REIMAGINING ONLINE STATISTICAL EDUCATION FOR ACCELERATED TEACHING AND LEARNING; A PERSPECTIVE FROM WEST AFRICA

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Electronic learning (e-learning) swiftly became the essential mode of teaching during the COVID-19 pandemic. Higher Education Institutions had to immediately migrate all in-person classes online. This posed some learning challenges to a lot of students especially those residing in more remote locations with inadequate online learning devices and poor internet facilities This study documents the online learning experiences of some undergraduate Statistics and Actuarial Science students from Kwame Nkrumah University of Science and Technology, Ghana, during COVID-19 lockdown. The responses revealed that majority (42.2%) of the students' preferred in-person learning, some preferred online (18.6%), and hybrid method (39%). Internet access was through MTN (60%), Vodafone (24%) and Airteltigo (14%). Multinomial logistic regression analysis was employed to identify determining factors for student preferred mode of teaching and results showed internet service provider, place of residence, gender and program of study as significant.

INTRODUCTION

Internet technologies and mobile applications have transformed the education system from the traditional structure to the modern method of teaching (Elumalai, 2020) .The world has changed over a short period of time, with the rise and spread of the COVID-19, which has forever change the education landscape (Digvijay,2020). The university in its role as a vital higher educational institution was among the hardest hit with the closure of educational institutions globally. University lecturers, tutors, and students have to use diverse online communication platforms to guarantee an uninterrupted education process (Al-Kumaim, 2021). About 9.2 million and 500,000 students from the basic and tertiary levels have been affected globally by COVID-19, respectively. Educational institutions throughout the world have made changes from traditional undergraduate classroom into virtual online education or blended teaching and learning approach. Merging In-person lectures with technology give rise to blended learning and flipped classrooms; this type of learning environment can increase the learning prospect of the students. Students can learn anytime and anywhere, thereby developing new skills in the procedure leading to life-long learning (Dhawan, 2020).

In spite of their familiarity with e-learning platforms or capacity to use these evolving information technologies in their education journey, the COVID-19 pandemic has tested the extent to which both lecturers and students are ready to adopt and use these technologies in their online learning activities (Allam, 2020). As per the assessment of researchers, it is uncertain to get back to normal teaching anytime soon. As social distancing is dominant at this stage, this will have negative effects on learning opportunities (Dhawan, 2020). To safeguard the continuity of teaching and learning against the substantial challenges for Ghana's education system during the onset of COVID-19 pandemic, the President of the Republic of Ghana directed the Ministry of Education and the Ministry of Communication to ensure that they roll-out distance and remote learning programs for all students (Henaku, 2020). The universities were not prepared for such a transition and their online teaching-learning process evolved gradually. Many academic institutions that were earlier reluctant to change their traditional pedagogical approach had no option but to shift entirely to online teaching–learning in order to ensure uninterrupted process. Some lecturers and students, have expressed the opinion that online learning is a flexible and effective form of teaching and learning as most of them believe that this helps in making distant learning very easy with relaxed administrative activities and accessibility along with less usage of resource and time. This article throws more light on online learning experiences of some undergraduate Statistics and Actuarial Science students from Kwame Nkrumah University of Science and Technology (KNUST), Ghana, during COVID-19 lockdown.

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Common Platform for online Tuition

Interestingly, despite having a variety of digital modes of teaching-learning, practically all the lecturers and students both were using institutional online platforms, WhatsApp/Telegram and Email for educational interactions, Zoom/Cisco WebEx/Google Meet/Skype platform for taking online classes.

METHODOLOGY AND DATA DESCRIPTION

The data used in this study is obtained from structured questionnaires which were administered online to undergraduate students at the Department of Statistics and Actuarial Science, KNUST-Ghana. The sample size for the study was 250 students from the department. The year one students were not included in the study since they were not in school. The questionnaires collected information on the preferred mode of teaching, the effectiveness of the online teaching during the pandemic, factors that inhibit the online teaching and students' experiences and challenges in accessing learning materials online. The Department of Statistics and Actuarial Science is in the Faculty of Physical and Computational Sciences, KNUST. Currently student population is about 1,370 undergraduates and 130 postgraduate students. The Department offers high quality training and research in all the functional and professional areas of Statistics and Actuarial Science (7).

