Pakistan Journal of Distance & Online Learning
Volume: V, Issue I, 2019, 45-58

Determinants of Academic Achievement in Introductory Physics Courses among Distance Learners

Folashade Afolabi*

Abstract

Teaching quantitative courses in open and distance learning (ODL) has been a challenge to educators. This research work examined factors that determined the academic achievement of distance learners in introductory physics. A questionnaire consisted of twenty-five (25) items was used to collect data from one hundred (100) respondents who were selected using random sampling technique. The result showed that use of technology and technology components were rated high in determining the academic achievement of distance learners. However, the variables examined could be improved upon by incorporating more factors. Therefore, undertaking the research study further using a larger sample size that includes participants from numerous academic institutions would help improve results of the study.

Keywords: e-learning, quantitative courses, academic achievement, Physics

* Department of Education Science, Distance Learning Institute, University of Lagos
Email: afolabigrace13@yahoo.com

Introduction

The 21st century teaching and learning arrived with an astonishing technological revolution which has helped in the transmission of information in our daily lives and general public (Batoon, Morales & Figuera, 2018). The growth in technology has resulted in the spread of distance education around the world. Distance education has been widely used to improve skills needed to contribute to growing economy. It has been found to have a great potential in reaching the unreached, marginalized and excluded group (Perrato, 2003).

As distance education continue to grow among tertiary Institutions, many articles in recent times, support distance education as a viable method for providing effective education for the less privileged in getting the conventional education through the four walls of the school (Moran &Rumble, 2004) considerable concerns and problems however, developed. Teaching online courses required dedication and difficult as more time and attention is required to teach and provide feedback to learners during interaction (Ganyaupfu, 2013). It is however, more difficult to teach science courses where numerical values are involved and usually require more hands-on activities and live demonstrations (Yang & Cornelius, 2003; Akdemir, 2010).

The teaching of quantitative orientated courses such as mathematics, physics, chemistry and statistics have generated controversies as researchers debated on how effectively they can be taught online. Academic achievements of learners in quantitative courses remained an issue of concern. This has led to learners' increase dropout rate, reduced graduate through put and low enrolment rate to mention a few (Liaw & Huang, 2007; Ganyaupfu, 2013).

The academic achievement of Distance Leaning Institute (DLI) science leaners has recently come under spotlight for a number of reasons. One the thrust of Distance Learning Institute is to produce science teachers who would be gainfully employed for educational development of the country. Therefore, the teaching of quantitative courses such as mathematics, statistics, physics become indispensable. The quantitative values contained in such courses poses threat to teaching and learning of such courses to learners' comprehension. In order for students to learn effectively there are several factors to be considered (Perraton, 2003).

Traylor (2010) discussed factors related with social or cultural values, the school environment as well as teachers and administration has an impact on students learning ability. Another important factor falls up

on the student ability and willingness to learn (Pamela and Davis-Kean, 2005). High failure rate in most of these courses huge running cost of programmes, reduces the number of learners to be admitted as well as reduces throughput rate (Mlambo, 2011). It has been observed that the rate of attrition at the second year of their degree programme could be attributed to the poor achievement of learners in introductory courses such as PHS 102 (Introduction to Physics) upon which the thrust of this research is investigated. Al-Mutairi (2011) found out that students' academic achievement is influenced by numerous factors applicable from one context to another.

MacDonald and Gibson (2011) used an open-ended process to evaluate students' opinions on their poor achievement in pre-requisite courses. However, their goal was not to gather data on student satisfaction but to determine why students dropped out during the second year of their degree programmes. In this open-ended approach, the sample of students wrote their thoughts regarding certain key issues with reference to the first year of study.

Over the years, there have being recurring poor achievement of learners that enrolled for this course. The failure rate keeps increasing yearly with an average failure rate of over 45 percent. It is therefore imperative to look into factors responsible for the poor achievement recorded and provide plausible solutions.

Statement of the Problem

Quantitative courses in have been recording poor academic achievement among distance learners of Distance Learning Institute, University of Lagos. Most especially PHS 102 which serves as a pre-requisite course has led to learners' dropout and low turnout of graduates to this effect, this study seeks to find out factors responsible for the poor academic achievement of learners in PHS 102 course peradventure there may be an appreciable improvement.

Purpose of the Study

The study is specifically designed to achieve the following objectives:

i. To examine factors responsible for learners' underachievement in quantitative courses especially PHS 102 (Introduction to Physics) among distance learners
ii. Suggest possible measures for teaching quantitative courses to reduce learners' drop out among distance learners

Relevant Research Questions

i. What are the factors responsible for learners' underachievement in quantitative courses e.g PHS 102 among distance learners?
ii. What are the possible recommendations to improve on the teaching of quantitative courses?

