

Artículo de investigación

A Confirmatory Factor Analysis of Student Engagement at the University of Hail, Saudi Arabia

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Written by:
Ajay Singh⁵⁹**Abstract**

The research aims to examine the validity of four factors (course structure, course learning outcomes, Constructiveness of learning environment, and instructors' skills) about student engagement at the University of Hail, Kingdom of Saudi Arabia. The research applied the Confirmatory factor analysis (CFA) technique to confirm and validate the four factors. The data of the small sample size of 380 students of business administration took place for analysis. These four factors consisting of 18 variables, have considered from the existing literature for examination. The research uses a survey questionnaire to collect the students' perception of these factors to validate the four-factor model. The study uses Convergent validity and Discriminant validity to construct validity. The research finding supports the construct of four-factors to confirm the model is adequately fit. The results of the research contribute to existing literature from the perspective of the students of the University of Hail, Saudi Arabia, and other similar institutions of the country and outside world. The research also has created the scope for further improvement by adding some more factors along with variables of equal importance.

Key Words: Construct Validity, CFA, Employee Engagement, Convergent Validity, Discriminant Validity, Saudi Arabia

Introduction

Student engagement is a psychological state when they are studying, and it has engrossed over time when there are positive motivation and conducive work-environment (Austin, 1993; Wefald and Downey, 2009). Engagement is a predictor of student learning, high moral, personal development, academic effort, performance & achievement, and overall satisfaction (Strauser et al., 2012; Bakkar et al., 2015). The research investigates the Student Engagement at the University of Hail, Kingdom of Saudi Arabia, through analyzing four-factors consisting of 18 variables. The research validates these four-factors by applying Confirmatory Factor Analysis (CFA). The factors considered for analysis are course structure, course learning outcomes, the constructiveness of the learning environment, and Instructor skills. The present research is incremental research over the past studies, as the University of Hail, had not any such type of research to the date.

On the other hand, an EFA (Exploratory Factor Analysis) technique is a multivariate technique to explore the no's of factors represents the data. CFA specifies the representation of the variables in a construct in a logical manner. The factors examined in EFA had considered for CFA to validate the construct. Engagement is, no doubt, a critical tool for the institutional environment to establish the relationship among students (LasNasa et al. 2007). In a study performed by LaNasa et al. (2009), the research predicts that students' outcomes about their learning, academic achievements, critical thinking, etc., accepted through numbers of institutional settings. CFA analyzes the factors, variables within factors, variances, and covariance among the elements, relationship with variables, and factors (Jöreskog et al., 1989). CFA is a construct validation technique, followed by testing (Prudon, 2015). The present research shows that the Confirmatory factor analysis of the four factors stated as course structure, learning outcomes, learning environment, and Instructor

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skills have good-fit representing the model. The research construct first hypothesized, and then CFA was performed to test the validity of the construct. The results of the findings are dependent upon how the students interpret the questions of factors and respond to them.

Literature Review

Pruden (2015) stated that "Predicting the factor structure of a test and comparing this with the factor structure, empirically derived from the items scores, is a powerful test of the content validity of the test items." Student engagement is highly dependent on academic institutions' strategies about program structure, learning environment, instructor's skills, and development plan for the students (Meng and Jin, 2017). Al Kuwaiti and Subbarayalu (2015) conducted a student experience survey on the "Medical and Nursing students" to examine teaching & learning effectiveness on various aspects through using the six sigma tool by applying a Poisson Distribution model. Al-Kuwaiti A. (2014) addressed "students evaluating teaching effectiveness (SETE)" process on selected medical colleges in the Kingdom of Saudi Arabia. The opinions of students and faculty get identified. The outcomes of the study were statistically significant about students' and instructors' perceptions of the SETE process. Ugulu (2013) measured the attitude of university students by using confirmatory factor analysis. The study applied three factors with 15 variables recorded on 4-point of scale. The findings of the study show that the Traditional Knowledge Attitude Scale (TKAS) serves as an essential tool to assess student's knowledge attitude. Andre (2012), in a study on students of the University of Utah conducted a confirmatory factor by

