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Research Article

Confirmatory factorial validity for Student engagement constructs in online learning environment: A study in University of Technology and Applied Sciences (HCT), Muscat

Anitha Ravikumar[1], Anupam Sharma[2] and P.Venkata Durga Rao[3]

[1] Dr., Faculty, Department of Business Studies, University of Technology and Applied Sciences (HCT), Muscat, Sultanate of Oman, anitha.ravikumar@hct.edu.om

[2] Dr., Faculty, Department of Business Studies, University of Technology and Applied Sciences (HCT), Muscat, Sultanate of Oman, anupum.sharma@hct.edu.om

[3] Dr., Faculty, Department of Business Studies, University of Technology and Applied Sciences (HCT), Muscat, Sultanate of Oman, durga.rao@hct.edu.om

Abstract

The effectiveness of students' learning depends on the perception of learning outcomes and satisfaction. Only a questionnaire with good model fit can measure the student engagement precisely. Hence, a study was conducted to analyze the effectiveness of student engagement questionnaire to find out how effective is the questionnaire used. In order to understand how well the students are engaged, an assessment tool is necessary. Exploratory factor analysis supported the similar structure from previous research. To validate the questionnaire, confirmatory factor analysis was performed. The confirmatory factor analysis revealed that the removal of some statements under the factors proved to be a good model fit. However, the study has to be further evaluated with more samples and broader population to ratify the results. The level of student engagement, as well as the correlation between demographic variables and student engagement has also been analyzed in this study.

Keywords: Student engagement, Confirmatory factor analysis, online learning, Technology

Introduction

Employment of technology to promote a healthy learning environment creates profound experiences, which leads to a person's development (El-Khawas, E., 2004). Over the last decade, online learning has shown immense growth. Covid-19 outbreak has made online learning even more significant. Covid-19 has forced schools, colleges and even companies to work remotely and this has augmented the practice of online learning even further (Koksal, I.,2020) Along with remarkable development in online learning,

there has been an increased demand to prove the accountability and substantiation of efficacy in teaching. Achievement of student engagement in online learning tends to be more significant than on-campus learning as the students in online classes have lesser ways of engaging with the institution. Moreover, online classes demand more time and attention of the students (Robinson,C.C. & Hullinger, H., 2008)

Engagement means emotional state of mind, making sense and action; it is much more than participation. An action without emotional engagement is just participation as well as emotionally engaged without action is dissociation (Harper, S.R. and Quaye, S.J., 2017) The time and the physical energy the students spend on activities in their academic experience is student engagement (Jacobi,M., 1987). According to The Australian Council of Educational Research, 'students' participation in activities and conditions likely to create high quality learning' (ACER,2008).

Student Engagement is the vigor / effort a student puts while learning that can be observed in number of cognitive, affective and behavioral indicators during their course. It is created by many physical and inner factors that includes learning activities and environment apart from relationships. It was observed that if students are more engaged in the learning, the chances of them channelizing more energy in to the system that will help in the long term and short term achievements of the learning outcomes, (Bond et al, 2019)

Student engagement is classified into three dimensions: 1. Behavioral engaged type of students would normally observe certain behavioral norms such as attending classes regularly and show lack of troublesome or adverse behavior. 2. Emotionally engaged students would show interest, enjoyment or sense of belongingness. 3. Cognitively engaged students would go beyond the expectations and would savor the challenges (Fredricks J.A. 2004)

To majority of the people, the primary goal of university is to impart the students with skills and knowledge, which is crucial to prosper in notable careers after the successful completion of their education. As college educators, we seek to achieve more; to inculcate and nurture the intellectual inquisitiveness, which will lead to lifelong learning, also induce transformation to motivate students to make them independent thinkers keen to participate with the larger global public. Achieving these goals needs not only dedication and determination on the part of the educators, willingness of the students to exhibit passion for engaging in their learning process is essential as well (Miller, Corey L. Guenther & Richard L., 2011). The devotion of time and energy to academically focused activities is the only best predictor of the students learning and personal development (Astin, 1993).