Model Specification

The Multinomial logistic (MLogit) regression analysis and log linear models were adopted to analyze the data. This type of regression is similar to logistic regression, but it is more general because the dependent variable is not restricted to two categories. MLogit Regression is the regression analysis to conduct when the dependent variable is nominal with more than two levels. MLogit regression is a generalized linear model used to estimate the probabilities for the m categories of a qualitative dependent variable Y, using a set of explanatory variable **X**:

$$\Pr(Y = Y_{ik} = K \left| x_i; \beta_1, \beta_2, ..., \beta_m = \frac{\exp \beta_{0k} + x_i \beta_k}{\sum_{j=1}^{m} \exp \beta_{0j} + x_i \beta_j} \right.$$ .Where k = 1, 2, 3, 4…….m and

β_k is the row vector of regression coefficient of X for the K^{th} category of Y (Maurizio, 2014). Parameter estimation is however performed through an iterative maximum-likelihood algorithm. The parameter estimates are relative to the referent group, the standard interpretation of the multinomial logit is that for a unit change in the predictor variable, the logit of outcome relative to the reference group is expected to change by its respective parameter estimate given that other variables are held constant. The model adequacy can be determined by looking at the Pseudo-R-square statistics and Likelihood Ratio (LR) Chi-Square test that for both equations at least one of the predictors' regression coefficient is not equal to zero.

Multinomial logistic Regression Model specification

In this study Multinomial logistic Regression was used to examine learning experiences during the pandemic related university closure. Our nominal dependent variables were student preference of teaching: online, In-person and Hybrid. The independent variables were: Gender, Program of Studies, Residence, network and internet connectivity problem. The analysis was carried out using Statistical Package for the Social Sciences, version .**20.**

RESULTS AND DISCUSSION

The main objective of the study was to identify factors that affect students' online learning experiences of statistics and Actuarial Science students in a Ghanaian university. The summary of the response of the demographic statistics to the questionnaire obtained from the undergraduate students was given percentage figures are summarized in *Table 1* below.

Table 1. Demographics statistics

Variable	Category	N (%)
Gender	Male	165 (66.0)
	Female	85 (34.0)
Age	≤ 20	40 (16)
	21-23	150 (60)
	≥24	60 (24)
Level	200	0 (0)
	300	192 (76.8)
	400	58 (23.2)
Program	Statistics	192 (76.8)
	Actuarial Science	58 (23.2)
Residence	Urban	106 (42.4)
	Rural	21 (8.4)
	Semi-Urban	90 (36)
	Semi-Rural	33 (13.2)

Form *Table 1* above it can be observed that most of the respondents were found in the urban area (106 (42.4%)) while (21 (8.4%)) among the respondents lived in the rural area. With regards to gender the dominance of the males in our tertiary institution was evident as the male recorded 165 (66%) males and the females 85 (34%). The age bracket for our respondents was from 19 to 25years, however between 21-23 years record the highest number of 150 (60%). Again most of our respondents were students studying Statistics 192 (76.8%).

Table 2. Internet Connectivity and learning experiences

Variable	category	N (%)
Connectivity Challenges	Yes	208 (83.2)
	No	42 (16.8)
Internet Service provider	MTN	150 (60)
	Vodafone	60 (24)
	Airteltigo	40 (16)
Learning Effectiveness Rating	Very Good	31 (12.4)
	Good	71 (28.4)
	Average	101 (40.4)
	Poor	47 (18.8)

To quantify determinant factor for effective online learning experiences of undergraduate statistics and Actuarial Science students from Kwame Nkrumah University of Science and Technology, Ghana, during COVID-19 lockdown, the effect of internet services can't be overlooked. The communication network however provided these internet services through the SIM card used by their customer. Despite the challenges about half 101 (40.4%) of the students considered the effectiveness of the online learning as Average, Good 71 (28.4%), Very Good 31 (12.4%) and Poor 47 (18.8%).

Discussion of Model Parameter Estimates

An important feature of the multinomial logit model is that it estimates ***k-1*** models, where *k* is the number of levels of the dependent variable. Parameter estimates are relative to the student who preferred In-person teaching, the standard interpretation of the multinomial logit is that for a unit change in the predictor variable, the logit of outcome relative to the reference group is expected to change by its respective parameter estimate given the variables in the model are held constant. The In-person mode of teaching was the referenced group, therefore estimated a model for online relative to in-person and a model for Hybrid relative to In-person.