analyzing four factors. These factors were: "organization of course and materials, course outcomes, Effective learning environment, and instructor's skills" to validate the construct (Vahedi et al., 2011) performed a study on 298 university students to determine factor structure on statistical anxiety measures using CFA. Student Engagement is significantly related to learning, performance, personality development, moral, award and personal satisfaction (Astin, 1993, Casuso-Holgado et. al., 2013 and Bakker et al., 2015). Engaged students show more optimistic behavior with reflective learning (Siu et al., 2014; Salmela-Aro and Upadyaya, 2014). Yusoff (2012) conducted a study to evaluate the construct validity of DREEM "The Dundee Ready Educational Environment Measure" using confirmatory factor analysis. It did not support the five-factor confirmatory model. Salehi et al. (2015) conducted a social study on 391 women to evaluate the "trust and control-self efficacy" scale in Iran by using confirmatory factor analysis. A survey on student engagement was conducted by Steven (2009) by using confirmatory factor analysis on eight dimensions. These dimensions use in the study was: "learning strategies, academic integration, Institutional emphasis, Co-curricular activity, diverse interactions, Effort, Overall relationships, and workload." Tschannen-Moran et al. (2013) conducted measures from the perspectives of student optimism.

The research performed to test the validity of the construct of four factors relating to student engagement at the University of Hail, Saudi Arabia. The study applied the confirmatory factor analysis (CFA) to test the four-factor model. The hypothesized four-factor construct to examine construct validity is as given below.

Table 1: Hypothesized Student Engagement Construct

1. Course Structure (CS)	<ul style="list-style-type: none"> a. The course objectives add value to students' personal objectives. b. The contents of the course are in the order and well organized. c. The course syllabus is useful, interesting for teaching & learning. d. All intended learning outcomes (ILOs) cover all the examinations including, Homework, quizzes, assignment, cases and presentations.
2. Course Learning Outcomes (CLO)	<ul style="list-style-type: none"> a. The content of the course is effective.a. b. The course has improved the student's learning. c. The courses fulfill the objectives described. d. The course has enough future opportunities about the job.

- e. The course is designed as per international standards.
 - a. Instructors' creativity in classroom
 - b. Instructors' motivation to students
 - c. Instructors' problem solving in extra hours
 - d. Advising to student for course related queries
3. Constructiveness of Learning Environment (CLE)
- a. Instructors have excellent organizing skills about course.
 - b. Instructors have excellent demonstration skills about course.
 - c. Instructors have excellent presentation skills of content delivery.
 - d. Instructors' behavior is appreciable inside or outside the class.
 - e. Instructors have remarkable diversity in teaching.
4. Instructors' -skills (IS)

Research Objective

The research aims to evaluate the construct validity using confirmatory factor analysis (CFA), and internal consistency by using the students as the sample of the University of Hail, Saudi Arabia.

Research Approachability

Step 1: Construct Design: The step designs construct theoretically to test the model. The construct considers the pre-defined items from the existing works of literature and a measurement model to validate the model through confirmatory factor analysis (CFA).

Step 2 Develop a model of measurement: The model applied more than three variables in each construct of the group of four. The essential requirement to perform the CFA is that the construct should not be less than four, and each construct should not have less the three variables to test the model. Also, the model considers the uni-dimensionality principle of error between constructs and constructs error variance (Hagell, 2014).

Step 3: Design the model of research to estimate outcome: The model specifies single loading estimates per construct. The model identification methods available are rank and order condition.

Step 4 Research Model Validation: The Goodness-of-fit index indicators in the study are: Chi-square goodness-of-fit (ideal, 0.05), Goodness-of-fit index (GFI), Adjusted Goodness-of-fit index (AGFI), Comparative Fit Index (CFI), Normed Fit Index (NFI), Relative Fit Index (RFI), Incremental Fit Index (IFI), and

Tucker-Lewis Fit Index (TLI) (Kline, 2010; Piaw, 2009; Brown, 2006; Arbuckle, 1995). Further, for the badness of fit index is Root mean square error of approximation (RMSEA) and Root mean squared residual (RMR) (Piaw, 2009, Stevens, 2009; Steiger, 2007 and Brown, 2006).