Majority levels of Oman's educational institutions have implemented electronic learning, which all conduct the teaching and training programs to the students through internet (Al Musawi, A. S.,2010). After the outbreak of Covid-19 in Sultanate of Oman, all the educational institutions started online classes in the middle of April 2020. University of Technology and Applied Sciences (HCT, Muscat) also started its online classes through Microsoft teams and the examinations are conducted online through e-learning. All the course lectures, exams and assignments are conducted online. Online classes are challenging and expects more from the students. To meet the academic expectations, vast majority of the students have to work harder than they normally would do. Evaluations and exams are even more challenging (Robinson,

C.C. & Hullinger, H.,2008). In order to optimize academic accomplishment in a learning environment, vigorous engagement of students is needed (Anaya, G., 1996).

University of Technology and Applied Sciences (HCT, Muscat) strives to promote academic excellence by developing students' communication, teamwork, practical competence and entrepreneurial skills. In order to develop these skills, student engagement is necessary.

The effectiveness of students' learning depends on the perception of learning outcomes and satisfaction (Adarsh, G., 2020). Only a questionnaire with a good model fit can measure the student engagement precisely. Hence, a study was conducted to analyze the effectiveness of student engagement questionnaire to find out how effective is the questionnaire used. Student engagement is measured with various instruments with emphasis on different factors. Present study is aimed to check the factorial validity of the instrument used for student engagement. The study also analyzed the level of student engagement, as well as to find out the correlation between demographic variables and student engagement.

About the university

University of Technology and Applied Sciences (HCT, Muscat) is one of the second largest higher educational institution in Oman, which provides higher education to more than 13,000 students. University of Technology and Applied Sciences (HCT, Muscat) was established in the year 1984. It is one of the seven colleges under the ministry of manpower in Oman. It has seven departments namely Engineering, Applied Sciences, Business studies, Pharmacy, Photography and Fashion design. Apart from these seven departments, there is English Language Center(ELC) also.

Review of literature

Online learners have to lead a complicated life with lots of disruptions and challenges. Meeting the family needs, business travel and health issues are some of the several challenges faced by them. Weddings, health issues, births, deaths etc. can disturb their learning process. Apart from that there will also technological faults. However, personal problems has a greater impact on learning than technological ones (Conrad and Donaldson, 2004).

A significant relationship was observed between taking online courses and student engagement. The relationship indicators and the number of courses taken online might support certain category of engagement, while limiting other categories. It was observed in the research that students were likely to be engaged more in the quantitative reasoning with less faculty interaction and collaborative learning as compared to traditional learning, if they take more number of online courses. The result further suggests that online learning encourages certain types of engagement while it is detrimental to other types of engagement. Hence, it is necessary for the educational institutions to design curriculum to encourage student engagement (Dumford.D.D. & Miller, A.L., 2018).

According to Chickering & Gamson (1987), there are seven best engagement indicators, which are student-faculty interaction, teamwork among students, dynamic learning, quick feedback, time on task,

high anticipations, and reverence for different aptitudes and methods of learning. Responsibility for improving undergraduate education rests with both the students and teachers. However, lot of help is needed for them from college and university heads, government officials and accrediting institutions to provide an environment suitable for good practice in higher education.

Harper S, et al. (2004) found a significant difference in engagement between men and women. There is considerable evidence to show that women are significantly less engaged than their male colleagues. Men interact with teachers more frequently than women do. The interaction of men is more when compared to women in University of Technology and Applied Sciences (HCT, Muscat) has to be uncovered. According to Mary C. Thill et al., (2016), in online instruction, female and older students appear to be more engaged when compared with the male and younger students.

A study by Chen et al. (2010) claimed that there is a positive correlation between the application of learning technology, student engagement and the results of learning. When courses were taught only using online mode, will it be effective? Adarsh, G.,(2020) in his study points out that the learners were hesitant to use online mode as the only way of learning and they also find online learning to be less productive when compared with traditional mode of learning. The study finds that the students are not able to concentrate and easily deviate from learning.

Students are assessed for their skills, knowledge, and problem solving skills, analytical and critical thinking skills (Nixon,E,, et al., 2018). On the other hand, students pursue higher education to get a well-paid job (Molesworth,M.E., et al., 2009). Hence, higher educational institutions delivering services to satisfy the students has become crucial.