Table 3. Estimated effects of selected predictors

	Variable	Coeff. (OR)	SE	Wald	Df	P-value	95% CI
Online	Intercept	3.134	1.070	8.572	1	.003	
	Gender: Female	0.656 (1.927)	.463	2.007	1	.046	0.778-4.774
	Gender: Male (Ref)	-	-	-	-	-	-
	Program: statistics	-1.493 (0.225)	.557	7.200	1	.007	0.075- .669
	Program: Actuarial(Ref)	-	-	-	-	-	-
	Residence: Semi-Urban	0.096 (1.100)	0.655	.021	1	0.883	0.305-3.976
	Residence: Rural	-1.190 (0.304)	.758	2.467	1	.116	0.069- 1.343
	Residence: Semi Rural	-1.963 (0.303)	0.100	19.163	1	0.0001	-2.9E-9, 2.69E-9
	Residence: Urban (Ref)	-	-	-	-	-	-
	Network: MTN	1.105 (3.01)	0.728	2.302	1	0.0129	0.080-1.380
	Network : Vodafone	0.973 (2.646)	.772	1.587	1	.208	0.083-1.717
	Network: Airteltigo (Ref)	-	-	-	-	-	-
	Internet connectivity Problems: Yes	-2.246 (0.106)	0.514	19.080	1	0.000	0.039-0.290
	Internet connectivity Problems: No(Ref)	-	-	-	-	-	-
Hybrid	Intercept	1.136 (3.11)	0.900	2.136	1		
	Gender: Female	0.935 (2.54)	0.363	6.625	1	0.010	1.250-5.191
	Gender: Male (Ref)	-	-	-	-	-	-
	Program: statistics	-0.456 (0.63)	.467	0.953	1	.329	0.254 -1.583
	Program: Actuarial(Ref)	-	-	-	-	-	-
	Residence: Semi-Urban	0.072 (1.07)	0,499	0.021	1	0.886	0.404-2.858
	Residence: Rural	0.161 (1.17)	0.498	.104	1	.747	0.442- 3.118
	Residence: Semi Rural	0.432 (1.54)	0.632	3.474	1	.041	.447-5.336
	Residence: Urban (Ref)	-	-	-	-	-	-
	Network: MTN	0.764 (2.15)	0.567	9.679	1	0.002	0.056-1.521
	Network : Vodafone	0.226 (1.25)	.684	22.252	1	.000	0.010- 0.152
	Network: Airteltigo (Ref)	-	-	-	-	-	-
	Internet connectivity Problems: Yes	0.394 (1.48)	0.575	0.469	1	0.0494	0.480-4.578
	Internet connectivity Problems: No(Ref)	-	-	-	-	-	-

REF.: Reference. The reference category of dependent variable: *In-person.* OR**:** *Odds Ratio*

Table 3 above depicts the multinomial logistic model estimates of several predictor variables against the student preferred mode of teaching. It is shown that the odds female student for Online relative to In-person is 1.927 times that of the male counterpart and for Hybrid relative to In-person odds of the female student was 2.54 times the male. It can therefore be concluded that female students prefer Online teaching than the male students. For Statistics student the odds of online relative to in person is decreased 0.225 units, as well as for Hybrid relative to In-person the odds is also decrease by 0.63 Actuarial students while considering all other predictors constant in the model. From the OR of place of residence, if a student residing in semi- urban, rural and semi-rural desiring Online relative to In-person was *1.100, 0.304 and 0.303units* than a student leaving in the urban, respectively. For a student located in the semi urban, Hybrid relative to In- person is increased by *1.07units.*

However, for rural and semi-rural, desiring Hybrid relative to In- person is increased by *1.17 and 1.54units* than to students located in the urban. It is also observed that student with connectivity problems have *0.106units* lower chance of choosing online relative to In- person when compared those with no connectivity issues. However, student with connectivity problems have 1.48 units higher chance of choosing Hybrid relative to In-person. For MTN and Vodafone users it had a higher *OR of 3.01 and 2.646* for Hybrid relative to In-person than those using AirtelTigo, respectively. Moreover, for MTN and Vodafone users it had an *OR of 2.15 and 1.25* higher than Airteltigo for Hybrid relative to In-person, respectively.

Model Adequacy .

The model fitting information (Likelihood Ratio Chi-square test) is 0.00 significant level. Pearson (χ^2 =183.850 p-value <0.00). Cox and Snell and Nagelkerke were 0. 654 and 0.415 respectively indicating significant model fit of date.

CONCLUSION

The outcome of our study revealed that most of the students preferred in-person teaching to online teaching. Again it was revealed that poor connectivity affected that effectiveness of the teaching and learning during the pandemic. Our study also discovered that gender, program of study and location significant in the determination of preferred mode of teaching.

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