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DISTANCE-AND-ONLINE LEARNING SUPPORT SERVICE BENEFITS AND BARRIERS IN UNDERGRADUATE MATHEMATICS LEARNING IN NIGERIA

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ABSTRACT

The paper explores the benefits and barriers of Support Services (SS) in learning undergraduate mathematics through the distance-and-online mode. The aim was to explore SS that employ accessible and advanced technologies to improve the students' distance-and-online learning of mathematics at university-level. Samples of students from the University of Lagos' Distance Learning Institute (DLI) and the National Open University of Nigeria (NOUN) were selected purposively for this mixed-methods research study designed to understand how distance-and-online students perceived undergraduate mathematics, with regard to SS in the two Open and Distance Learning (ODL) institutions in Nigeria. The analyses of the data included a one-sample binomial test and students' narratives. The Cognitive Theory of Multimedia Learning (CTML), which has become increasingly influential in distance-and-online education, was used as a lens to explain student benefits and barriers of SS in undergraduate mathematics learning. The findings, which were consistent between quantitative and qualitative analyses, revealed that print materials, the Learning Management System (LMS), online processing of admission, registration, results checking and availability of course materials online all have significant benefits for students who are learning mathematics. However, the findings show that apart from uploading the course materials and leaving occasional information on the LMS, many mathematical activities were not available on the platform. The students' desire for audio and visual systems, as advocated in CTML, also did not find expression in the findings, as students strongly disagreed that the utilisation of these technologies in their institutions was prevalent, thus creating barriers to the learning of mathematics in the institutions. The paper recommends that the SS which encourage constructivist–based learning aimed at inspiring, supporting and satisfying students' needs, should be the major focus for improvements in the mathematics

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programmes offered through this mode.

Keywords: Distance-and-online learning; Support Services; benefits and barriers; undergraduate mathematics; Distance Learning Institute (DLI); National Open University of Nigeria (NOUN)

INTRODUCTION

Distance-and-online education has been a great success in recent times partly because of the increased role of technology in its provision. The rapid changes in technology have compelled many institutions to make necessary changes to adapt to their learning Support Services (SS). Open and Distance Learning (ODL) institutions have the mandate to offer distance-and-online learning opportunities to students in such a way that if the students cannot go to school, the school attempts to go to them. Support services in distance-and-online learning therefore serve as a link between the students and the institutions. Researchers have claimed that successful SS help both the distance-and-online students, and ODL institutions in achieving academic goals (Brindley, Walti and Zawacki-Richter 2004; Floyd and Casey-Powell 2004). According to Simpson (2015), SS consists of the cognitive, otherwise known as academic support, where students are helped in developing their learning skills. On the other hand, non-academic support comprises the organisational and emotional support. This involves helping the students manage their study time and stress associated with learning, among others. Tait (2015) argues that the cognitive, affective and systemic are three important components of students' success in distance-and-online learning environments. Consequently, any form of support to distance-and-online learning students must be monitored constantly to ensure that all barriers to learning are mitigated for the students to engage in active learning.

This paper which originates from the potential success associated with SS in distance-and-online learning, has the main aim of identifying the SS benefits and barriers in undergraduate mathematics learning. Specifically, the paper examines the availability of technological support to distance-and-online mathematics undergraduate learners; assesses the media support provided and evaluates the benefits and barriers of institutional support for mathematics learning.

BACKGROUND

In general guidelines for best practices in distance-and-online education programmes in Nigeria, the National Universities Commission (NUC 2009) encouraged provision of SS to the students. The use of diverse media is suggested to cater for the students' learning needs. However, little research has been conducted to provide insight and guidance regarding well-defined benefits and barriers of SS in various distance-and-

online academic programmes in Nigerian ODL institutions. For instance, local studies have pointed out SS as a major hindrance to distance-and-online learning programmes, many are not linked to learning specific subjects (Onwe, 2013; Olibie, Offor, and Onyebuchi 2016). There is a clear gap in terms of how distance-and-online mathematics learners benefit from the available learning resources across various ODL institutions.

