Verification of Learning Outcomes Inventory Using Exploratory Factors Analysis (EFA)

Zainatuliza Zainal Abidin[1], Siti Rosminah MD Derus [2],

[1] Politeknik Sultan Azlan Shah, Behrang, Perak, Malaysia
[2] Faculty of Art, Computing & Creative Industry, University Pendidikan Sultan Idris, Tanjung Malim, Perak

ARTICLE INFO

ABSTRACT

The purpose of this study is to validate an instrument to study student perceptions towards their achievement of learning outcomes domains which were knowledge, practical skills, and generic skills. Through a factor analytic process it is shown that the instrument did reflect the theoretical model. It was also useful in refining the items for the questionnaire. The instrument is for use in future research designed to measure student perceptions towards their achievement of learning outcomes domains. A total of 158 engineering students of Premier Polytechnic in Malaysia were involved in this research. A set of questionnaires was developed using four Likert-scales. Data were analyzed descriptively for reliability (Cronbach Alpha values) and exploratory factors analysis (EFA) was utilized to discover the latent variables that underlie the scale. The results showed that the classification of the Cronbach Alpha was high and very high, more than 0.70. The factor analysis showed three factors which is Knowledge, Practical Skill and Generic Skill. Each items shows the satisfactory load values which is greater than 0.5. Therefore, the questionnaire developed is suitable for assessing the learning outcomes of engineering students in the context of polytechnic education in Malaysia.

INTRODUCTION

The key to the future of any country and any institution located in the talent, skills and abilities of its people. With the talent shortage is expected to worsen in many developed and developing world, it will be important to turn our attention to how these deficiencies can be met in the short term and limited long term. Many higher educational institutions had started implementing Outcomes Based Education (OBE) as students' centered-learning had proven to produce better quality students. The main objective of OBE is to produce highly competence students in three domains; knowledge, technical skills and generic skills, as well as fulfilling the nation vision.

To achieve the mission and vision of an educational institution, they must ensure that the entire learning outcomes specified domain can be achieved. There are three domains of learning outcomes of cognitive, psychomotor and affective involving knowledge, practical skills and values and attitudes. Learning outcomes is where the guidance of the skills needed by students. The importance of learning outcomes is to say what needs to be mastered by students. It can help students focus on mastery of specified. It is also

important for lecturers in designing and using a variety of learning methods, especially student-centered learning and effective teaching tool for students to master learning outcomes.

Polytechnic education system continues to identify measures to improve the availability of graduate work in accordance with the qualifications required. One of the efforts made to ensure that the system complies with the guidelines of polytechnic education Malaysian Qualifications Framework (MQF) under the Malaysian Qualifications Agency (MQA). In June 2010, the Department of Polytechnic has started to develop an outcome-based curriculum for all programs operated either in engineering or other non-engineering. This is consistent with the accreditation requirements set by the Board of Engineers Malaysia (BEM) which requires all engineering programs in Malaysia to be redeveloped in accordance with this new approach. This paradigm shift is needed to Malaysia via BEM gain full membership in the Washington Accord pact in 2007 that enables Malaysian engineers can work in other countries such as the United States, Canada, United Kingdom, South Africa and Australia [1].

Malaysian Qualifications Framework (MQF) is an instrument that develops and classifies qualifications based on a set of criteria that have been regulated under the Malaysian Qualifications Agency (MQA), Ministry of Higher Education Malaysia. MQA provides educational pathways that these qualifications are systematically being turned into practice at the national level and as a benchmark internationally. Inside there are two components MQF skills assessed cognitive component involves the knowledge and practical skills and generic skills components. [2] also states that all education takes place in Malaysia must meet the eight domains of learning outcomes which are i) knowledge; ii) practical skills; iii) skills and social responsibility; iv) values, attitudes and professionalism; v) communication skills, leadership and teamwork; vi) problem solving skills and scientific skills; vii) information management skills and lifelong learning; viii) management and entrepreneurial skills.

Learning outcomes are statements that describe the knowledge, skills, and attitudes that learners should have after successfully completing a learning experience. Learning outcomes also are statements that provide measurable evidence of the understanding that students should have. Learning outcomes give you evidence to see the quality of students' knowledge, skills, and attitudes they have learned in their course, and can reflect different levels of thinking or mastery. Polytechnic as one of the leading TVET in Malaysia have established domain of learning outcomes to be achieved for each of the graduates.

[3] questioned whether the graduates produced by institutions of higher to meet the requirements of the employer at the time. This question is not immune to polytechnic graduates Malaysian ministry of higher education. Now, the question is whether the graduates produced by the polytechnics to meet the country's workforce and also the current job market. The process of transformation of polytechnic is one of the goals to be achieved to be one of the premier institutions in technical and vocational education. Therefore, the purpose of this study is to validate an instrument to study student perceptions towards their achievement of learning outcomes domains which were knowledge, practical skills, and generic skills. Through a factor analytic process it will show that the instruments reflect the theoretical model. Since it useful in refining the items for the questionnaire. The instrument is for use in future research designed to measure student perceptions towards their achievement of learning outcomes domains.

The analysis of factor is a statistical method used to describe the changeability between variables observed, correlated in terms of potentially low number of variables not observed called factors. Factor analysis is a statistical approach used to analyze the relationship between several variables and explains these variables in certain forms of latent factors [4], [5]. Factor analysis was conducted to identify factors or components that exist in the questionnaires that have been created. Factor analysis is a statistical technique that transforms the original data set of build to a small group of linearly constructs can present a comprehensive for all information contained in the original building [6]. The objective factors analysis is to reduce the dimensions of the original data to several smaller components and can be interpreted more convenient and meaningful [6]–[8]. According to [9] factor analysis through several ranks. Ranked first thought correlation matrix between all the constructs were analyzed factors. Ranked onwards revoke extracting some factors than the correlation matrix and determine the number of factors that are formed. The main applications of factor analytic techniques are: (1) to reduce the number of variables and (2) to detect structure in the relationships between variables, that is to classify variables. Therefore, factor analysis is applied as a data reduction or structure detection method.

