hypotheses. The path coefficients and confidence intervals are presented in Table 4. The p-value is not recommended for significance testing due low power than of confidence intervals (Ringle et al., 2019). It shows that the service quality has positive significant effect on customer satisfaction as the value of 0 does not straddle in between 0.8496 and 0.9224. The explained variance of the endogenous construct is 0.7876. Values of 0.67, 0.33 and 0.19 of total variance are substantial, moderate and weak respectively (Chin, 2001). Based on this, the impact of this study is substantial.

Conclusion

The empirical example in this study illustrates that the GSCA method produces similar results regarding the model assessment and structural model. It shows that GSCA method also effective as PLS-SEM in examining the hypothesized model. The main difference between GSCA and PLS-SEM is the model fit. Although this study has provided a contribution in promoting the application of GSCA in library research, it has its limitations. One of major limitations of this study is that the model tested for empirical example has focused the first order measurement. Additionally, the mediation and moderation analyses are not investigated in the current study. Despite these limitations, this study contributes to the GSCA literature by providing its development and efficacy for estimating the reflective constructs and by offering researchers guidelines to report the first order constructs.

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