Distance-and-online students across the globe require various forms of support to alleviate the barriers associated with the provision of learning through this mode. Literature also indicates the need to design the SS to accommodate all users such as students and staff (Floyd and Casey-Powell, 2004). Specifically, some research in Nigeria has demonstrated that despite the benefits of SS in distance-and-online education, students still experience barriers with SS due to challenges witnessed in availability and use of modern technologies like computers and communication software (Nakpodia 2010). The evidence presented in studies seems to point to a disturbing conclusion that the benefits of SS in distance-and-online learning do not seem to contribute much to improved learning in specific subjects like mathematics through this mode. Researchers such as Simpson (2015) argue that there is a need for more studies on SS to determine the best ways of improving distance-and-online students' success. This paper aims to contribute to this debate by looking at the benefits and barriers in SS for undergraduate mathematics learning using the Distance Learning Institute (DLI), university of Lagos (a dual mode) and National Open University of Nigeria (NOUN), (a single mode) institution. Specifically, the paper presents findings on the following research questions: (1) What are the technological support benefits and barriers to mathematics learners? (2) What media support impacts on students' mathematics learning? (3) How does institutional support affect distance-and-online mathematics learners?

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

Based on the aim of this paper, we are faced with the problem of giving a solution to the question: what are the SS benefits and barriers in undergraduate mathematics learning in Nigeria? Distance-and-online mathematics students expect to receive support services that will enable them to succeed in their programme by making available the SS that are more user-friendly and learner-centred. Simpson (2015) maintains that the distance-and-online learning students' isolation from institutions, tutors and other students lead to low graduation rates witnessed among the learners in this mode. ODL institutions recognise that SS is needed as a back-up to keep the dropout rate of the learners at a minimum.

Abrami *et al.* (2011) propose three principles of media support necessary in distance-and-online learning, viz. (1) "Reduce extraneous processing and the waste of cognitive capacity; (2) Manage essential processing and reducing complexity, and (3) Foster generative processing and encourage the use of cognitive capacity" (Abrami *et*

al. 2011, 98). Other researchers have outlined media for support to include technological communication, such as email, face-to-face, telephone, Short Message System (SMS), social media (Simpson, 2015; Tait, 2015). Brindley, Walti and Zawacki-Richter (2004) identify different support services distance-and-online students can benefit from to include learning and study skills assistance, orientation, career and personal counselling, admission and registration, library and information systems and peer tutoring. Despite the critical importance of SS in successful administration of distance-and-online programmes in ODL institutions, few researchers have examined its benefits and barriers in the learning of undergraduate mathematics.

Tait (2014) studied how reconfiguring student support for distance and e-learning in the digital age in Open University, United Kingdom has impacted on more powerful and affordable learning designs. The study argues that "educational mission, not mode of delivery, is the more powerful explanatory driver" (Tait 2014, 5). The study proposes integration of student SS with teaching and assessment, to reduce the drop-out rate of students learning through this mode. Adegbile and Oyekanmi (2014), on the other hand, research support facilities available to degree programme distance learning students in the southwestern Nigerian universities. Their investigation indicates that facilities for effective student support were not provided. What was not explored are the experiences of third-year mathematics students with SS and technological benefits/barriers to mathematics learning. The knowledge of how SS impact on the learning of mathematics through the distance-and-online mode was examined in this paper.

The framework in this paper attends to Mayer's Cognitive Theory of Multimedia Learning (CTML) which is prevalent in distance-and-online education. CTML occurs when the learner uses visual and verbal systems to select, organise and process information. This process promotes student learning. Moreno and Mayer (1999) emphasise that visual information and verbal information are each processed differently by the brain to aid learning. Consequently, teaching using multimedia tools where learning materials are presented in multiple forms, allows the learner the potential to gain a better understanding compared to using only single media tools. This enhances constructivist learning that enables the learner to solve different mathematical problems on their own. Generally, Mayer argues that "students are better able to make sense of a scientific or mathematical explanation when they are able to hold relevant visual and verbal representations in working memory at the same time" (1999, 621). The underlying principle of this theory is that students learn more profoundly when words and pictures are used to teach compared to when words or pictures are used alone (Mayer 2005; Vilardi and Rice 2014). This view renders the theory more beneficial when examining SS in undergraduate mathematics. However, very few studies have used this theory as a framework in distance-and-online education to explore the benefits and barriers in undergraduate mathematics learning.