In order to assess the engagement of students, there is a need for a reliable questionnaire, which can accurately measure the student engagement. Smidt, W. & Embacher, E.V. (2021) examined the factorial validity on the preschool children in Austria. The in class factors like teachers interactions, peer interactions, task orientation and conflict interaction, the initial confirmatory analysis showed a negative residual variances is > 1 for teacher communication as well as behavioural control. Adjustments were made to make the model fit and the questionnaire was made available for use in schools in Austria.

Eather,N. et al. (2020), assessed the factorial validity of high intensity interval training self-efficacy questionnaire and reassessed its reliability. Confirmatory factory analysis was carried out and it affirmed that all items were highly related to the factor. The study provided the reliability and validity of the Self Efficacy Questionnaire that can be used with adolescents. Hence, the present study aimed to check the factorial validity of the instrument used for student engagement.

Sample

The study focused on the students of University of Technology and Applied Sciences (HCT, Muscat). Samples for the study was collected from all the departments of the University. The questionnaire for collecting the data consisted of demographic factors like gender, educational level, department and student engagement factors like skills engagement, emotional engagement, participation engagement and

performance engagement. Skills engagement was measured by using a set of nine questions, emotional engagement by using six, participation management by five and performance management. Student engagement factors were measured by using a five point likert scale ranging from five to one ranging from strongly agree to strongly disagree.

Handelsman, M. M et al. (2005) designed a Student Course Engagement Questionnaire (SCEQ) which has divided the student engagement in to four factors. The first factor which is called, Skills engagement included questions related to practicing skills. The second factor is the emotional engagement factor, which consisted of questions related to students engagement with the class materials. Participation or Interaction engagement factor consisted of questions about the students' participation in the class. The fourth factor performance engagement consisted of questions related to student engagement through levels of performance. These four factors as clearly shown from the results of Handelsman, M. M., et al.(2005) is more comprehensive and it provides a better explanation of student engagement. Hence the questionnaire devised by Handelsman, M. M., et al. (2005) is adopted with slight modifications to suit the online learning for the purpose of the study.

The questionnaire was uploaded in Google forms and the link for it has been sent to the lecturers of Information Technology, Science, Business and Engineering departments. . The lecturers of the respective departments provided the link to their students during the class and asked the students to fill them up. Target was to collect 500 responses but only 165 responses were received.

Methodology

The level of student engagement was measured using the mean score. Student engagement variables were measured at five levels. The mean score of 4.2 to 5 indicated highly engaged, 3.4 to 4.19 for engaged, 2.6 to 3.39 for moderately engaged, 1.80 to 2.59 for unengaged and 1 to 1.79 for highly unengaged. Spearman Rank Correlation was used to find the relationship between the demographic variables and student engagement variables.

In order to confirm the results carried out by Handelsman, M. M., et al. (2005), exploratory factor analysis was carried out using SPSS 16.0 and to check how well the measured variables portray the number of constructs, confirmatory factor analysis was done using AMOS software.

Results and Discussions

Table 1- Distribution of sample based on demographic factors

Variables	**Numbers**	**Mean score**			
		Skills engagement	**Emotional engagement**	**Participation or Interaction engagement**	**Performance engagement**

Sample size	**165**				
Gender					
Male	44	3.45	3.31	3.09	3.68
Female	121	3.63	3.40	3.19	3.46
Educational level					
Bachelor	90	3.24	3.27	2.9	3.45
Advanced Diploma	32	3.65	3.06	2.9	3.72
Diploma	43	4.23	3.86	3.93	3.51
Department					
Business	38	3.45	3.34	2.94	3.34
Engineering	82	3.54	3.35	3.13	3.62
Science	31	3.94	3.58	3.45	3.39
Information Technology	14	3.42	3.21	3.36	3.71

Source: Primary data

Table 1 shows the distribution of samples and the mean score according to gender, educational level and department. Total sample size was 165. Out of that, 44 were male and 121 were female respondents. Bachelor students constituted ninety out of 165. Of all the departments considered for the study, engineering department has responded more than other departments. The mean score was found to be more or less the same. Mean score of diploma students for participation engagement was more when compared with Advance diploma and Bachelor. Even the mean score of participation engagement of business students were found to be low when compared with other departments.

