

Factor Analysis of the Challenges faced in Online Learning by the Students in Higher Educational Institutions in Sultanate of Oman

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Abstract

During the Corona pandemic for last two years, academic institutions depended on using online mode of teaching in imparting knowledge to the student community. But there were many challenges faced by the students that affected academic performance. This study aims to identify the major challenge factors faced by 715 students in higher educational institution in Sultanate of Oman. Among the various challenge factors taken for the study 59% were contributed to poor internet connection and low speed of internet and high cost. The inter-correlation is highest between the challenge variables 'very boring and difficult to concentrate and the challenge variable 'feel tired and sleepy while attending'. After the factor rotations two components derived are 'Online method related factors' and 'Teaching related factor'.

Key terms: Online learning, Challenges, online method factors, teaching factor.

Introduction

COVID-19 pandemic has created the largest disruption of education systems in human history, affecting nearly 1.6 billion learners in more than 200 countries. Closures of schools, institutions and other learning spaces have impacted more than 94% of the world's student population. This has brought far-reaching changes in all aspects of our lives (Sumitra and Roshan, 2021). This research highlights the weakness of online teaching infrastructure, the limited exposure of teachers to online teaching, the information gap, non-conducive environment for learning at home. This article evaluates the challenges of the COVID-19 pandemic on teaching and learning process in a higher educational institution in Oman.

Scope of the study

From March 15, 2020, all the educational institutions in Oman went for a lockdown due to the impact of Corona pandemic. This resulted in the closure of educational institutions and students were devoid of attending classes on campus. The academic classes were continued through online medium during the academic year 2020-2021. During this academic year students learned 12 courses in three semesters through online learning. This sudden change in the medium of teaching has caused an impact among the students positively and negatively. This study addresses those issues and the challenges faced by students through online learning. Even though the learning is now offline, the recommendations put forth through this study may be useful in future, in any case of online learning for the students.

Statement of the problem

The Corona pandemic across the global countries has affected the academic services and performance of students adversely. Many studies have been conducted about the effectiveness of online teaching and its impact. But a comprehensive study has not been conducted in Sultanate of Oman. Hence this study on the challenges of online teaching is highly relevant. Due to online learning, the students faced lot of difficulties and that affected their academic performance. This led the researchers to identify the challenges of online learning that affects their academic performance.

Objectives of the study

1. To measure the correlation among the factors that affect online teaching.
2. To identify the major challenges of online teaching faced by the students.
3. To find the major contributing challenge factors of online learning.

Research methodology

The study uses a descriptive research design. In this cross-sectional research the respondents were selected through judgment sampling. The respondents were informed about the objective of the study and information gathering process. They were assured about the confidentiality of the data. The information utilized for this study was gathered through an online survey. The questionnaire was prepared through Google forms, and then it was circulated through the mails. Data was collected from 715 students in University of Technology and Applied Sciences, Nizwa, Sultanate of Oman. Data collection was done during the period during September –December, 2021. Data were exported and analyzed using SPSS version 21.0. To measure the effect of challenges of online learning, 5-Point Likert Scale was used. Factor analysis is done to reduce the variables and to identify the relevant challenges.

Literature Review

Broadly identified challenges with e-learning are accessibility, affordability, flexibility, learning pedagogy, life-long learning and educational policy (Murgatrot, 2020). Many countries have substantial issues with a reliable Internet connection and access to digital devices. In many developing countries, the economically backward children are unable to afford online learning devices and moreover it poses a risk of exposure to increased screen time for the learner. The level of academic performance of the students is likely to drop for the classes held for both year-end examination and internal examination due to reduced contact hour for learners and lack of consultation with Lecturers when facing difficulties in learning/understanding (Sintema, 2020). Many of these students have now taken online classes, spending additional time on virtual platforms, which have left children vulnerable to online exploitation. Increased and unstructured time spent on online learning has exposed children to potentially harmful and violent content as well as greater risk of cyberbullying. Majority of students do not have access to smartphones or TV at home in addition to poor Internet connectivity. There is no or less income for huge population due to closure of business and offices. The data package (costs) is comparatively high against average income earned, and continuous access to Internet is a costly business for the farming community. The Lecturers are in dilemma as to whom to listen to and which tools to adopt. Some think pre-recorded videos could help; however, this would restrict interactions. According to Emma and Elaine (2020), the more students miss the school, the worse their performance is. The two main tools for education available to children during the lockdowns have been remote and alternative learning and, at least technically, a homeschooling environment. Successful online learning thus requires that students (and teachers) be familiar and proficient in their uses of those devices for learning. Hjelsvold et al. (2020) investigated educators' feedback on the distance learning during the COVID-19 lockdown, as a result of a survey conducted on 303 university students and 56 educators in Norway. The study reported that short time and lack of ready resources were important barriers to sudden shift to distant learning. According to the report in Almalnews in Egypt (2020) results of the four surveys included the following: the majority of educational leaders endorsed online distant learning in higher education; Internet connectivity and weak IT skills are the most prominent difficulties of distance education in Egypt; and recorded lectures are the most plausible ways to deliver educational materials.