METHODOLOGY

The paper explored the SS benefits and barriers in distance-and-online learning of mathematics in two ODL institutions in Nigeria. In-depth findings from explanatory sequential design was explored. This involved interpreting, explaining SS and mathematics learning of the students in these universities as related to CTML. In explanatory sequential design, qualitative data are used to improve, complement and in some instances, follow up on unexpected quantitative results (Harwell 2011). This design allows quantitative (numeric) data to be collected, followed by gathering qualitative data with the purpose of using the findings of the qualitative data to interpret and explain the findings of the quantitative data (Creswell 2014).

A purposive sampling approach was used to collect data from sixty (n=60) third-year DLI (n=30) and NOUN (n=30) distance-and-online mathematics learners. The reason for adopting this sampling method is to be able to select the specific group necessary for the study. The instruments were applied because of the institution's experience in offering ODL programmes, diverse students' background and experience in the programmes. The closed and open-ended questionnaire was based on a 5-point Likert scale of strongly agree, agree, neutral, disagree and strongly disagree. The instruments (questionnaire and interview) developed by the researcher to suit a Nigerian ODL setting was in line with Ramsden's (1991) course experience questionnaire (CEQ). A twenty-seven (27) item questionnaire was administered to DLI mathematics students as their fortnightly centre meetings, while NOUN learners were invited to complete the questionnaire using SMSs, since they do not have a specific centre meeting date. Directors of NOUN study centres assisted by arranging transport for the participants. This helped to obtain the students' views on SS benefits and barriers in their mathematics learning. Thereafter, ten students were conveniently selected and interviewed from among those who completed the questionnaire at the two universities. The interview was recorded with the permission of the participants for the purpose of retaining their words necessary for in-depth analysis. The students' participation in this study was voluntary and they were assured that their participation would not impact their studies in any way. A pilot study was conducted in a small sample similar to but different from the study sample to ensure the validity of the instruments (closed and open-ended questionnaire and interviews). The results showed that the students understood the subject matter of the study. Also, the triangulation of quantitative and qualitative data helped to improve the validity and reliability of the results.

Mixed methods research was sequentially used for the data analysis. The quantitative analysis was conducted independently of qualitative analysis and the results were compared and consolidated during discussion of the findings to provide information about the benefits and barriers to SS in undergraduate mathematics learning in ODL institutions (Onwuegbuzie and Leech 2004). The data used for this study are ordinal categorical, hence a non-parametric one-sample binomial test was employed in data analysis. The interest in using a binomial test was to determine the number of

students who agree and disagree with each of the questionnaire items. This necessitated grouping the 5-point Likert scale into agree (consisting of strongly agree and agree) (A), disagree (consisting of strongly disagree and disagree) (D) and neutral as included in the table, but as not reported since the emphasis is not on the students with indifferent opinions. The one-sample binomial test was calculated for each item and $p<0.05$ was deemed significant. Narratives and content analyses on the other hand were used to analyse the qualitative data. The data were transcribed word-for-word, coded according to categories, subcategories and themes (Creswell, 2009). The students' words were used to bring out the understanding of the benefits and barriers to SS in distance-and-online mathematics learning.

FINDINGS

The results discussed in this paper are based on the two sets of data collected using a closed and open-ended questionnaire and the interviews. The students' responses to the first question was represented in table 1. Highlights were used on tables 1 to 3 to show when the p-value is less than 0.05 ($p<0.05$), indicating a significant response from the students. Use of the p-value in this study was to determine whether the percentage of the responses of DLI and NOUN students are related.