Table 2. Distribution of sample based on responses

Response variable	**Percentage (%)**	**Response variable**	**Percentage (%)**
Skills engagement		**Participation or Interaction engagement**	
Highly Engaged	35.8	Highly Engaged	18.2
Engaged	23.0	Engaged	29.1
Moderately engaged	18.8	Moderately engaged	21.2
Unengaged	8.5	Unengaged	14.5
Highly unengaged	17.0	Highly unengaged	8.5
Emotional engagement		**Performance engagement**	
Highly Engaged	24.2	Highly Engaged	26.7
Engaged	31.5	Engaged	23.6
Moderately engaged	16.4	Moderately engaged	32.7

Unengaged	13.9	Unengaged	9.1
Highly unengaged	13.9	Highly unengaged	7.9

Source: Primary data

The results for skills engagement shows that 35.8% of the students were highly engaged, 23% engaged, 18.8% moderately engaged, 8.5% unengaged and 17% highly unengaged. In Emotional engagement, more number were engaged with 31.5% followed by highly engaged, which constituted 24.2%. 29.1% were engaged and 21.2% moderately engaged in participation engagement. 32.7% were moderately engaged in performance engagement and 26.7% were highly engaged.

Table 3. Exploratory Factor Analysis

	Statements	**Factor Loadings**	**Kaiser–Meyer–Olkin (KMO)**	**Bartlett's test of sphericity**	**Total variance explained**	**Cronbach's alpha**
Skills engagement	I make sure to study on a regular basis (SK1)	.763	.931	1079.972***	66.823	.937
	I put the best efforts possible (SK2)	.738				
	I do all the homework exercises (SK3)	.705				
	I stay up to read (SK4)	.700				
	Looking over class notes between classes to make sure I understand the material (SK5)	.765				
	I am organized in my studies (SK6)	.817				
	I take good notes in class (SK7)	.756				
	I listen carefully in the class (SK8)	.825				
	Iam attending classes every day (SK9)	.741				
Emotional Engagement	I find ways to make the course material relevant to my life (EET 1)	.677	.876	498.080***	63.129	.879
	I apply course material to my life (EET 2)	.582				

	I find ways to make the course interesting to me(EET 3)	.643				
	I think about the course between class meetings (EET 4)	.640				
	I am really desiring to learn the material (EET 5)	.607				
	I raise my hand in class to raise questions, clear doubts or to answer the questions asked (EET 6)	.526				
Participation Engagement	I ask questions when I don't understand the lecturer (Part 1)	.597	.786	311.884***	59.757	.829
	I have fun in online class (Part 2)	.620				
	I participate actively in small-group discussions (Part 3)	.669				
	I send mails or messaging in teams to review assignments or tests or to ask questions (Part 4)	.713				
	I help fellow students (Part 5)	.671				
Performance Engagement	I am confident of getting a good grade (Perf 1)	.744	.613	63.253***	57.62	.628
	I can do well on the tests (Perf 1)	.757				
	I am confident that I can learn and do well in the class (Perf 1)	.641				

Source: SPSS output

Table 3 shows exploratory factor analysis. Factor loadings, Bartlett's test of sphericity and Cronbach's Alpha confirms the results carried out by Handelsman, M. M., et al. (2005).

Confirmatory Factor Analysis

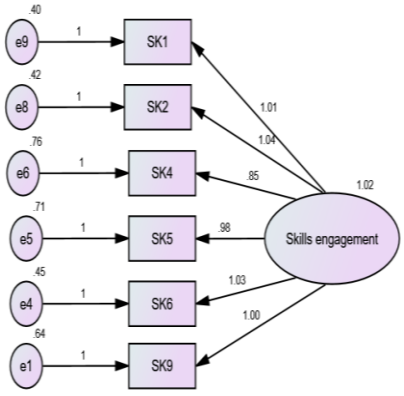
According to Bandalos, D. L., & Finney, S. J. (2010), when the relationship among the factors are tested and known, Confirmatory factor analysis was suggested to be applied. Hence, Confirmatory factor Analysis was applied to see whether the statements have a good model fit or not. In order to understand how well the students are engaged, an assessment tool is necessary. Hence confirmatory factor analysis is performed to validate the questionnaire. Table 4 shows the index category and levels of acceptance. According to this table, the acceptance levels of results were analysed and the results are presented.