Research Methodology

Participants

The research consists of the data of 380 students collected from both male & female of the business stream from the University of Hail, Kingdom of Saudi Arabia. The data collected in a year of two academic semesters. For validation, the questionnaire piloted among 30 students of different streams. The data collected from the students of various departments consisting of Management, MIS, Finance, and Accounting students. The selections of the samples have performed by applying random cluster sampling. The participants were ensured not to disclose any information provided by them at present or future and kept confidential.

Assessment Measure

The research applied a 5-points Likert scale from strongly agree to strongly disagree from five to one (5= strongly agree, 4= agree, 3= Not sure, 2=disagree to 1= strongly disagree) for the total 18 variables comprising of 4 factors of the model. These factors are 1-Course Structure (CS), 2-Course Learning Outcomes (CLO), 3-Constructiveness of Learning Environment (CLE), and 4-Instructor's skills (IS). The measured value of Cronbach's alpha (0.957) shows the internal consistency and higher reliability of data. The path analysis assumes that the model is recursive.

Data Analysis Techniques

The research uses the Confirmatory Factor Analysis (CFA) technique to confirm the four explored factors in the construct, considered from the existing literature. The study applied SPSS AMOS 21 statistical software for data analysis to validate the construct.

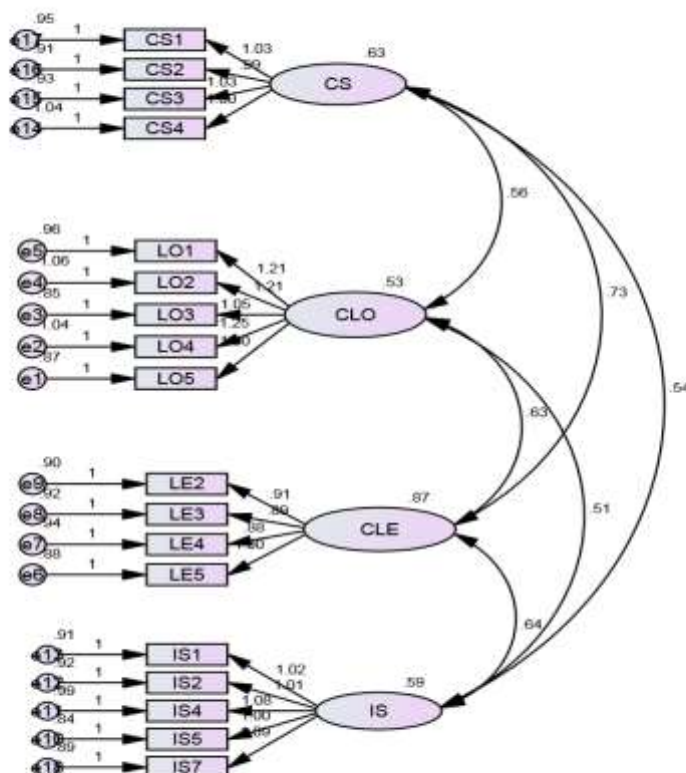
Findings and Discussion: SPSS AMOS 21

Findings of the Confirmatory Factor Analysis (CFA) of Students' Engagement

A total of 380 students (N=380), both male & female (68:32), contributed to the research. Confirmatory factor analysis (CFA), explore the 18 variables of the four factors with the model fit. The outcome of the model shows that the value of chi-square (CMIN/DF) is 1.600/129, which is less than 2 (the value less than 2 is preferable while the ideal range 2-5 is acceptable) is quite