Table 1: One-sample binomial test for technological support for distance-and-online mathematics learners

	Questionnaire item	DLI			NOUN			p-value	
N	**Technological support for mathematics students**	**A (%)**	**D (%)**	**N (%)**	**A (%)**	**D (%)**	**N (%)**	**DLI**	**NOUN**
1	Learning mathematics with computers is beneficial to students at my institution	12 (40.0)	15 (50.0)	3 (10)	14 (46.6)	2 (6.7)	14 (46.7)	.700	1.000
2	Internet is provided to meet mathematical needs of students at my university	11 (36.7)	12 (40.0)	7 (23.3)	18 (60.0)	2 (6.7)	10 (33.3)	1.000	.186
3	Audio and video conferencing support students' mathematical learning at my institution	6 (20.0)	18 (60.0)	6 (20.0)	6 (20.0)	16 (53.3)	8 (26.7)	.023	.052
4	The institution Intranet is aimed at supporting students' mathematics learning	5 (16.7)	15 (50.0)	10 (33.3)	7 (23.3)	16 (53.4)	7 (23.3)	.014	.093
5	Print materials meet my mathematical needs	22 (73.3)	6 (20.0)	2 (6.7)	21 (70.0)	6 (20.0)	3 (10.0)	.005	.007
6	Study materials on CD/DVD are very helpful in mathematics learning in my school	8 (26.6)	17 (56.7)	5 (16.7)	2 (6.6)	17 (56.7)	11 (36.7)	.108	.001
7	Technological support through radio lessons is beneficial to mathematics students at my institution	3 (10.0)	20 (66.7)	7 (23.3)	3 (10.0)	19 (63.3)	8 (26.7)	.000	.000
8	Mathematical students at my institution benefit from technological support through television lessons	3 (10.0)	21 (70.0)	6 (20.0)	-	19 (63.3)	11 (36.7)	.000	.003

**Binomial test: Study data*

The participant from the two institutions agreed that print materials (DLI=73.3%, NOUN=70%, $p<0.05$) have strong significant benefits for their mathematics learning. These indicate that students drive benefits in using print materials in mathematics learning (Pitsoe and Baloyi 2015). While participants from the two ODL institutions disagreed outright (DLI=60%; NOUN=53.3%; $p<0.05$) with the audio and video conferencing support and radio and television lessons; DLI students seem to have significant biases with benefits of learning mathematics with computer and intranet. Significant biases were also seen regarding CDs/DVDs in both DLI and NOUN. These items show mixed responses despite $p<0.05$. This is consistent with the study of Olibie, Offor and Onyebuchi (2016), who found that these technologies pose a hindrance to distance-and-online learning. The responses suggest that these technologies are not utilised in learning mathematics in the two ODL institutions that participated in this study. There seems to be no statistically significant effects on the benefits of the internet ($p>0.05$) in meeting the mathematical needs of these students. The proportion shows diverse perception with regard to its benefits in learning mathematics through the distance-and-online mode.

The second question examined the media support impacting on students' mathematics learning. The participants' responses from the two ODL institutions are represented in table 2.

Table 2: The media support that impact on students' mathematics learning

	Questionnaire item	DLI			NOUN			p-value	
N	**Media support for mathematics learners**	**A (%)**	**D (%)**	**N (%)**	**A (%)**	**D (%)**	**N (%)**	**DLI**	**NOUN**
9	Mathematics students benefit from email support at my university	10 (33.3)	14 (46.7)	6 (20.0)	17 (56.7)	12 (40.0)	1 (3.3)	.541	.458
10	Telephone is a means of communicating with mathematics students at my university	11 (36.7)	16 (53.3)	3 (10.0)	11 (36.7)	14 (46.7)	5 16.6)	.441	.690
11	Chats with tutors help to improve my mathematics learning	9 (30.0)	17 (56.7)	4 (13.3)	12 (40.0)	11 (36.7)	7 (23.3)	.170	1.000
12	On-site tutorial support helps my mathematical learning	9 (30.0)	16 (53.3)	5 (16.7)	17 (56.7)	6 (20.0)	7 (23.3)	.230	.035
13	Mobile text messages are used to support mathematics students at my institution	11 (36.7)	13 (43.3)	6 (20.0)	14 (46.7)	9 (30.0)	7 (23.3)	.839	.405
14	Learning Management System e.g. Blackboard or Moodle is provided to learn mathematics	21 (70.0)	2 (6.7)	7 (23.3)	19 (63.3)	8 (26.7)	3 (10.0)	.000	.054
15	Facebook or other social media platforms are beneficial to mathematics learning at my university	11 (36.7)	11 (36.7)	8 (26.6)	12 (40.0)	12 (40.0)	6 (20.0)	1.000	1.000