Data

The research design adopted for this study is survey design. The questionnaire which had twenty-five items was developed to cover many factors as perceived by learners in the preliminary study. Stratified sampling technique was adopted to select participants for the study. One hundred and fifty (150) questionnaires were sent out via email to learners that registered for the course (PHS 102) and only One hundred (100) were returned. Descriptive statistics was explored for some section of the questionnaire while exploratory factor analysis was used (principal component analysis) to filter the best items that can represent the construct under study. Principal component analysis was used in this study to confirm the dimensions of the concepts that have been operationally defined as well as to indicate which of the items were most appropriate for each dimension (Hair, Anderson, Tatham, and Black, 1998).

Results

Reliability Analysis of Questionnaire

The test of reliability of the responses on 25-items using Cronbach's Alpha was 0.795 (79.5%) this implies that the instrument of evaluation is highly reliable judging from the fact that 79.5% > 70%. Furthermore, there exists an internal consistency of the items in the instrument. The validation of the instruments was carried out using analysis of variance (ANOVA), the result showed that the test was significance.

Table 1

Reliability Test Results of Instrument

Instrument		Scale Statistics				Reliability Statistics	Validity Statistics (ANOVA)	
Source	No of Items	No. of Samples	Mean	STD	CV	Cronbach's Alpha	F-value	P-value
Factors Achievement of Student	25	100	54.75	7.281	0.13	0.795	50.300	0.000

Source: Field Survey, 2015. STD (Standard Deviation)

Factor Analysis

The Kaiser-Meyer-Oklin statistics was computed and the result obtained was 0.707 which implies that the instrument used were also good (Kaiser, 1970, 1974). The Bartlett's Test of Sphericity (Barlett, 1954) shows that the test was statistical significance at p = .000, while the chi-square test was 968.624, supporting the factors of the correlation matrix, and confirming its suitability for factor analysis.

Table 2

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Adequacy.	Measure of Sampling	.707
Bartlett's Test of Sphericity	Approx. Chi-Square	968.624
	Df	300
	Sig.	.000

The communalities are estimates of the variance in which each variable accounted for by the factors (or components) in the factor solution. Small values (red) Table 3 below indicate that those variables do not fit well with the factor solution, and should possibly be dropped from the analysis.

Table 3

Communalities of the Factor Analysis

Communalities

	Initial	Extraction
Technology has greatly transformed the dynamics of teaching and learning of PHS 102	1.000	.803
Technology has helped to create innovative learning environment in learning PHS 102	1.000	.724
E-learning provides opportunity and flexibility for both school age and adult learners	1.000	.791
I perform better using face-to-face in learning PHS 102	1.000	.777
Digital technologies on education is more pervasive than any curricular or instructional innovation in the past	1.000	.653
Materials for PHS 102 online are self- sufficient for my studies	1.000	.762
I considered myself less able to adjust to the newest high-technology used in ODL	1.000	.511
I don't understand concepts using online resources	1.000	.728
I learn science best through teacher interaction in the classroom and not through online	1.000	.582
I learn best in science through Physics textbooks	1.000	.799
Students cannot be successful in in learning PHS 102 until they have mastered computational skills	1.000	.637
Text books should be the primary instructional tool for science	1.000	.733
Technology makes learning of quantitative courses (PHS 102) difficult for me	1.000	.551
Using learning management system takes me away from important instructional time	1.000	.728
Working online should be as important and pencils and paper should be made available	1.000	.654
I am confident using technology as a learning resources	1.000	.595
I feel out of place when confronted with technology	1.000	.713

I do not believe the use of technology in learning PHS 102	1.000	.628
I am concerned that technology might interfere with my teacher interaction	1.000	.596
There is no enough time to incorporate technology into solving calculations	1.000	.663
I really enjoy using computers and internet instructionally	1.000	.744
I have used computers and technology to make informed decisions	1.000	.656
I have used internet and computers to inculcate problem solving skills	1.000	.612
Worthwhile science skills and activities is learn best through computer interaction	1.000	.682
if more time could be spent drill and practice using internet I would be better in learning	1.000	.770

Extraction Method: Principal Component Analysis.

The result of the communalities revealed that 80.3% are associated with question 1. And so on with others while communality coefficient of 1.00 means that 100% of the variance in the variables under factors responsible underachievement in quantitative courses.