Table 4. Index category and levels of acceptance

Category of fit	Index name	Acceptance level	Source
Absolute fit	Chi-square (Chisq)	$p > 0.05$	Wheaton et al. (1977)
	Root-mean-square error of approximation (RMSEA)	RMSEA < 0.08	Browne and Cudeck (1993)
	Goodness-of-fit index (GFI)	GFI ≥ 0.80	Forza and Filippini (1998), Greenspoon and Saklofske (1998)
Incremental fit	Adjusted goodness-of-fit index (AGFI)	AGFI ≥ 0.80	Forza and Filippini (1998)
	Comparative fit index (CFI)	CFI > 0.90	Byrne (1995), Hair et al. (2010)
	Tucker–Lewis index (TLI)	TLI > 0.90	Vandenberg and Scarpello (1994)
	Normed fit index (NFI)	NFI ≥ 0.80	Forza and Filippini (1998)
Parsimonious fit	Chi-square difference ($\chi 2$/df)	Chi square/df < 5.0	Marsh and Hocevar (1985)

Source: Adopted from Ishiyaku,B. et al., 2017

Skills engagement: P-Value - .479



RMSEA - .000

GFI - .983

AGFI - .961

CFI -1.000

TLI-1.001

NFI- .986

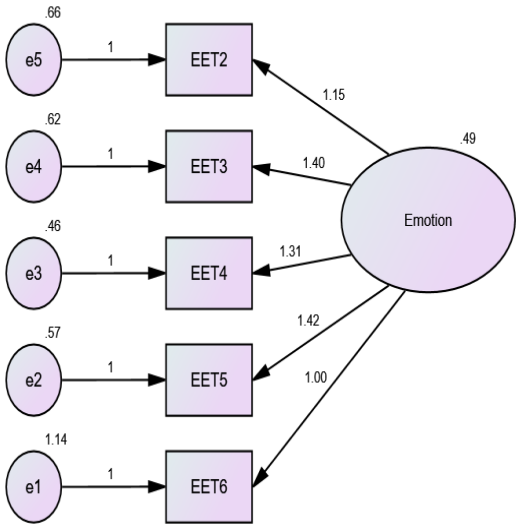
Chi-Square/DF- 0.951

Figure 1: Skills engagement:

Exploratory factor analysis showed that all the nine statements under factor loadings was above 0.700 and it proved to be fit. When Confirmatory factor analysis was carried out to find the model fit, the values were above or below the acceptance levels. So, the statements with low factor loadings like I do all the homework exercises (SK3), I take good notes in class (SK7) and I listen carefully in the class (SK8) were removed after two iterations. Skills engagement with six statements indicated an improved model with P-value(.479), RMSEA(.000), GFI(.983),AGFI(.961), CFI(1.000), TLI(1.001), NFI(.986), Chi-square/DF(.951).

Emotional Engagement

Exploratory factor analysis showed that all the six statements under factor loadings was above 0.590 and it proved to be fit. When Confirmatory factor analysis was carried out to find the model fit, the values were above or below the acceptance levels. Therefore, the statement with low factor loading was removed after one iteration. Emotional engagement with five statements indicated an improved model with P-value(.784), RMSEA(.000), GFI(.994),AGFI(.982), CFI(1.000), TLI(1.016), NFI(.993), Chi-square/DF(.490).



P-Value - .784 RMSEA - .000

GFI - .994

AGFI - .982

CFI -1.000

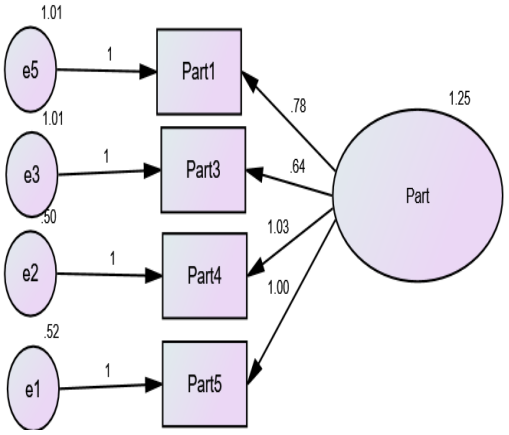
TLI-1.016

NFI- .993

Chi-Square/DF-0.490

Figure 2: Emotional Engagement

Participation Engagement: Exploratory factor analysis showed that all the five statements under factor loadings was above 0.525 and it proved to be fit. When Confirmatory factor analysis was carried out to find the model fit, the values were above or below the acceptance levels. So, the statement with low factor loading "I have fun in online class" (Part 2) was removed after one iteration. Participation engagement with four statements indicated an improved model with P-value(.261), RMSEA(.046), GFI(.992),AGFI(.960), CFI(.997), TLI(.992), NFI(.989), Chi-square/DF(1.342).



