

INSTRUCTIONAL DELIVERY AND STUDENTS' EXPERIENCES WITH DISTANCE AND ONLINE LEARNING OF UNDERGRADUATE MATHEMATICS IN NIGERIA

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ABSTRACT-This paper examines the students' experiences with instructional delivery (ID) of distance and online learning of undergraduate mathematics in two major Nigerian universities. Purposive sampling was used in the study to select mathematics students from University of Lagos Distance Learning Institute (DLI) and the National Open University of Nigeria (NOUN). Data were collected through mixed-methods and a one-sample binomial test was employed to analyse the quantitative data. Furthermore, narrative and content analyses were done to explore how respondents make sense of their experiences of learning mathematics through the distance and online mode. Among others, the results of the study suggest that the abstract nature of mathematics was not appropriately addressed in the course content and that the absence of helpful and visible tutors for the subject complicated the challenge of understanding abstract mathematics even further. Among the many challenges, the abstract nature of mathematics and the absence of qualified tutors point to the need for improvement in the design, development and provision of mathematics course materials and programmes for distance and online mathematics learning.

Keywords: Instructional Delivery; Distance and Online Learning; Undergraduate Mathematics.

1. INTRODUCTION

In recent years, distance and online learning have become major topics in education, in part because of their increasing popularity as means for broadening access to higher education for many students (Tapfumaneyi, 2013). Where many universities and colleges are creating more online and distance education programmes, the original single mode Open and Distance Learning (ODL) institutions are expected to be leaders in ID. New challenges are also emerging, such as how ODL institutions can enhance their distance and online delivery in an environment that is becoming more and more diverse, thus creating new areas for research investigation (Bertini, 2016). Prior studies have identified instructors' competence to deliver quality instruction to establish meaningful educational experiences for the learners as one of the basic barriers of distance and online learning (Harrington & Loffredo, 2010). The overall aim of this paper is to examine students' experiences with ID of distance and online learning of undergraduate mathematics at two ODL universities in Nigeria.

The growth witnessed in distance and online education worldwide has affected distance and online learning of mathematics positively and hence, driven the revision of ID in institutions of higher learning. However, there is still a gap in our understanding of students' experiences with ID in distance and online learning of undergraduate mathematics. In this paper, we discuss ID in an ODL environment and its effect on students' experiences of learning university-level mathematics using the Nigerian ODL context as our focus. We provide answers to the following questions specifically:

How does the use of ID course materials affect students' experiences in distance and online learning of undergraduate mathematics?

How can undergraduate mathematics students' experiences with ID be understood and/or explained?

What suggestions can be made to enhance ID and students' experiences with distance and online learning of undergraduate mathematics?

2. BACKGROUND

The increasing adoption of distance and online learning is considered a major and fundamental educational advancement in Nigeria (Osipita, 2016). Information and Communication Technology (ICT) was interestingly included in the policy guidelines establishing distance and online learning in Nigeria (Federal Republic of Nigeria, 2004). It was recommended that ICT should be used in ID of ODL academic programmes and students should have adequate access to it. However, there is no plan on how ICTs will be made available for both the learners and ODL institutions. The Distance Learning Institute (DLI), University of Lagos (a dual mode) and the National Open University of Nigeria (NOUN), (a single mode) are two of the designated ODL institutions in the country. The aim of designating these universities was to provide opportunities to people who cannot get away from their work for full time conventional learning (Jimoh, 2013). These institutions primarily employ print in delivery of instruction to the students and are presently and actively utilising online resources (Garrett, 2016). Notwithstanding the improvements observed in the utilisation of online resources, their impact in distance and online learning of mathematics specifically is yet to be established. Some researchers have identified lack of consistency in policy implementation, lack of instructors and poor developed instructional materials as problems affecting distance and online ID in Nigeria (Osipita, 2016; Edu, Sule, & Nsor, 2016). In view of these challenges, the present study sought to understand students' experiences of learning mathematics through this mode.