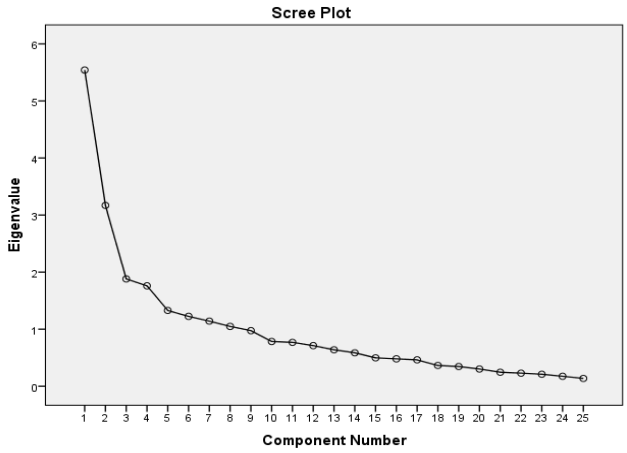
Table 4

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.542	22.167	22.167	5.542	22.167	22.167	3.625	14.502	14.502
2	3.169	12.678	34.845	3.169	12.678	34.845	3.511	14.043	28.545
3	1.881	7.523	42.368	1.881	7.523	42.368	1.859	7.438	35.982
4	1.760	7.039	49.407	1.760	7.039	49.407	1.853	7.413	43.396
5	1.328	5.311	54.717	1.328	5.311	54.717	1.776	7.103	50.499
6	1.224	4.896	59.614	1.224	4.896	59.614	1.775	7.100	57.599
7	1.141	4.563	64.177	1.141	4.563	64.177	1.386	5.543	63.142
8	1.048	4.191	68.368	1.048	4.191	68.368	1.306	5.226	68.368
9	.974	3.897	72.265						
10	.783	3.133	75.398						
11	.769	3.075	78.472						
12	.711	2.846	81.318						
13	.639	2.556	83.874						
14	.586	2.343	86.217						
15	.498	1.990	88.207						
16	.480	1.921	90.128						
17	.462	1.848	91.976						
18	.364	1.455	93.431						
19	.345	1.381	94.812						
20	.301	1.205	96.017						
21	.245	.980	96.997						
22	.229	.917	97.914						
23	.210	.841	98.755						
24	.174	.698	99.453						
25	.137	.547	100.000						

Extraction Method: Principal Component Analysis.

The SPSS analysis has been able to identify 25 linear components within the data set. The Eigen values associated with each factor represent the variance explained by that particular linear component and the result of the SPSS displayed the eigenvalue in terms of the variance explained. There were eight components involved, the first factor accounted for 22% of the variation, the second factor accounted for 12.67% while the other six factor loadings only small amount of variance. The total variance presents for all was 68.36%. The figure below is the scree plot of the analysis which supported the Table 4 above.



The screen plots provide the opportunity to visually inspect the factors that are significant in order to determine the number of factors to retain. The screen plot is a graph of the eigenvalues against all the factors. The point where the curve starts to flatten indicates the number of factors to retain. The flattening starts to occur after factor 8. We therefore retain 8 factors.

Rotated Component Matrix

	Component							
	1	2	3	4	5	6	7	8
I really enjoy using computers and internet instructionally	.760							
Digital technologies on education is more pervasive than any curricular or instructional innovation in the past	.735							
I have used computers and technology to make informed decisions in quantitative courses like PHS 102	.719							
I have used internet and computers to inculcate problem solving skills	.624							
Worthwhile science skills and activities is learn best through computer interaction and the Learning Management System	.612							
I am confident using technology as a learning resources	.578							
I feel out of place when confronted with calculations		.792						
Using Learning Management system for learning takes me away from important instructional time		.779						
There is no enough time to incorporate technology into solving calculations		.719						

I do not believe the use of technology in learning PHS 102	.719						
Technology makes learning of quantitative courses difficult for me	.662						
Technology has greatly transformed the dynamics of teaching and learning of PHS 102		.870					
OER has helped to create innovative learning environment and problem solving skills		.791					
E-learning provides opportunity and flexibility for both school age and adult learners			.875				
Materials used for teaching PHS 102 are self-sufficient for my studies online			.713				
Course materials (Modules) should be the primary instructional tool for teaching PHS 102				.754			
I learn best through Physics textbooks				.713			
I am concerned that technology might interfere with my teacher interaction				.567			
I learn PHS 102 best through teacher interaction in the classroom and not through online					.664		
I perform better using face-to-face in learning PHS 102					.619		
I considered myself less able to adjust tothe newest high- technology used in teaching PHS 102.					.612		
Students cannot be successful in learning PHS 102 until they have mastered computational skills						.771	
Computers should be as important and available as pencils and paper							
if more time could be spent to drill and practice using computer and internet I would be better in learning							.776
I don't understand the teaching of PHS 102 concepts using e- learning							.574

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 13 iterations.