**Binomial test; Source: Study data*

Regarding table 3, (70% DLI students and 63.3% NOUN students) there was agreement that LMS has significant benefits as concerns their learning of mathematics through distance-and-online mode, with $p<0.05$. It is the medium through which learning materials are passed on to the students. This indicates that the students can track the learning materials, interact with the materials, collaborate and be assessed (Sneha and Nagaraja 2013). A further significant response was seen among NOUN students in an on-site tutorial, 17(56.7%) acknowledged benefiting from on-site tutorial support. Mixed responses could be seen among DLI participants about telephone and on-site tutorials as a binomial test (p-values well above 0.05) shows no significant benefits in the responses. Such an insignificant benefit is witnessed among NOUN students in email support (p.0.05). The results show balanced opinions between those who agreed and those who disagreed; indicating an advocacy for media support strategies aimed at students' mathematics learning benefits. The results obtained from mobile text messages and social media in the two universities were more evenly spread with $p>0.05$. This indicates the need for improvement in the use of social media platforms to enhance mathematics learning.

The third question in this paper on institutional support benefits and barriers of distance-and-online mathematics learning is addressed in table 3.

Table 3: The effect of institutional support on distance-and-online mathematics learning

	Questionnaire item	DLI			NOUN			p-value	
N	**Institutional support for mathematics students**	**A (%)**	**D (%)**	**N (%)**	**A (%)**	**D (%)**	**N (%)**	**DLI**	**NOUN**
16	SS are provided for mathematics students throughout the week (24 hours/7 days)	9 (30.0)	12 (40.0)	9 (30.0)	12 (40.0)	12 (40.0)	6 (20.0)	.664	1.000
17	Provision of SS only during working hours in the week	7 (23.4)	13 (43.3)	10 (33.3)	9 (30)	10 (33.3)	11 (36.7)	.263	1.000
18	Mathematics students at my institution benefit from online admission	19 (63.3)	3 (10.0)	8 (26.7)	22 (73.3)	3 (10.0)	5 (16.7)	.001	.000
19	Mathematics students at my institution benefit from online registration	21 (70.0)	3 (10.0)	6 (20.0)	27 (90.0)	2 (6.7)	1 (3.3)	.000	.000
20	Mathematics students at my institution check their results online	18 (60.0)	6 (20.0)	6 (20.0)	25 (83.3)	4 (13.4)	1 (3.3)	.023	.000
21	My institution provides course materials and resources to learn mathematics	21 (70.0)	2 (6.7)	7 (23.3)	26 (86.7)	1 (3.3)	3 (10.0)	.000	.000
22	One-stop services on technology-related challenges, e.g. login problems or software compatibility, etc. are provided	17 (56.7)	6 (20.0)	7 (23.3)	20 (66.7)	4 (13.3)	6 (20.0)	.035	.002
23	Help in solving major problems encountered by distance-and-online mathematics learners	13 (43.3)	8 (26.7)	9 (30.0)	14 (46.7)	7 (23.3)	9 (30.0)	.383	.189
24	Provision of sufficient library resources for mathematics	16 (53.3)	6 (20.0)	8 (26.7)	12 (40.0)	9 (30.0)	9 (30.0)	.052	.664
25	Accessibility of library resources for use by mathematics distance-and-online learners	14 (46.6)	8 (26.7)	8 (26.7)	15 (50.0)	7 (23.3)	8 (26.7)	.286	.134
26	Ability to access the library resources online from anywhere in the world	5 (16.7)	15 (50.0)	10 (33.3)	17 (56.7)	8 (26.7)	5 (16.6)	.041	.108
27	Provides access to career counselling for distance mathematics students	12 (40.0)	8 (26.7)	10 (33.3)	14 (46.7)	6 (20.0)	10 (33.3)	.503	.115