3. CONCEPTUAL FRAMEWORK

The foundation of the paper is based on Experiential Learning Theory (ELT). The theory is chosen because of its emphasis on the interaction between the students and the learning environments. The assertion of the ELT (Kolb, 1984) is the idea that the process of learning is represented in a cycle of concrete experiencing, reflective observation, abstract conceptualisation, and active experimentation. Kolb stressed that students exhibit different preferences of learning within a cycle. The theory is learner-centred and allows the students to manage and control their individual learning while the instructors facilitate the learning. It has been used as framework by some researchers on ID in distance and online mode (Harrington & Loffredo, 2010). Carver, King, Hannum and Fowler (2007) stated that experiential learning provides an already existing framework in which to develop a new model for online learning, featuring the individual either alone or in creative interaction. The indicators expressed in this theory make it more helpful in exploring students' experiences in ID of mathematics at the university. However, there is very little research on ID using ELT as framework in distance and online education in Nigeria, hence, the choice of this theory in this paper. The relevance of ELT has made its application in generating data to answer the three questions raised in this paper necessary. The theory also guides the analysis and discussion of the findings.

4. METHODOLOGY

This paper examined students' experiences with ID of distance and online learning of undergraduate mathematics at universities. The explanatory sequential mixed-method design as described in Creswell (2014) was employed to provide insights on two ODL institutions about undergraduate mathematics learning through distance and online programmes. This design allowed for the collection and analysis of quantitative, followed by gathering and analysis of qualitative data. Consequently, the qualitative data in this study was used to complement and better interpret the results of the quantitative data. As a multiple case study, purposive sampling was used to select an informative sample of sixty third year mathematics students at both DLI and NOUN respectively.

The instruments, a largely closed ended questionnaire with a limited number of open-ended questions, together with semi-structured interviews were developed by the researcher in which some aspects were in line with Ramsden's (1991) course experience questionnaire (CEQ). The questionnaire [formulated on a 5-Likert scale of strongly agree, agree, neutral, disagree and strongly disagree] was administered to DLI students on their centre meeting days which were fortnightly; while a Short

Message System (SMS) was used to invite NOUN students to complete the questionnaire since they did not have a specific day of centre meetings. Appropriate transport arrangements were made for the participants to facilitate our meetings. In addition to the questionnaire, ten students that completed the questionnaire in the two ODL institutions were conveniently sampled and interviewed. This was done so as to obtain additional information regarding students' experiences with ID of mathematics in the ODL institutions studied. The interviews were recorded, with permission from the interviewees; for the purpose of capturing the participants own words for proper analysis. The participants were assured that their participation was voluntary and that there would be no penalty for withdrawal or non-participation.

The triangulation of quantitative and qualitative data helped to improve the reliability and validity of the results. In addition, a pilot study was conducted with mathematics students (n=8) to test the survey (questionnaire) instrument and two of those students were also interviewed. The pilot results indicated that the students understood the questions and the key constructs of the study. Mixed methods data analysis was done through a Parallel Analysis (PA) as proposed by Teddlie and Tashakkori (2009). This allows quantitative analysis to be conducted independently of the qualitative analysis. A one-sample binomial test was used to analyse the quantitative data because the data was fixed at n=60, the responses were independent of each other and the data is ordinal categorical. The qualitative data was transcribed word-for-word, coded to generate categories and subcategories and thereafter themes were developed and analysed using the narrative approach (Elo & Kyngäs, 2008).

5. RESULTS

The results of the students' responses to each of the questions in this paper were explored. The number of the students that agree or disagree on each of the questionnaire items necessitated re-grouping the 5-Likert scale into agree (consisting of strongly agree and agree) (A), disagree (consisting of strongly disagree and disagree) (D), and neutral (N). Neutral was presented in the table but was not reported on since the emphasis of the findings was not on the students with indifferent opinions.

5.1. ID Using Course Materials

Table 1: Responses of DLI and NOUN students as related to course materials

N	Questionnaire item	A (%)	D (%)	N (%)	M	SD	B.T (p-value)
1	The abstract nature of mathematics is not simplified in the design of the course materials.	23 (38.4)	26 (43.3)	11 (18.3)	2.95	1.24	.775
2	I have access to course materials online over the Internet.	45 (75.0)	9 (15.0)	6 (10)	3.92	1.20	.000
3	ODL course materials in my institution meet students' mathematical and experiential needs for personal mathematics interest.	31 (51.6)	14 (23.4)	15 (25.0)	3.30	1.06	.017
4	ODL course materials in my institution meet students' mathematical and experiential needs for requirements for degree award and certification	48 (80.0)	3 (5.0)	9 (15.0)	3.90	0.84	.000
5	I usually feel so bored when I study mathematics concepts that I quit before I finish what I planned to cover in the course material.	19 (31.7)	32 (53.3)	9 (15.0)	2.65	1.12	.000