P-Value - .261

RMSEA-.046

GFI - .992

AGFI - .960

CFI -.997

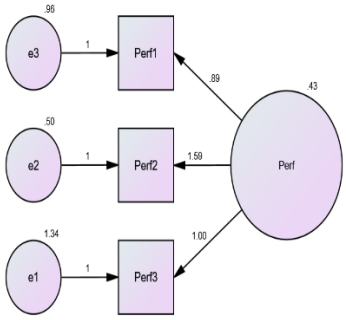
TLI-.992

NFI- .989

Chi-Square/DF- 1.342

Figure 3: Participation Engagement

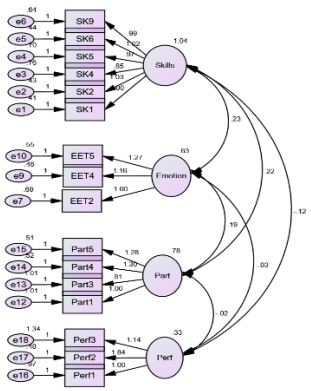
Performance Engagement:



Exploratory factor analysis showed that all the three statements under factor loadings was above 0.640 and it proved to be fit. As there are only three statements under performance engagement, all the three statements were retained.

Figure 4: Performance engagement

Multiples Regressions for Student Engagement



P-Value - .351

RMSEA-.017

GFI - .927

AGFI - .899

CFI -.996

TLI-.995

NFI- .916

Chi-Square/DF- 1.049

Figure 5: Multiples Regressions for Student Engagement

Pooled model (Figure 5) to evaluate the fitness indices, factor loadings of every item and correlations between the constructs (Skills, Emotion, and Part and Perf) was calculated concurrently. The outcome showed that the pooled model has attained uni-dimensionality with all the factor loadings ≥0.5. The construct validity was accomplished as all the models' fitness indices achieved the suggested levels. Along with that, discriminant validity was also attained as all redundant items were excluded.

Table 5. Spearman's Rank Correlation Coefficient

	Gender	Educational level	Department	Skills engagement	Emotional engagement	Participation engagement	Performance engagement
Gender	1.000						
Educational level	.009	1.000					
Department	.143	.322	1.000				
Skill engagement	.051	.317**	.077	1.000			
Emotional engagement	.043	.144	.027	.181	1.000		
Participation engagement	.032	.284**	.124	.345	.131	1.000	
Performance engagement	-.065	.039	.052	-.111	.002	-.024	1.000

**-Correlation is significant at 0.01 level

Table 5 shows the Spearman's Rank Correlation Coefficient for demographic and student engagement variables. Correlation between Educational level and skills engagement as well as participation engagement was positive and highly significant. This shows that the level of education would lead to skills engagement and participation engagement. Gender and department does not have any influence on the student engagement variables.

Conclusion

This study confirmed the results as presented by Handelsman, M. M., et al. (2005). However, confirmatory factor analysis showed that the factor, skills engagement with nine statements did not show a good fit, so the statements like I do all the homework exercises (SK3), I take good notes in class (SK7) and I listen carefully in the class (SK8) were removed to have an improved model with six statements. Emotional engagement had six statements before confirmatory factor analysis was performed. As the model did not show a good fit, one statement with low factor loading was removed to have a good model fit. In the same way, Participation engagement with five variables did not show a good fit. After removing one statement with low factor loading, the model showed a good fit. Now, the student engagement questionnaire has eighteen statements. This questionnaire can be used in the future for finding out the level of student engagement. Correlation, which was performed to check the relationship between demographic variables

and student engagement variables, showed that only the level of study has an impact on the student engagement variables.

Limitations of the study

Factorial validity of the results are reported based on the study conducted in University of Technology and Applied Sciences (UTAS-HCT), Muscat with only 165 samples which cannot be generalized. Hence, it is necessary to repeat the study with broader populations to validate the results.

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