Analysis of the study

	Mean	Std. Deviation	Analysis N
Poor internet connection (X1)	3.4797	1.37630	715
Low Speed of internet and high cost (X2)	3.6378	1.42171	715
Don't have quality learning devices (X3)	2.8769	1.47489	715
Cannot listen for long time online (X4)	3.3413	1.46993	715
Lecturer's explanations are limited to the contents of PowerPoint slides (X5)	3.2923	1.34826	715
Less interaction between students in the same class (X6)	3.5343	1.33153	715
Very boring and difficult to concentrate (X7)	3.5385	1.44928	715
Lack of consultation with Lecturers (X8)	3.3455	1.25785	715
Feel tired and sleepy while attending (X9)	3.5091	1.54425	715
More information and workload (X10)	3.6182	1.33093	715
Spend more time online than attending classes (X11)	3.5469	1.37768	715
More stress in online learning (X12)	3.6000	1.44245	715
Excess online tasks and activities (X13)	3.6280	1.26969	715
Lack of interaction with Lecturers to clarify doubts (X14)	3.3804	1.27381	715
Lack of self-discipline (X15)	3.2392	1.32953	715
Difficulty in attending practical and lab sessions (X16)	3.5287	1.38629	715
Engage in social media, eat food during online classes (multitasking) (X17)	3.3273	1.38389	715
Less outcomes are covered in online teaching (X18)	3.3301	1.36898	715
Less time to solve online test (X19)	3.7147	1.39717	715

Table 1 shows the descriptive analysis of the challenges of online learning. The mean value of variable X2 (Low Speed of internet and high cost) is 3.63 is the highest with a standard deviation of 1.42. The mean value of variable X13 (Excess online tasks and activities) is 3.62, is the highest with a standard deviation of 1.26. Similarly, the mean value of X12 (more stress in online learning) is 3.6 with a standard deviation of 1.44. The variable, X3, lack of availability of quality learning devices, has the lowest mean value of 2.87 and its standard deviation is 1.47. Since the standard deviation for variable X13 is less (1.26) the spread of values around the mean will be less and it can be considered as a contributing challenge factor.

Correlation Analysis

The correlation analysis helped to determine the relationship between the independent variable categories (X1- X19) relating to the challenges of online learning. The Pearson's correlation coefficient is used to show the direction, strength and significant of the relationship. The p-value is based on a 95% confidence interval, meaning that if the p-value is lower than 0.05 ($p < 0.05$), it is regarded as statistically significant, *vice versa* (Cohen, Cohen, West & Aiken, 2013).