good and under the assumption that model is fit. The approximate fit indices value above 0.9 has a justification that the model is adequately fit (Brown, 2006; Steiger, 2007; Piaw, 2009; Kilne, 2010, Hair et al., 2017). The approximate fit indices value from the CFA analysis are: the value of Goodness of fit index (GFI = 0.945), Adjusted Goodness of fit index value (AGFI = 0.927), Comparative fit index value (CFI = 0.970), Normed fit index value (NFI = 0.924), Relative fit index value (RFI = 0.910), Incremental fit index value (IFI = 0.970) and Tucker-Lewis fit index value (TLI = 0.964) are above than 0.9 justify the model fit. Root mean square error of approximation value (RMSEA =0.040), which has a value of less than 0.07, meets the cut-off criteria and signifies model fit (Bagozzi and Yi, 1991). Root mean squared residual (RMR =0.055), which is close to 0.05, meets the cut-off criteria and also signifies model fit (Brown, 2006; Stevens, 2009; Piaw, 2009, Steiger, 2007; Hooper, 2008).

Figure 1: Measurement Model: Confirmatory Factor Analysis of Student Engagement



Source: Students Survey Data and SPSS AMOS 21 Output

In Figure 1 the standardized regression weights are the representative of latent variables that signifies the indicator variables. Also, a two-way correlation between variables is the representatives of correlation indices. Modification Indices use in model modification in the situation of a poorly fitting model (Bagozzi, 2010; Tiffany, 2012). When added to the model, it reduces the value of Chi-square and improves the model fit (Brown, 2006).

Residual correlations may be preferable to standardize residual covariance (SRC). Both have used to assess the source of misfit if the model is poorly fitted (Maydeu-Olivares, 2017). Also, if the model is fit, standardized residual covariances (SRC) have used to measure the standard normal distribution. The absolute value of SRC is lower than 2 (Arbuckle, 1995).

Table 2: Goodness-of-Fit (GFI) Statistics of Student Engagement by CFA

Fit Indices	Result of Analysis	Acceptable Levels
Chi-square (χ^2)	Chi-square (χ^2/df) = 206.263/129	P > 0.05; for a good model, Chi-square (χ^2) test should be non-significant (Hu and Bentler, 1998, 1999)
Absolute Fit measures	GFI = 0.945 (Goodness-of-Fit) RMSEA = 0.040 (Root mean square error of approximation) At 90% of confidence level for RMSEA = (0.029; 0.050) RMR = 0.055 (Root mean square residual)	GFI value > 0.090 RMSEA values < 0.07 (Steiger, 2007) RMSEA values < 0.08 (Bagozzi and Yi, 1991) Small SMR is preferable for good models (Widaman, K. 1984)
Incremental Fit indices	NFI = 0.924 (Normed fit index) CFI = 0.970 (Comparative fit index) RFI = 0.910 (Relative fit index)	NFI value > 0.90 CFI value > 0.90 RFI value > 0.90
Parsimony Fit Indices	AGFI = 0.927 (Adjusted goodness-of-fit index) PNFI = 0.779 (Parsimony normed fit index)	AGFI value > 0.90 PNFI value > 0.90

Construct Validity

The paper tests convergent validity and discriminant validity to reflect the theoretical latent-construct. The ideal standardized factor loading range for construct validity should be 0.5 to 0.7 (Wang et al., 2005).

Convergent Validity

Tables 3 to 6 describe that all the related reliability estimates have a value greater than 0.7; it shows that there is adequate reliability in the construct. On the other hand, the estimated value of the average variance extracted (AVE) is less than 0.050, which is between 0.40 to 0.46. The variation in the construct also dependent on the size of the construct estimated, as the size of the construct is small and limited to only four factors. Also, the size of the variables in each construct is small and limited to 4 to 5 variables.