**Binomial test: Study data*

The results show that online admission, registration, results checking, resources and one-stop services are most significant with $p<0.05$ in the two ODL institutions. This indicates that the distance-and-online mathematics students who participated in this study benefit from some SS at their institutions. While DLI participants agreed with provision of sufficient library resources (53.3%, $p<0.05$) and disagreed outright with accessing these materials online (50%), NOUN participants were indifferent in the two items with ($p>0.05$). There seems to be no significant benefits in 24-hours/7-days provision of support services, help in solving major mathematics problems, accessing an online library anywhere in the world and career counselling for mathematics students at the two universities (their p-values are greater than 0.05), indicating the need for the institutions to pay more attention in providing support to learners in order to ease difficulty in learning mathematics via this mode. Studies have shown that in order to retain engagement and provide mathematics students with a pathway to successful distance-and-online learning, their expectations have to be addressed through effective institutional support (Brindley, Walti and Zawacki-Richter 2004).

QUALITATIVE DATA ANALYSIS

The qualitative data analysis relating to questions raised in this paper was used to confirm the findings from the quantitative data analysis presented in tables 1 to 3. The detailed information from qualitative data analysis provides more profound understanding of the students' support benefits and barriers in undergraduate mathematics learning. The themes, sub-themes and categories that arise are summed up in figure 1 below.

The theme (SS benefits and barriers) as indicated in figure 1 was very important in distance-and-online undergraduate learning. The theme is divided into the following sub-themes: technological support, media support and institutional support. The categories are as represented in figure 1.

The reported responses among DLI and NOUN mathematical students revealed similar scenarios with technological support. They expressed concern regarding learning mathematics through this mode and had mixed reactions on the benefits of this support to their learning. For instance, a participant from DLI argued that:

> No. I have no idea if there is [sic] any support services provided by my school. I do not know any support services apart from lectures. Our learning materials are not in CDs/DVDs, no video conferencing, radio lessons and televising of our lectures. So if such support will really be made available for students, I will really appreciate that. In fact I don't even have personal computer to study, I source [from the] Internet by myself whether in school or at home. It is a great barrier to me.

Another participant from NOUN mentioned that:

> I haven't seen anything of such [sic]! That is burning mathematics course materials on CD for students? No way. They may have video conferencing, a radio programme, and others for other

courses they run here but not in mathematics education as it were. The i-learn they said they have, well it is a good idea but it is not well planned to bring in mathematics students. They designed the platform and that is all. Lecturers are not available online. Since I have been here, I have not received any technological help like that. Students and students alone provide the technology they study with, like computer[s], internet and the like. In fact, SS for mathematics education students are frustrating and require improvement.