Table 2 Correlations

Pears on Correlation	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19
X1	1.000	.724	.458	.509	-.049	.487	.479	.491	.449	.421	.427	.505	.457	.479	.464	.431	.390	.438	.378
X2	.724	1.000	.444	.593	-.105	.549	.541	.536	.525	.492	.451	.579	.473	.550	.502	.507	.416	.482	.437
X3	.458	.444	1.000	.524	-.055	.411	.475	.415	.463	.367	.327	.421	.388	.453	.438	.391	.370	.436	.360
X4	.509	.593	.524	1.000	-.175	.604	.712	.617	.702	.543	.497	.659	.521	.628	.607	.599	.539	.552	.498
X5	-.049	-.105	-.055	-.175	1.000	.001	-.183	-.103	-.169	.013	-.058	-.152	-.017	.154	-.125	-.119	-.072	-.151	-.059
X6	.487	.549	.411	.604	.001	1.000	.614	.613	.573	.550	.489	.567	.490	.592	.515	.520	.470	.433	.467
X7	.479	.541	.475	.712	-.183	.614	1.000	.670	.785	.558	.551	.696	.538	.670	.637	.662	.566	.572	.523
X8	.491	.536	.415	.617	-.103	.613	.670	1.000	.600	.530	.502	.586	.529	.697	.578	.560	.480	.511	.460
X9	.449	.525	.463	.702	-.169	.573	.785	.600	1.000	.606	.594	.705	.553	.664	.629	.660	.615	.565	.505
X10	.421	.492	.367	.543	.013	.550	.558	.530	.606	1.000	.607	.647	.659	.573	.493	.590	.457	.470	.481
X11	.427	.451	.327	.497	-.058	.489	.551	.502	.594	.607	1.000	.606	.546	.548	.486	.571	.478	.454	.460
X12	.505	.579	.421	.659	-.152	.567	.696	.586	.705	.647	.606	1.000	.624	.665	.549	.642	.534	.585	.531
X13	.457	.473	.388	.521	-.017	.490	.538	.529	.553	.659	.546	.624	1.000	.605	.488	.549	.467	.478	.510
X14	.479	.550	.453	.628	-.154	.592	.670	.697	.664	.573	.548	.665	.605	1.000	.710	.692	.567	.584	.540
X15	.464	.502	.438	.607	-.125	.515	.637	.578	.629	.493	.486	.549	.488	.710	1.000	.575	.570	.512	.489
X16	.431	.507	.391	.599	-.119	.520	.662	.560	.660	.590	.571	.642	.549	.692	.575	1.000	.578	.574	.552
X17	.390	.416	.370	.539	-.072	.470	.566	.480	.615	.457	.478	.534	.467	.567	.570	.578	1.000	.551	.395
X18	.438	.482	.436	.552	-.151	.433	.572	.511	.565	.470	.454	.585	.478	.584	.512	.574	.551	1.000	.512
X19	.378	.437	.360	.498	-.059	.467	.523	.460	.505	.481	.460	.531	.510	.540	.489	.552	.395	.512	1.000

Based on the results in Table 2 above, there is a moderate positive relationship between challenge construct variables such as less interaction between students in the same class (X6) very boring and difficult to concentrate (X7), lack of consultation with lecturers (X8), feel tired and sleepy while attending (X9), more information and workload (X10), spend more time online than attending classes (X11), more stress in online learning (X12), excess online tasks and activities (X13), lack of interaction with lecturers to clarify doubts (X14), lack of self-discipline (X15), difficulty in attending practical and lab sessions (X16), engage in social media, eat food during online classes (multitasking) (X17), less outcomes are covered in online teaching (X18), less time to solve online test (X19). From Table 2 it is clear that there is a negative correlation between the challenge variable that lecturer's explanations are limited to the contents of PowerPoint slides (X5) ($r = -0.049$). The only variable which has a positive correlation is the low speed of internet and high cost (X2) ($r = 0.724$) that affects online learning.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.962
Bartlett's Test of Sphericity	Approx. Chi-Square	9008.495
	Df	171
	Sig.	.000

The Kaiser-Meyer-Olkin measure the sampling adequacy. The KMO statistic varies between 0 and 1. A value close to 1 indicates that patterns of correlations are relatively compact and so factor analysis should yield distinct and reliable factors. Kaiser (1974) recommends adequacy values greater than 0.5 as acceptable. Values between 0.5 and 0.7 are mediocre, values between 0.7 and 0.8 are good, values between 0.8 and 0.9 are great and values above 0.9 are superb (Hutcheson and Sofroniou, 1999). For this data the value is 0.962, which falls in the range of superb. Therefore, factor analysis is appropriate for these data. Bartlett's measure

tests the null hypothesis that the original correlation is an identity matrix. For factor analysis to work some relationships between variables and if the R-matrix were an identity matrix then all correlation coefficients would be zero. For the test to be significant, the significance value should be less than 0.05. For these data, Bartlett's test is highly significant ($p < 0.001$) and therefore factor analysis is appropriate.