Table 3: Convergent Validity of Factor 1 (Course Structure)

Variables	Factors	SRW Estimate	SRW Squared	1- (SRW Squared)
CS5	CS (Course Structure)	0.613	0.3758	0.6242
CS4	CS (Course Structure)	0.647	0.4186	0.5814
CS2	CS (Course Structure)	0.637	0.4058	0.5942
CS1	CS (Course Structure)	0.642	0.4122	0.5878
	Sum	2.5390	1.6123	2.3877
	Sum of SRW Estimates (Squared)	6.4465		
	Composite Construct Reliability	0.7297		
	Average Variance Extracted	0.4031		

*SRW=Standardized Regression Weights

Table 4: Convergent Validity of Factor 2 (Course Learning Outcomes)

Variables	Factors	SRW Estimate	SRW Squared	1- (SRW Squared)
LO5	LO (Learning Outcomes)	0.615	0.3782	0.6218
LO4	LO (Learning Outcomes)	0.667	0.4449	0.5551
LO3	LO (Learning Outcomes)	0.639	0.4083	0.5917
LO2	LO (Learning Outcomes)	0.649	0.4212	0.5788
LO1	LO (Learning Outcomes)	0.669	0.4476	0.5524
	Sum	3.2390	2.1002	2.8998
	Sum of SRW Estimates (Squared)	10.4911		
	Composite Construct Reliability	0.7835		
	Average Variance Extracted	0.4200		

Table 5: Convergent Validity of Factor 3 (Learning Environment)

Variables	Factors	SRW Estimate	SRW Squared	1- (SRW Squared)
LE5	LE (Learning Environment)	0.705	0.4970	0.5030
LE4	LE (Learning Environment)	0.646	0.4173	0.5827
LE3	LE (Learning Environment)	0.657	0.4316	0.5684
LE2	LE (Learning Environment)	0.668	0.4462	0.5538
	Sum	2.6760	1.7922	2.2078
	Sum of SRW Estimates (Squared)	7.1610		
	Composite Construct Reliability	0.7643		
	Average Variance Extracted	0.4481		

Table 6: Convergent Validity of Factor 4 (Instructor's skills)

Variables	Factors	SRW Estimate	SRW Squared	1- (SRW Squared)
IS7	IS (Instructors' skills)	0.664	0.4409	0.5591
IS5	IS (Instructors' skills)	0.643	0.4134	0.5866
IS4	IS (Instructors' skills)	0.641	0.4109	0.5891

IS2	IS (Instructors' skills)	0.630	0.3969	0.6031
IS1	IS (Instructors' skills)	0.637	0.4058	0.5942
	Sum	3.2150	1.6621	2.3379
	Sum of SRW Estimates (Squared)	10.3362		
	Composite Construct Reliability	0.8155		
	Average Variance Extracted	0.4155		

Discriminant Validity

Correlations confirmed discriminant Validity among the construct. The value of associations 0.085 or above shows a weak or no discriminant validity. Table 7-1 & 7-2 shows that none of the correlation value is less than 0.085 (Wang et al.

(2015). It indicates that there is no discriminant validity in the construct. Also, Tables 7-1 & 7-2 describe that all Average Variance Extracted (AVE) estimates have their value lower than the inter-construct correlations. The outcome of the analysis shows that there is no discriminant validity in construct.

Table 7-1: Measurement of Discriminant Validity: Average Variance Extracted (AVE)

AVE (Average Variance Extracted)	Factors	CS	LO	LE	IS
0.4031	CS (Course Structure)	1.0000			
0.4200	LO (Learning Outcomes)	0.964	1.0000		
0.4481	LE (Learning Environment)	0.984	0.924	1.0000	
0.4155	IS (Instructor's Skills)	0.878	0.908	0.898	1.0000

Table 7-2: Measurement of Discriminant Validity: Square Root of AVE

SQRT (Square root)	Factors	CS	LO	LE	IS
0.6349	CS (Course Structure)	0.6349			
0.6481	LO (Learning Outcomes)	0.964	0.6481		
0.6694	LE (Learning Environment)	0.984	0.924	0.6694	
0.6446	IS (Instructor's Skills)	0.878	0.908	0.898	0.6446

