Discriminant Validity Assessment of Religious Teacher Acceptance: The Use of HTMT Criterion

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Abstract. This study was conducted to produce empirical evidence of validity and reliability of a set of questionnaire. Questionnaire drawn from the results of previous studies and the validity of the tests will determine whether all aspects of the construct domain were represented, thus ensuring the high objectivity level of the questionnaire. In addition, an alternative approach was used to assess the discriminant validity, using heterotrait-monotrait ratio of correlations. The study empirically proves that the questionnaire used is unchanged by culture. This is important because if not, its use will be restricted to a population in which the questionnaire was developed. The proposed method is better in which to enhance and improved the discriminant validity, using heterotrait-monotrait ratio of correlations. The results of the analysis in the measurement model indicated that the questionnaire meets the standards of reliability and construct validity.

Keywords. Measurement Model, Technology Acceptance, Validity and Reliability

1. Introduction

Virtual learning system (VLS) is an information system that facilitates e-learning have been widely implemented by education institutions to support face-to-face teaching and self managed learning in the virtual learning and education environment [1]. Classrooms in Malaysia practise 21st century learning with the emphasis on an active student-centred learning. This method will show that the high order thinking skill (HOTS) is applied in the curiculum, assessments and co-curricular activity as well as the application of information technology and communication in preparing the students for the new landscape of higher learning and future opportunities [2]. Surveys conducted by the Ministry of Education in 2010 found that the use of ICT in school is limited. Approximately 80% of teachers use ICT less than one hour per week. Only a third of students stated their teachers regularly use ICT [3]. According to the analysis by the national audit on the use of VLE based on the number of schools who logged in to VLE from 1st march till 31 march 2014, they found that the use of VLE in schools in Malaysia is low which is between 19.5% to 33.5% schools only. The audit also found that the use of VLE among teachers in Malaysia is very low, between (19.5%) to (33.5%) [4]. Despite the emerging trend of using various types of e-learning systems to facilitate teaching and learning activities, the number of e-learning users is not increasing as fast as predicted such as the use of web based learning [5].
There are several models and theories which previously constructed for the purpose of explaining the behavior of computer use in humans [6]. Technology acceptance model (TAM) and (Unified Theory and Acceptance Use of Technology (UTAUT) for example, have been used repeatedly in a number of contexts (e.g. business and commercial and organizational environment), nevertheless, a similar scenario cannot be in the context of education [7]. Empirical studies of cultural settings and their influence on processes or outcomes of teacher’s perception of intention to adopt VLE require reliable and valid measurement instruments. Such instruments would also provide practitioners with an analysis and benchmarking tool that could be used to examine the extent to which their organizational culture, which would in turn aid educational efforts in improving teacher intention and thereby encourage better performance towards VLE usage. Based on the literature, there are many instruments that are found in the business and IT systems. At the same time, the use of a specific questionnaire used in the field of education in schools is different from the innovation of information technology systems that are more practical. Researchers like [8] claimed that the instrumentation is necessary to ensure that the questionnaire remains valid, if used in a different culture from which it was developed. This article provides numerically study of the validity of the tests in education to get an estimate of the extent of which the specification model can be used to verify the reliability and validity testing using PLS-SEM.

2. Measures of Teacher’s Perception
To assess the psychometric properties of the measurement, the researchers analyzed the validity and reliability of the scale according to the recommendation by [9,10] and [11] namely evaluating (1) reliability, (2) the convergent validity and (3) discriminant validity. Thus, the analysis model used in this study involves checking the reliability, convergent validity and the discriminant validity [10]. The discriminant validity was tested to determine whether a construct measures what should be measured by checking the square root of the AVE. Each construct exceeds the correlation of each other, thus confirming that the instrument met the criteria for the validity of the [10]. The study also used comparative table of cross-loading items to test discriminant validity to see the AVE [12].

Although Fornell-Larcker were used in assessing discriminant validity before, there is almost no systematic examination of its effectiveness in assessing discriminant validity [13]. This would make the Fornell-Larcker criteria [10] having the problem of uncertainty in detecting the discriminant validity of a normal research situation. This is important because failure to disclose the discriminant validity problem can lead to biased estimates discriminating criteria of the structural parameters and formulations that do not fit the hypothesis of the relationship between constructs [13]. Therefore, the methods commonly used in the Fornell-Larcker criteria and Cross-Loadings have problem in revealing problems of discriminant validity of the VB-SEM.