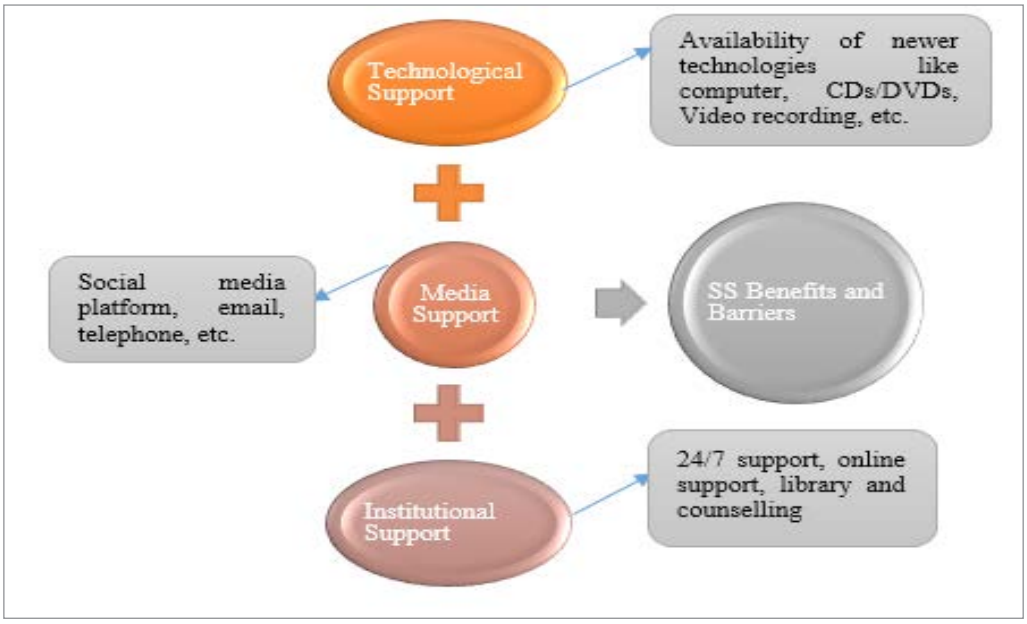

Figure 1: Summary of theme, sub-themes and categories from DLI and NOUN

The students are demotivated with the barriers created with lack of appropriate technological support to learn mathematics and it seems very challenging for them to provide these things on their own without help from the institution. They stressed that with CDs/DVDs or through access to audio and visual recordings, it will be easier for them to learn mathematics more effectively at their convenience.

The students further indicated they are not exposed to much media support at their universities. Many stated that SMSs are the only main media support they receive which in most cases are not interactive. Here is a sample of what a participant from DLI said concerning the sub-theme (media support) in figure 1:

As for that media support thing, hmm, it is not there. I thought it will be a kind of learning where I can meet my instructors and other students online and chat with them if I have a challenge, but now, it is not so. I only get SMS[s] which in most times not clear enough but thank God for our governor (class representative) who is on [the] ground to pass [around] available information. He is doing nice work to update us in what we need to know in this mathematics programme.

Learners in NOUN expressed similar concerns, one of them commented:

> We do not have social media platform purposely for learning mathematics. You call this distance-and-online learning right? My own understanding is that different forms of social media should be employed for learning. The school did not involve people knowledgeable in hi-tech in designing platform where math students can chat with their tutors and peers. This make[s] learning math in this mode so boring and challenging.

The responses suggest that the students are familiar with SMS support and lack other social media platforms like Facebook, telephone and email in learning mathematics. The statements on these matters echoed sentiments on the barriers of learning mathematics through distance-and-online modes in these universities. This supports Handal, Campbell, Cavanagh, Petocz and Kelly, who point out that "social networking and mobile technologies appear to be way behind their implementation in the mathematics classroom" (2013, 36).

The participants indicated that print materials, online processing of admission, registration, results checking, availability of course materials online and learning platforms (LMS) form the major institutional support they receive.

One of the DLI students mentions:

> I do not know any support from my school apart from lectures, doing my registration online, check my result[s] and may be [sic] get some modules online. As for e-library and councillor for mathematics students and others you spoke about, I don't know.

The opinions expressed by a NOUN student was captured thus:

> Yes, some support is provided, though not 24/7. They do online admission, register us online and yes, we can also check our result[s] online. Counselling is available for all students but there is no separate one for math students. Otherwise, students provide all the technology they need to study in this mode, like computer[s], Internet and the like.

This result suggests that the students receive some measure of support, even though it is not sufficient or satisfactory. This is to a certain extent consistent with the findings of Brindley *et al.* (2004), stating that essential services assisting and monitoring the process of learning of students were a priority in distance-and-online learning.

DISCUSSION

The findings are consistent between the quantitative and qualitative analysis among the DLI and NOUN mathematics students. It is indicated that the students who participated in this study struggle to access support and strongly disagreed that the utilisation of these technologies in their institutions was prevalent. This was also captured in the students' narrative:

> We don't have CDs, DVDs and videos of our course materials. We don't have [the] latest technology to support online studies.