The factor rotation was computed; the result shows that the variables were classified or group according to their contributions. The first component shows that the use of technology was loaded very high. The skill in the use of the computer component was also loaded high in the second component, while component 3,4,5,6,7 and 8 which were the technology transformation, E-learning, Material for teaching quantitative courses through e-learning, learning through face to face with teachers, computational skills and the problems of using e-learning in teaching quantitative courses (PHS 102) were loaded high on each respectively.

Discussion

The test of reliability was conducted on the Instrument used for the survey using Cronbach's Alpha with 0.795 (79.5%) to prove that the instrument is highly reliable. Also to validate the instrument Kaiser-Meyer-Oklin statistics was computed and the result obtained was 0.707 which was also good. The result of the communalities revealed that 80.3% are associated with question 1 and so on with others while communality coefficient of 1.00 implies 100% of the variance in the variables under E. The SPSS analysis identified eight components. The first factor component accounted for 22% of the variation, the second factor accounted for 12.67% while the other six factor loadings accounted for only small amount of variance. The total variance presents for all was 68.36%. The screen plots provide the opportunity to visually inspect the factors that are significant in order to determine the number of factors to retain. The screen plot is a graph of the eigenvalues against all the factors. The point where the curve starts to flatten indicates the number of factors to retain. The flattening starts to occur after factor 8. Researcher therefore retains 8 factors.

The factor rotation was computed; the result shows that the variables were classified or group according to their contributions. The first component shows that the use of technology which was loaded very high follow by the skill in the use of the computer component while others components are 3,4,5,6,7 and 8 which were the e-learning, learning through face to face with teachers, computational skills and the problems of using e-learning in teaching quantitative courses (PHS 102) and the problems of e-learning were loaded high on each component respectively.

Conclusion and Recommendations

The paper has been able to X-rayed the contribution of each of the variable to learning of quantitative course (PHS 102) to provide solution to required technology tools for effective teaching and learning of PHS 102 Open and Distance Learning. The variables were classified or group according to their contributions. The first component which is the use of technology was loaded very high follow by the required skill in the use of the computer component which was also loaded high in the second component. The technology transformation, e-learning, learning through face to face with teachers, computational skills and the problems of using

e-learning in teaching quantitative courses (PHS 102) were loaded high on components 3,4,5,6,7 and 8 respectively.

Based on the above conclusion, the variables examined could be improved upon by incorporating more factors. Moreover, the sample size used was relatively small (n=100) in comparison to other previous similar studies. Therefore, undertaking the research study further using a larger sample size that includes participants from numerous academic institutions would help improve results of the study.

References

Akdemir, O. (2010). Teaching math online: current practices in Turkey. *Journal of Educational Technology System, 39*(1), 47-64.

Al-Mutairi, A. (2011). Factor affecting business students' performance in Arab open university:case of Kuwait. *International Journal of Business and Management, 6*(5), 146-155.

Batoon, M, Morales, L.D & Figueroa, J.A (2018). Instructional design to measure the efficacy of interactive e-books in a high school setting. Turkish Online Journal of Distance Education –TOJDE, 19(2), 47-60.

Ganyaupfu, E.M. (2013). Factors influence academic achievement in quantitative courses among business students' private higher education institutions. *Journal of education and Practice, 5*(1), 1-19.

Liaw S.S, and Huang, H.M. (2007). Developing a collaborative e-learning system based on user's perceptions. Lecture notes in computer science, 4402, 751-759.

MacDonald, K and Gibson, C. (2011). Your tutor is your friend: using experiential learning to enhance second year transition. *Journal of Applied Research in Higher Education, 3*(2), 107-115.

Mlambo, V. (2011). Analysis of some factors affecting student academic performance in an introductory biochemistry course at the University of the West Indies. *Caribbean Teaching Scholar, 1*(2), 79-92.

Yang,Y. and Cornelius, L.F (2003).Ensuring the quality of online education instruction. Paper presented at Mid-South Educational Research Association Conference, Biloxi, MS.

Hair J.F Jr, Anderson R.E, Tatham, R.I and Black, W.C (1998) Multivariate Data Analysis, 5th Edition. Upper saddle River, NJ Prentice Hall

Perraton, H. (2003). Models for open and distance learning 1: teacher education and training. International Research Foundation for Open learning and the common wealth.

Prince, M. (2004). Does active learning work? A review of research. *The Research Journal of Engineering Education, 92*(3), 223-231.

Traylor, D. (2010). Factors that affect student learning. Retrieved online www. Wikinut.com on 23rd August, 2017

Citation of this Article:
Afolabi, F. (2019). Determinants of academic achievement in introductory physics courses among distance learners. *Pakistan Journal of Distance and Online Learning, 5*(1), 45-58.