This article presents an exhaustive review of these studies and suggests a direction for future developments uses recommendations by [13] to give more attention to the discriminant validity confirmation to empirically prove measuring item.

3. Research Methodology
Measurement model in Structural Equation Modeling (SEM) is often referred to as the outer model. It shows how variables manifest represent the latent constructs to be measured and to test the validity and reliability of latent constructs. Researchers developed a measurement model, before proceeding to examine the structure of the proposed model [14]. The study was conducted by collecting data on teachers who teach Islamic education in primary and secondary schools in the state of Terengganu. Pre-test was administered on 212 teachers from primary dan secondary school to look at the teachers' understanding of the questionnaire. No specific signs exist when the questionnaire was administered, thus giving the assurance the questionnaire could be used. The original questionnaire in this study is in English. Then back-translation method and pre-test method were used. However the use of back-translation method did not eliminate the problems that might arise from differences in language or culture. Therefore, according to [15][16,17] a pre-test is necessary even after careful translation. This
study used questionnaires as the data collection for the survey. Response from survey questions are collected by cross sectional time dimension. The proposed variables in the model study was analyzed to verify the research model. Questionnaire using a five-point Likert scale, ranging from strongly disagree (1) to strongly agree (5) and consists of 25 items related to seven constructs of the model.

Finally, all items were tested to meet the requirements of reliability and validity. This process ensured that each item was suitable and could be used for the corresponding concept in Malay/Education. Model studies were analyzed using SmartPLS 3.0 which is part of the structural equation modeling (SEM). PLS was selected for the analysis of data over the approach based on covariance because the study was quite complex and had a number of great items, and unstable measurement. It was also good because the relationship between the items and the variables of latent (latent variables) needed to be modeled in different modes (eg formative and reflective) [5,18].

The researcher used structural equation modeling (SEM) for the purpose of fulfilling the objectives of the study which included estimation of measurement error for all variables specified. Reliability test was assessed using a composite reliability and Cronbach's alpha. The results of the numerical simulation indicate that the high alpha value indicates that items in specific constructs have the same meaning and value in explaining a construct [19]. To assess the internal consistency reliability, researcher selected composite reliability and Cronbach alpha because evaluation using composite reliability is equal to Cronbach alpha. The composite reliability was used to address some of the shortcomings in the measurement using Cronbach alpha as suggested [9,20]. The Cronbach alpha is limited by the assumption that the indicator has the same reliability (tau-equivalence) and efforts to maximize it may affect reliability [21]. On the other hand, the reliability of composite is not considered to have tau-equivalence. This makes it more suitable for PLS-SEM, the priority indicator according to the respective reliability.

### Table 1: Results of Reliability Test

| Constructs             | Composite Reliability | Cronbachs Alpha | AVE  |
|------------------------|-----------------------|-----------------|------|
| Compatibility          | 0.944                 | 0.921           | 0.809|
| Ease of Use            | 0.943                 | 0.909           | 0.847|
| Facilitating Condition | 0.905                 | 0.843           | 0.762|
| Intention              | 0.948                 | 0.927           | 0.820|
| Personel Innovation    | 0.892                 | 0.819           | 0.735|
| Usefulness             | 0.966                 | 0.953           | 0.875|
| Social Influence       | 0.928                 | 0.885           | 0.812|

In this study (Table 1), all of the items meet the guidelines to construct composite reliability greater than 0.70 [22] and the reported Cronbach alpha surpassed the minimum level of 0.60 [23] or 0.70 [24]. The validity of the construct was tested through two methods, namely convergent validity and discriminant validity [25] by examining the AVE (average variance extracted) of each construct.

### Table 2: Convergent validity

| Constructs | COM | EOU | FC | IT | PITT | PU | SI |
|------------|-----|-----|----|----|------|----|----|
| com1       | 0.895 |     |    |    |      |    |    |
| com2       | 0.866 |     |    |    |      |    |    |
| com3       | 0.915 |     |    |    |      |    |    |
| com4       | 0.920 |     |    |    |      |    |    |
According to the convergent validity in Table 2, it was found that the convergence of an item to construct represented. The method used to test the convergent validity is by measuring the AVE using the AVE guidelines which is equal to or greater than 0.50 [9]. Apart from that the terms convergent validity can be referred to construct loading which is equal or more than 0.7 [10].