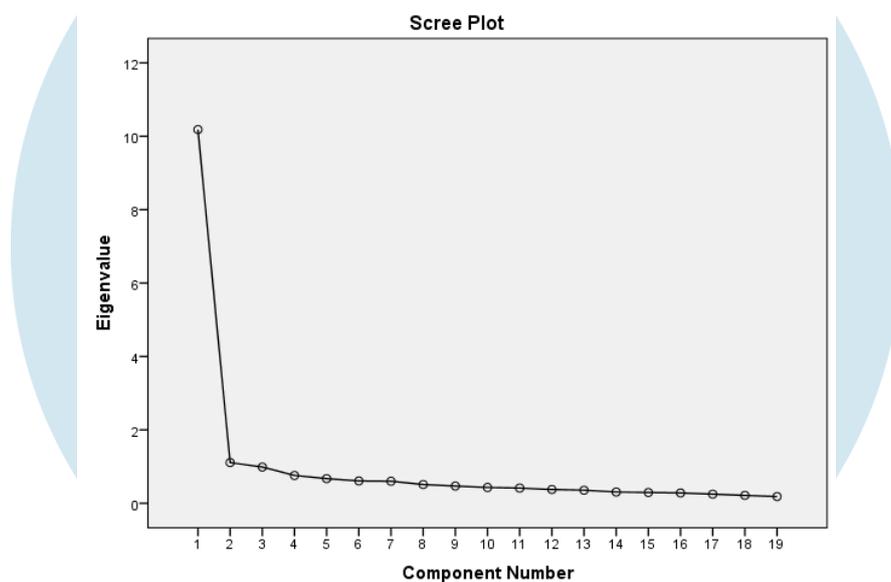
	Initial	Extraction
Poor internet connection (X1)	1.000	.452
Low Speed of internet and high cost (X2)	1.000	.527
Don't have quality learning devices (X3)	1.000	.351
Cannot listen for long time online (X4)	1.000	.675
Lecturer's explanations are limited to the contents of PowerPoint slides (X5)	1.000	.838
Less interaction between students in the same class (X6)	1.000	.572
Very boring and difficult to concentrate (X7)	1.000	.729
Lack of consultation with Lecturers (X8)	1.000	.597
Feel tired and sleepy while attending (X9)	1.000	.715
More information and workload (X10)	1.000	.625
Spend more time online than attending classes (X11)	1.000	.525
More stress in online learning (X12)	1.000	.686
Excess online tasks and activities (X13)	1.000	.585
Lack of interaction with Lecturers to clarify doubts (X14)	1.000	.706
Lack of self-discipline (X15)	1.000	.591
Difficulty in attending practical and lab sessions (X16)	1.000	.632
Engage in social media, eat food during online classes (multitasking) (X17)	1.000	.494
Less outcomes are covered in online teaching (X18)	1.000	.535
Less time to solve online test (X19)	1.000	.455
Extraction Method: Principal Component Analysis.		

The above table shows the table of communalities before and after extraction. Principal component analysis works on the initial assumption that all variance is common. Therefore, before extraction the communalities are all 1. The communalities in the column labeled extraction reflect the common variance in the data structure. 83.8% of the variance is associated with factor 5 (lecturer's explanations are limited to the contents of PowerPoint slides) is common or shared variance. Similarly, 72.9% of the variance is associated with the seventh factor (very boring and difficult to concentrate) is common or shared variance. 71.5% of the variance is associated with the factor 9 (feel tired and sleepy while attending). Another way to look at these communalities is in terms of the proportion of variance explained by the underlying factors. After extraction some of the factors are discarded. The amount of variance in each variable that can be explained by the retained factors is represented by the communalities after extraction.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings ^a
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	10.183	53.593	53.593	10.183	53.593	53.593	10.175
2	1.109	5.835	59.428	1.109	5.835	59.428	1.192
3	.987	5.194	64.622				
4	.758	3.990	68.612				
5	.671	3.533	72.144				
6	.609	3.205	75.349				
7	.600	3.159	78.508				
8	.510	2.684	81.192				
9	.470	2.473	83.665				
10	.431	2.269	85.934				
11	.415	2.184	88.117				
12	.374	1.970	90.088				
13	.356	1.874	91.962				
14	.307	1.615	93.577				
15	.294	1.545	95.122				
16	.281	1.482	96.603				
17	.249	1.309	97.912				

18	.214	1.126	99.039
19	.183	.961	100.000
Extraction Method: Principal Component Analysis.			
a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.			