6	When the mathematics course material is difficult to understand, I give up or study only the easier parts.	17 (28.3)	34 (56.7)	9 (15.0)	2.48	1.23	.025
7	Even when the mathematics course materials are not interactive enough, I manage to continue working to understand and finish them.	46 (76.7)	5 (8.3)	9 (15.0)	3.78	0.92	.000

*Binomial test; Source: Survey data

Items 2, 4, 5, and 8 with $p < .05$ indicated that the provision of course materials is considered the lifeblood of ID for their degrees and certification. The findings are consistent with the results of previous studies by Osipita (2016), which indicated that students pay more attention when the online course materials are presented with clear guidelines and expectations. Furthermore, items 6 and 7 seemed to have significant biases, indicating student persistence in learning mathematics through this mode. Item 1 suggested that the abstract nature of mathematics is not completely dealt with in the design of the course materials.

5.2. How ID can be Understood and/or Explained

Table 2: Responses of DLI and NOUN on how ID can be understood and/or explained

N	Questionnaire item	A (%)	D (%)	N (%)	M	SD	B.T (p-value)
8	Learning mathematics through a distance and online mode in my institution is frustrating.	19 (31.7)	28 (46.7)	13 (21.6)	2.82	1.37	.243
9	Many mathematical problems cannot be solved through distance and online learning.	33 (55.0)	22 (36.7)	5 (8.3)	3.20	1.36	.178
10	I enjoy learning mathematics through distance and online.	20 (33.3)	25 (41.7)	15 (25.0)	2.83	1.30	.551
11	I have reliable access to Internet for my school needs.	30 (50.0)	15 (25.0)	15 (25.0)	3.23	1.21	.037
12	The following can help to improve the students' experiences further in distance and online learning of mathematics in my institution: Access to my mathematics tutors/lecturers and media.	50 (83.4)	5 (8.3)	5 (8.3)	4.25	1.04	.000
13	Face-to-face remains the dominant method of teaching and learning of mathematics in my institution.	31 (51.7)	18 (30.0)	11 (18.3)	3.40	1.39	.086
14	Learning of mathematics through the distance and online mode is not efficient.	28 (46.7)	19 (31.7)	13 (21.6)	3.20	1.27	.243

*Binomial test; Source: Survey data

In Table 2, items 11 and 12, $p < .05$ suggested that access to efficient internet facilities, flexible teaching and learning; different forms of media and access to mathematics tutors in ID cannot be underestimated. This provides support for Jimoh's (2013) view on the importance of variety of media in distance and online learning environment. The $p > .05$ in items 9 and 13 signified that the students have diverse experiences with ID. Whereas, the results in items 8, 10, and 14, $p > .05$ show the need for

improvement in ID to remove frustration in learning mathematics through this mode (Edu, Sule, & Nsor, 2016).

5.3. Emerging Issues from Qualitative Data

The quantitative analysis results in tables 1 and 2 described the general picture of the students' experiences with ID while the qualitative analysis provided deep understanding of their experiences and answers the third research question in this paper. The emerging themes, sub-themes and the categories are summarised in figure 1.