Note: Square root (SQRT) of AVE (Diagonal Value) for the Construct

Discussion

The findings of the Confirmatory factor analysis (CFA) support the four-factors in the model. These factors are about the course structure (CS), course learning outcomes (CLO), the constructiveness of course learning environment (CLO) for the students and instructors, and the robustness of instructors' skills (IS) at the University of Hail, Kingdom of Saudi Arabia. The Confirmatory factor analysis (CFA) describes that the path coefficient in the path analysis is significant ($p < 0.05$), representing a meaningful outcome of each factor consisting of

each item from the 18 variables. The analysis of results of Goodness-of-Fit (GFI) statistics of students' engagement by CFA consisting of Chi-square Goodness-of-fit ($\chi^2/df = 206.263/129$), Absolute Fit measures (RMSEA = 0.040, GFI = 0.945, RMR = 0.055); Incremental Fit indices (RFI = 0.910, NFI = 0.924; CFI = 0.910), and Parsimony Fit Indices (PNFI = AGFI = 0.927, PNFI = 0.779) show the significant results of the analysis. It shows that the four-factor model of student engagement consisting of

all eighteen variables is adequately fit, leading to model fit.

The ideal standardized factor loading range for construct validity is 0.5 to 0.7. The related reliability estimated from the Convergent validity tables 2 to table 5 shows that there is adequate reliability in the construct. The results of the test also show that there is no discriminant validity in the construct (table 7-1 to table 7-2), i.e., constructs in the instrument are related to each. The study shows that the responses of the 380 students for the entire construct consisting of eighteen variables are appropriate for completing CFA, providing model fit.

Conclusion

In this research paper, Confirmatory factor analysis (CFA) of the four factors performed to assess the business administration undergraduate students' attitude to confirm the validity of the construct. The four-factors used for analysis are course structure (CS), course learning outcomes (CLO), the constructiveness of the learning environment (CLE), and instructors' skills (IS). The construct of four-factors developed through an extensive literature survey, taking the expert opinion for content and face validity. A pilot study over 30 students conducted to initiate the structure of the construct and finally administration of draft and cross-validation of the research to ensure the reliability of pieces of evidence and confirm the four-factor model. The findings of the Confirmatory factor analysis (CFA) support the factors about the course structure, course learning outcomes, the constructiveness of learning environment for the students and instructors, and the robustness of instructors' skills at the University of Hail, Kingdom of Saudi Arabia.

Limitation

The research analyzes the construct of only four factors through confirmatory factor analysis (CFA) of the students of business Stream of the University of Hail, Saudi Arabia. Presently, there are twelve operational colleges in the university. The study has scope to include some more factors in the existing construct for further analysis to increase the reliability and validity of the construct. Through, the research consists of 380 students of the business stream, but there is scope to consider more streams/variety of students of the other streams in the study from the university. The study limits the research to the feedback of Saudi students, as the multi-nationality students are negligible comparatively than local students.

The research inserts some new variables in each construct. Each factor has added at least one extra variable to the existing construct to strengthen the reliability and validity of the research outcome. These additional variables are about intended learning outcomes, future job perspectives, student advising, and diversity in teaching.

Research Implications

The research outcomes contribute to the existing literature by confirming four factors from the perspective of the students of the University of Hail, Kingdom of Saudi Arabia, and also other universities and educational institutions of the country and outside world. These four essential factors from the confirmatory factor analysis confirm the engagement of students with the university and create the scope for further studies by adding four-factors in the construct, or variables in the factors of similar importance. As the construct is available publicly, so that, its validity supposed to tested over regular intervals by taking students' feedbacks by the researchers. If the universities/institutions are interested in using the same factors along with variables, they can use it to know the level of students' engagement at their places. The existing factors/variable can be added to the existing research for further analysis of improvement to add value to the current body of knowledge. Also, the educational policymakers can draw a conclusion on teaching & learning processes (Kuwaiti & Subbarayalu, 2015) through analyzing all the success factors available.

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