The table total variance lists the eigenvalues associated with each linear component or factor before extraction, after extraction. The eigenvalues associated with each factor represent the variance explained by that particular linear component and SPSS also displays the eigenvalues in terms of the percentage of variance explained. Factor 1 (Poor internet connection) explains 53.59% of total variance. The first two attributes explain relatively large amounts of variance, especially factor 1, whereas subsequent factors explain only small amounts of variance. SPSS then extracts all factors with eigenvalues greater than 1, which leaves with eight factors. The eigenvalues associated with these factors are again displayed and the percentage of variance explained in the Extractions Sum of Squared Loadings. The values in the column are the same as the values before extraction. The values for the discarded factors are ignored and the table is blank after the second attribute. Similarly factor 2 'Low Speed of internet and high cost' accounts for 5.83% of variance. Thus 59.42% of the cumulative variance is contributed by the first two variables and remaining factors contribute 40.58% of cumulative variance. In the final part of the table labelled Rotation Sums of Squared Loadings the Eigenvalues after rotation are displayed. Rotation has the effect of optimizing the factor structure and the relative importance of these two factors are equalized.



From the Scree plot it is clear that after the second factor the curve begins to tail off. Therefore, it is probably justifiable to retain two factors. This output shows the rotated component matrix (also called as the rotated factor matrix) which is a matrix of factor loadings for each variable onto each factor. This matrix contains the same information as the component matrix except that it is calculated after rotation. Factor loadings less than 0.4 are not loaded as it is suppressed. The variables are listed in the size of their factor loadings. Before rotation, most variables loaded highly on to the first factor. After rotation the factor structure has clarified. There are two factors and the variables are loaded equally. The suppression of factors less than 0.4 and ordering variables by loading size also makes interpretation easier.

	Component	
	1	2
Veryboringanddifficulttoconcentrate	.841	
Lackofinteractionwithteacherstoclarifydoubts	.837	
Feeltiredandsleepywhileattending	.837	
Morestressinonlinelearning	.828	
Cannotlistenforlongtimeonline	.813	
Difficultyinattendingpracticalandlabsessions	.794	
Lackofconsultationwithteachers	.772	
Lackofself-discipline	.762	
Moreinformationandworkload	.744	
Lessinteractionbetweenstudentsinthesameclass	.736	
Excessonlinetasksandactivities	.730	
LowSpeedofinternetandhighcost	.723	
Lessoutcomesarecoveredinonlineteaching	.719	

Spend more time online than attending classes	.711	
Engage in social media, eat food during online classes	.700	
Less time to solve online test	.671	
Poor internet connection	.658	
Don't have quality learning devices	.593	
Lecturer's explanations are limited to the contents of PowerPoint s		.904
Extraction Method: Principal Component Analysis.		
a. 2 components extracted.		

The component matrix is shown in table no.6 before rotation. This matrix contains the loadings of each factor into each factor. All the loadings less than 0.4 are suppressed in the output so there are blank spaces for many of the loadings. The above table shows the loadings (extracted values of each item under 2 variables) of 19 variables on the 2 factors extracted. The higher the absolute value of the loading, the more the factor contributes to variable. Two variables are extracted wherein the 19 items are divided into 2 variables according to the most important items with similar response in component 1 and component 2. At this stage SPSS has extracted two factors. By Kaiser's criterion, two factors are extracted and is proved accurate. The criteria is accurate when communalities after extraction is greater than 0.7. The second ground for accuracy is when the average communalities is greater than 0.6. The average of the communalities is found by adding the communalities divided by the number of factors ($14.373/19 = 0.756$). Thus on two grounds Kaiser's rule is accurate. This is because of the sample size is more than 250 and number of attributes are less than 30. Scree plot is also used to explain this.

	Component	
	1	2
Lack of interaction with teacher to clarify doubts	.828	
Very boring and difficult to concentrate	.825	
More stress in online learning	.825	
Felt tired and sleepy while attending	.823	
Cannot listen for long time online	.799	
Difficulty in attending practical and lab sessions	.789	
Lack of consultation with teachers	.770	
More information and workload	.768	
Less interaction between students in the same class	.751	
Lack of self-discipline	.750	
Excess on line tasks and activities	.750	
Low Speed of internet and high cost	.728	
Spend more time online than attending classes	.722	
Less outcomes are covered in online teaching	.705	
Engage in social media, eat food during online classes	.692	
Less time to solve online test	.676	
Poor internet connection	.670	
Don't have quality learning devices	.592	
Lecturer's explanations are limited to the contents of PowerPoint s		.910
Extraction Method: Principal Component Analysis.		
Rotation Method: Oblimin with Kaiser Normalization. ^a		
a. Rotation converged in 3 iterations.		