METHODOLOGY

The purpose of this study is to validate an instrument to study student perceptions towards their achievement of learning outcomes domains which were knowledge, practical skills, and generic skills. Through a factor analytic process it will show that the instrument reflect the theoretical model. Since it useful in refining the items for the questionnaire. The instrument is for use in future research designed to measure student perceptions towards their achievement of learning outcomes domains. A set of questionnaires was developed using four Likert-scales. Data were analyzed descriptively for reliability (Cronbach Alpha values) and exploratory factors analysis (EFA) was utilized to discover the latent variables that underlie the scale. The respondent consists of students of Electrical Engineering, Civil Engineering and Mechanical Engineering at the Premier Polytechnic in Malaysia. A total of 158 students were selected by simple random method involved in this study. The variable studied were the learning outcomes domain; knowledge, practical skills and generic skills. The instrument used in this study is adapted from the model MQA, SCANS and Soft Skills, KPTM.

RESULT AND DISCUSSION

Reliability

To get the internal variable consistency, reliability test scale (Cronbach Alpha) was conducted. In this study, all values of Cronbach Alpha internal variable consistency for all variables exceed 0.7. According to [10], Cronbach Alpha value is classified into four categories: very high values are from 0.90-1.00, 0.70-0.89 is high, 0.30-0.69 is moderate and 0.00-0.30 is low. Therefore, the analysis results in this study have shown Cronbach Alpha for all variables in high classification. The analysis results of Cronbach Alpha value (Table 1) are in the classification of high and very high, whereby all are higher than 0.70.

Table 1: Alpha Cronbach values for the variables

Variable	Num of item	Num of item deleted	Cronbach Alpha Value
Knowledge	8	-	.792
Practical Skill	7	-	.871
Generic Skill	7	-	.887

Factor Analysis

Factor analysis procedures conducted involving three stages, 1) identifying the correlation between factors, 2) extracting the factors and 3) rotating factor [5]. Items that have a high correlation placed in a same construct as they measure the same concept, while the items contained in the different constructs have low correlation because they measure different concepts.

Prior to the extraction of the factors, several tests should be used to assess the suitability of the respondent data for factor analysis. These tests include Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity. The KMO value shows the multicollinearity. If the same correlation exists between two or more items, the items measure same aspect. KMO test used to determine whether the items are suitable to carried out the factor analysis. The result from the KMO test for 22 items of the learning outcome variable obtained was 0.899 > 0.6. This shows that the data does not have a serious multicollinearity problem. Therefore, all the items are appropriate to carried out for the factor analysis. Meanwhile, Bartlett's Test of Sphericity Test was used to identify whether there is a correlation between the items are sufficient to conduct the analysis factor. The result of Barletta's Test of Sphericity was significant (Chi square = 1680.6, p <0.05) showed that the correlation between the items sufficiently to perform the factor analysis.

Extracting factor was carried out using SPSS program. The communality (extraction) value is a factor analysis output of SPSS which is between 0.0 and 1.0. The proportion of variance for each factor is shown by the communality (extraction) value. A value of 1 indicates that these factors contributed 100 percent to the change of the overall variance. While a value of 0 does not contribute to the change in the overall variance.

The factor analysis (Table 2) were performed using varimax rotation to confirm the 3 constructs have been studied which is knowledge, practical skill and generic skill. The results of the factor analysis (total variance explained) for employability skills questionnaire indicated by 3 components (the factors) that gives the eigenvalues greater than 1. Eigen value indicates the proportion of the variance contribution of each factors extracted via factor analysis. These three factors accounted for 60.4 percent of the total variance changes. The total variance meets the recommendations of [4] which suggests the number of variance explained over 60%.

Varimax rotation method was performed on the items to produce a meaningful orthogonal factors (uncorrelated) and can be interpreted more accurately. According to [4], the rotation of these factors will improve the data by reducing the ambiguity in the existing factors that are not rotated. This method can determine the item actually categorized by similar characteristics that measure the same thing, as well as getting rid of items that are not relevant for further analysis. Items that have a load factors less than .50 or item which has a high correlation to a number of factors were dropped of the following analysis to ensure that the items contained in a particular factors is the high correlation of items only to those factors alone.

To ensure that the items contained in each the factors absolutely describes the factors, the items that have a load the factors less than a .50 or item which has a high correlation to a number of factors will be dropped. Item K4, K6, K7, K8, P2, P3, P6 and P7 has removed based on the criteria by [4] where each item must exceed 0.50.

Table 2: Factor Analysis

Items	Generic Skill	Practical Skill	Knowledge	Extraction
G4	.813			.699
G3	.801			.687
G6	.792			.697
G7	.741			.576
G2	.697			.579
G5	.664			.502
G1	.583			.504
P1		.749		.574
P8		.747		.680
P4		.713		.640
P5		.672		.600
K2			.752	.637
K3			.710	.648
K5			.675	.527
K1			.641	.511
		Total Variances Explained		60.4%

CONCLUSION

The results showed that the classification of the Cronbach Alpha was high and very high, more than 0.70. This instrument has high reliability according to the classification of [10], while the factor analysis showed three factors which is Knowledge, Practical Skill and Generic Skill. Each items shows the satisfactory load values which is greater than 0.5. Therefore, the questionnaire developed is suitable for assessing the learning outcomes of engineering students in the context of polytechnic education in Malaysia.

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