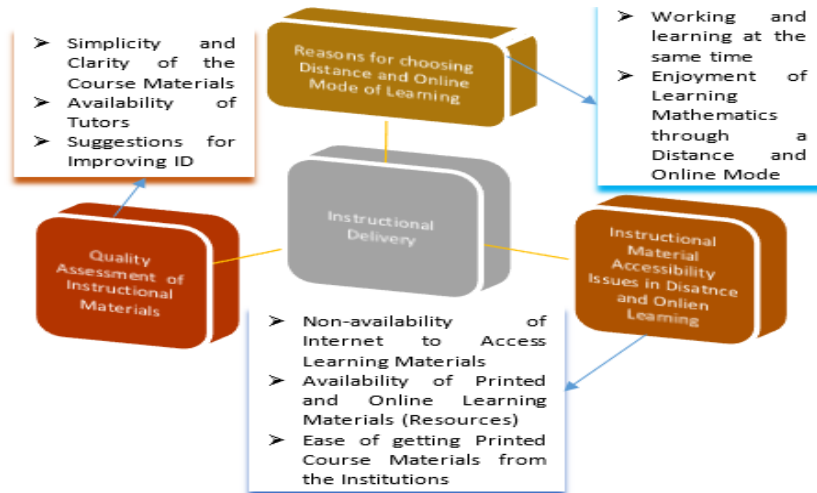


Figure 2: Outline of emerging themes, sub-themes and categories

The emerging categories from reasons for choosing distance and online mode of learning revealed that the students' desire for career development and improvement necessitated their choice of studying through the distance and online mode. As one of the participants reflected, "It gives room for somebody that is working to acquire knowledge, so that I will be going to school and also doing my work together". Despite the students pointing out experiences that hinder their enjoyment of the programme, which include not putting the right structure in place, there seems to be some level of enjoyment among the students who were learning mathematics through this mode, as captured by a student as follows:

I am enjoying the programme, it is just there are some difficulties here and there and this may be due to the new development going on in this school but maybe with time, they will improve the more.

The narratives of the students on the challenges they face in accessing learning materials through the internet revealed that the universities provide little or no internet facilities for the students but that many students provide their own internet access. One participant commented as follows: "Yea, I have my own personal access to Internet it's not from school and none from them at all".

The results further suggest that the students are not entirely satisfied with the learning resources in their institutions. The majority felt that mathematics resources were not available and also not simplified to mitigate the abstract nature of mathematics. The students also indicated that the process of obtaining the printed materials demands extra time due to long queues they experience. Interestingly, students' frustration regarding lack of mathematics tutors for ID can be gleaned from the following comment: "Talking about the tutor, we don't have any, we can just forget about that because they are not available. But we talk among ourselves, we normally meet face-to-face, sometimes to discuss some topics". The students made a number of suggestions including the need to provide occasional face-to-face lectures to address their challenges with content, using different forms of media for teaching, providing learning resources and greater availability of mathematics tutors for effective ID.

6. DISCUSSION

The study revealed that most students chose to study through this mode due to work commitments; however, the lack of essential resources for complete course delivery may be affecting them negatively in their studies. Based on the results from quantitative and qualitative analyses, it would appear that even while the students may have access to learning materials over the Internet and through prints (Garrett, 2016), the abstract nature of mathematics is not addressed adequately in the material and the content is not simplified enough to address the challenges. This paper has shown that to further improve the students' experiences in ID of mathematics, access to helpful tutors is not only necessary but perhaps critical. The ELT emphasised that every learner produces "rules and mental patterns" they can use to make meaning of their experiences (Murphrey, 2010). This was specifically demonstrated by how the students regulated their mental mind to adapt to new experiences in not giving up when there are challenges in understanding the learning materials and organising themselves to solve mathematical problems facing them. Noteworthy from this theory is the tutors' availability to facilitate and regulate learning instead of just giving out information. This expectation was, however, not fulfilled for many of the participants in this study, as expressed by the learners' quotes above.

7. CONCLUSION AND RECOMMENDATIONS

The results of this study provide evidence that well designed course materials and instructors' support are very important in the success of distance and online learning of undergraduate mathematics. This calls for an urgent need to improve the design, development and provision of mathematics course materials and programmes for distance and online mathematics learning. The processes involved in this study were fundamental because they helped to clarify thoughts and to generate new insight into the ID of mathematics in Nigeria. As a recommendation, further research is needed using specific mathematical topics to explore ID and student experiences of learning the topics through this mode. Students' dependence on printed materials suggests the need for mathematics course designers and developer to make the materials as simple as possible for the students to study and understand on their own.

Finally, the regulatory agencies such as the National Universities Commission (NUC) in Nigeria should ensure and oversee the ID of mathematics at university-level to strengthen the understanding of the subject and its applications in sciences, engineering and other courses that require mathematical literacy. One limitation of this study lies in the sample of two ODL institutions in Nigeria. Even though, these are large and fairly representative, student experiences at other ODL institutions would enhance our understanding of the challenges and opportunities for studying mathematics through this mode.

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