The pattern matrix gives coefficients that describe the unique relationship between each item and each factor (controlling for the other factors). The Pattern Matrix shows the factor loadings for the rotated solution. Factor loadings are similar to regression two (or slopes) and indicate the strength of the association between the variables and the factors. The solution has been rotated to achieve an interpretable structure. After rotation, the 18 challenge variable items hang together on the first factor and the last one item hang on to the second factor. All of these coefficients are above the 0.30 level to suggest a "salient" loading. This is a "clean" solution as there are no complex items and the factor loadings for each item onto its primary factor is above the salient threshold. From the pattern matrix, it is revealed that the challenge attributes of online learning, i.e., lack of interaction with teachers to clarify doubts, very boring and difficult to concentrate, more stress in online learning, feel tired and sleepy while attending, cannot listen for long time online, difficulty in attending practical and lab sessions, lack of consultation with teachers, more information and workload, less interaction between students in the same class, lack of self-discipline, excess online tasks and activities, low speed of internet and high cost, spend more time online than attending classes, less outcomes are covered in online teaching, engage in social media, eat food during online classes, less time to solve online test, poor internet connection, lack of quality devices, are loaded heavily on component 1, based on the loading size of coefficients. Thus component 1 can be

termed as “*Online method related factors*”. The challenge factor that is heavily loaded on component 2 is the limited explanation of Lecturer’s related to the contents of PowerPoint. Therefore, component 2 factor is renamed as “*Teaching related factor*”.

	Component	
	Online method factors	Teaching factor
Very boring and difficult to concentrate	.837	
Lack of interaction with teacher to clarify doubts	.835	
Feel tired and sleepy while attending	.833	
More stress in online learning	.827	
Cannot listen for long time online	.809	
Difficulty in attending practical and lab sessions	.793	
Lack of consultation with teachers	.772	
Lack of self-discipline	.759	
More information and workload	.752	
Less interaction between students in the same class	.741	
Excess online tasks and activities	.737	
Low speed of internet and high cost	.725	
Less outcomes are recovered in online teaching	.715	
Spend more time online than attending classes	.714	
Engage in social media, eat food during online classes	.698	
Less time to solve online test	.672	
Poor internet connection	.661	
Don't have quality learning devices	.592	
Lecturer's explanations are limited to the contents of PowerPoint		.914
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.		

The structure matrix yields the correlation of each item with each factor. It is a good idea to inspect it to see whether the interpretation from the pattern matrix also holds for the structure matrix. These two matrices yield similar conclusions.

Component	Online method factors	Teaching factor
Online method factors	1.000	-.067
Teaching factor	-.067	1.000
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.		

The correlation between “Online method related factors” and “Teaching related factor” is -0.067 and shows a negative correlation between “Online method related factors” and “Teaching related factor”. This means that when there is an increased focus on online method of teaching by the educational institutions, there is a decrease in teacher student interaction and teacher’s role as a facilitator is limited in online mode of education.

Findings of the study

1. The correlation value ‘ r ’ is highest for ‘very boring and difficult to concentrate (0.785) and the challenge variable ‘feel tired and sleepy while attending’.
2. Factor 1 (poor internet connection) explains 53.59% of total variance. Factor 2 ‘low speed of internet and high cost’ accounts for 5.83% of variance. Thus 59.42% of the cumulative variance is contributed by the first two variables and remaining factors contribute 40.58% of cumulative variance.
3. After the rotation, the pattern matrix shows that the highest loading is on ‘lack of interaction with teachers to clarify doubts (0.828), and very boring and difficult to concentrate (0.825) as the major challenging factors of online learning.
4. After the factor loadings and factor rotations there are two components derived which are termed as “Online method related factors” and “Teaching related factor”. It is also proved that there is a negative correlation between these two derived factors (-0.067)

Conclusion

In this paper the challenge attributes of online learning were analyzed using factor analysis. In all aspects, the data was appropriate to conduct factor analysis and hence sound conclusions could be drawn from this analysis. A principal component analysis has been carried out with oblique rotation. This resulted into two correlated factors, constituting the challenge attributes of online learning i.e. “Online method related factors” and “Teaching related factor”. It turned out that the measurements of the two components loaded on different factors, which could indicate that two major kinds of factors are relevant for online teaching.

This can be important for academicians, as it gives more insight to overcome these barriers and focus on these challenge attributes.

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