Through literature review, there’s an alternative approach, based on the matrix multitrait-multimethod, to assess the discriminant validity of heterotrait-monotrait ratio of correlations (HTMT). There are two ways to use HTMT to assess discriminant validity: (1) as a criteria or (2) as a statistical test. For the test criteria, if the HTMT is greater than the value of 0.85 [26], or the value of 0.90 [27], it shows the existence of discriminant validity issues. The second test criteria according to [13] is to test the null hypothesis (H0: HTMT ≥ 1) against the alternative hypothesis (H1: HTMT <1) and if the confidence interval contains the value of one, this indicates discriminant validity issues.

**Table 3: Discriminant validity of Heterotrait-Monotrait Ratio of Correlations (HTMT)**

| EC  | FC    | ITT | PEOU | PIIT | PU    |
|-----|-------|-----|------|------|-------|
| .78 | (.731)| (.853)|      |      |       |
| .79 | (.723)| (.867)| .68  | (.584)| (.771)|
| .82 | (.763)| (.885)| .75  | (.658)| (.823)| (.84  | (.767)| (.904)|
If the HTMT value is greater than HTMT.85 value of 0.85 or HTMT.90 value of 0.90, there is a problem of discriminant validity. Table 3 shows the results of HTMT is greater than the value of 0.85 [26] while the one problem regarding the HTMT.90 criterion is shaded grey or the value of 0.90 [27]. As shown in Table 3 all the values passed the HTMT.85 [26] and also the HTMT inference does not indicate discriminant validity problems. Comparing the approaches shows that HTMT.85 always exhibits higher or equal sensitivity, but lower or equal specificity values compared to HTMT.90. The results reveal that HTMT.85 is more likely to indicate a lack of discriminant validity, an expected finding considering the criterion’s lower threshold value.

### 4. Discussion and Conclusions

This article reports the development and validation studies of a self-report measure for assessing religious teachers’ perceptions of intention to adopt VLE. The results presented here may facilitate improvements in the standards of reliability and construct validity especially the discriminant validity tests. Based on the analysis, all items fulfil the guidelines of the confidence test that is based on composite reliability greater than 0.70 [9,28] and Cronbach's alpha greater than 0.70 [24]. The results of the analysis of convergent validity was assessed using the average variance extracted (AVE). It showed all item fulfilled the guidelines of AVE which is greater than 0.5 [9] and all loading items is significant with latent variables, (p <0.05) and above the minimum level of 0.4 by [11].

The discriminant validity tests [29] fulfill the conditions, when the square root of the average value of the extracted (AVE) for each construct is greater than any of the other constructs. Similarly the value of the cross-loading item is higher than the other constructs. Heterotrait-monotrait ratio of correlations (HTMT) analysis using the test criteria according to [13] also showed no problems of discriminant validity. From the table shown, all discriminant validity tests have fulfilled the conditions and support the discriminant validity analysis that exist between the two reflective constructs. Measurement model in PLS analysis involves checking the reliability, convergent validity and discriminant validity [10].

Measurements model is evaluated in terms of loading items, reliability, convergent validity and discriminant validity. All loading items are significant with latent variables (p <0.05) and above the minimum level of 0.4 by [11]. Reliability was assessed using Cronbach's alpha and composite reliability. All construct items meet the guidelines of composite reliability greater than 0.70 [28] and Cronbach's alpha greater than 0.70 [24]. Convergent validity was assessed using the average variance extracted (AVE). All items meet the guidelines of average variance extracted (AVE) which is greater than 0.50 [28]. The study also confirmed that the instrument meets the discriminant validity using the HTMT test criteria. Previously the Fornell-Larcker test and cross loading test were a pre-requisite generally accepted to analyze the relationship between latent for Structural Equation Modeling based on variance (VB-SEM).

In summary, many interesting results indicating the potential of discriminant validity using the HTMT test criteria have been reported. However most of the studies in the open literature did not simultaneously examine the effect of HTMT test criteria. Therefore, the results of the analysis in the measurement model indicated that the questionnaire meets the standards of reliability and construct validity. Verification of measurement model is needed to evaluate the structural model that will be
carried out later. If the model does not have the minimum acceptable measurement reliability and validity, then the structural model is not expected to contribute anything [30].

The findings of this study will help to facilitate a better understanding of the quality of the measurement used in current study. From the results of the tests carried out, the items can be used in a variety of different cultural contexts, thus providing legal proof that the items in the questionnaire have the ability to measure the acceptance of Islamic Education teachers in Malaysia.

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