Consequently, claims by DLI and NOUN that they provide CDs/DVDs, video and radio services are only partially confirmed by distance-and-online students in these institutions, showing the availability of these services, although not to the benefit of mathematics students. This indicates the exclusion of mathematics in video and radio services in these institutions. Owing to the students' responses on the benefits of support services in mathematics learning, they were probed if the distance-and-online learning of mathematics should be stopped. Many of them declined to say it should be stopped but were of the opinion that it could be improved upon. One of them commented that:

> Yea, I think, they shouldn't stop the distance-and-online learning of mathematics but improve on what they have now. For the fact that the programme is online, that is what attracted most of us even though we have many challenges due to the structure that is not in place.

This finding strongly supports Doug's (2002) argument that despite the problems students encounter when learning through the distance-and-online mode, they are reasonably satisfied with what they are learning. Hence, they liked the convenience they derive from distance-and-online learning of mathematics.

> Furthermore, it is revealed in this paper that the benefits of computers, Internet, email, telephone, chat sites, on-site tutorials and mobile text messages as support services in DLI and NOUN are yet to be maximised. The claim in the African Internet Status report (2002) and UNESCO-UIS (2015) that puts the number of computers in Africa in the population as low as 1:500 appears to be obvious in this paper. Not every distance-and-online student seems to have access to a computer, as indicated in the narratives of a student, "I don't even have [a] personal computer". This makes the students reliant on shared computers at local community centres or Internet cafés *(*Kawalilak *et al.*, 2012) in less than ideal conditions. Again, the assertion of Towhidi (2010) that the Internet, audio and video tapes, intranet, telephone, radio, television, teleconferencing and electronic mails are among the forms of multimedia support provided for ODL students is not completely upheld in this paper. Therefore, students' desire for audio and visual versions of their mathematics lectures is supported by CTML of Mayer (2005), but was inconsistent with this paper.

The findings also revealed that DLI and NOUN mathematics students benefit from printed materials, online admission, registration, checking of results and counselling, but experience barriers in accessing library facilities. Hence, the support services that encourage constructivist–based learning that aims to reduce barriers but to benefit, inspire and satisfy mathematics students' needs, should be improved for the students attempting to study mathematics in these institutions.

CONCLUSION AND RECOMMENDATIONS

The key findings of this paper provide similar evidence in SS benefits and barriers in distance-and-online undergraduate mathematics learning in DLI and NOUN. Though these students receive some measure of technology, media and institutional support, they still experience the biggest barriers in learning mathematics using these newer

and /or advanced technologies. In the study presented here, many students provide their own internet access when they are on or off campus. Research clearly shows that lack of internet access hinders support services, interaction and communication in distance-and-online learning (Pitsoe and Baloyi, 2015). Furthermore, students seem to benefit from printed course materials in the two ODL institutions (table 1) and this is consistent with findings of Manjulika and Reddy (2007) indicating that print remains a predominant media for distance-and-online learning. Apart from a pressing need for collaborative chat environments for the students and tutors, provision of mathematics course materials on CDs/DVDs, video and radio services for the students' benefits seems to be lacking. The overarching findings of this study have revealed the need for restructuring and improvement of support services with the aim of accommodating mathematics students in this mode of learning.

Implementation of recommendations suggested in this paper can help to bridge the claimed gap of support service barriers in undergraduate mathematics learning in DLI and NOUN. The findings have revealed that technologies are available in other subjects, but not in mathematics. It is suggested that further study should be done to explain the reasons why this is so. These institutions should prioritise the adoption of technologies in mathematics learning owing to the importance of the subject in other science and engineering professional courses. Moreover, since support services are central to mathematics students, DLI and NOUN also need to make library resources available in all the study centres and provide guidance and counselling opportunities specifically for mathematics students. This will help promote maximum benefits for studying mathematics through this mode and enhance good mathematics memory in students. Government needs to invest more funds in ODL institutions to provide technologies; media support necessary for mathematics learning, and to engage the tutors in constant training, to ensure they are exposed to new learning technologies and its design in teaching and learning mathematics. Moreover, the National University Commission (NUC) as regulatory agency in Nigeria should be concerned about support services for mathematics at the undergraduate level to strengthen the benefits of the subjects and its application in other courses that require mathematical knowledge.

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