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# Learners' Perceptions of the Challenges and Improvement Strategies in Distance and Online Undergraduate Mathematics Learning

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# Learners' Perceptions of the Challenges and Improvement Strategies in Distance and Online Undergraduate Mathematics Learning

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## Abstract

In order to address the diverse needs of the present-day distance and online Mathematics learners, it is necessary to obtain the opinions of the learners on the improvement strategies of their Mathematics programmes. In distance and online learning (DOL) education in Nigeria, different strategies to improve mathematics learning have been initiated. The aim of this paper is to provide students' standpoint on the challenges and improvement strategies of learning mathematics through the distance and online method of education. The study explores how internet connectivity issues, institutional strategies and facilitation skill development impacted upon mathematics students' engagement in distance and online mode of learning. In this study, distance and online mathematics learners from two Open and Distance Learning (ODL) universities who were in the third year of their study were interviewed. A thematic analysis and a word-for-word narrative inquiry approach that encourages students to tell their story were adopted in the analysis. The findings indicated among others a need for provision of efficient, viable and affordable internet connectivity in their schools. Moreover, inclusion of several online mathematics activities for students learning in this mode and provision of relevant mathematical resources for effective learning were evident. It was recommended that the school in collaboration with the government should provide costless personal computers equipped with mathematical capabilities for effective mathematics learning. The students' opinions presented in this paper can be used as informed improvement strategies designed to enhance distance and online mathematics learning in ODL universities in Nigeria.

## Introduction

Recently, universities and colleges have engaged in exploring the potentials of distance and online technology education in a bid to enhance teaching and learning (Strategic Review of Online Education, 2015). The immediate outcome of technological abilities has brought about learning mathematics through the distance and online mode, thereby increasing the student needs for high-tech prospects. One of the reasons why distance and online mathematics education has remained popular in the recent times is that several studies have proved its practices and revealed there is no significant differences in the learning outcome between traditional face-to-face and online distance learners (Ashby, Sadera, & McNary, 2011; Jones, & Long, 2013; Kalelioglu, 2017). Consequently,

learning mathematics through any mode has no significant differences on its effectiveness (Burns, Duncan, Sweeney, North & Ellegood, 2013). A logical question that arises from this study is how learners perceive the improvement strategies of learning mathematics through distance and online education in Nigeria.

Distance Learning Institute (DLI), University of Lagos as a dual mode institute and National Open University of Nigeria (NOUN) (a single mode) are among the higher learning institutions approved to practice distance and online education in Nigeria. Mathematics has been one of the programmes of these institutions, though little has been known about how the learners perceive learning mathematics through this mode. One of the improvement strategies incorporated in the guideline for best practices of Open and Distance Learning in Nigeria, the National University Commission (NUC) (2009: 5) stated that: the 'students should have access to ICT to assist their learning. For specific programmes (Mathematics inclusive), functional internet access would be required for all study centres for learners' use. In order to implement this guideline, it means that the processes and procedures of administering the programme have to be followed and there is a need for the learners' input concerning the progress of the programme. It was on this basis that the authors felt it is essential to explore the perception of mathematics learners as stakeholders in distance and online learning (DOL) education. This will help to provide accurate view of the mathematics students learning in this mode while adding to the existing literature on its perception.

In distance and online education, learners are expected to be engaged and participate in the learning processes. Study has shown that online distance learners as autonomous students are influenced by positive perception they have toward technologies (Drennan, Kennedy, & Pisarski 2006; Jaradat & Ajlouni 2021). Also, as the opportunities call for these learners to relate with their facilitators and tutors, opinions are gathered on the issues in connection with the challenges and the improvement strategies. Such remarks are concerned with access to viable internet connectivity, interactive online facilitation, and computer resources with mathematical capabilities. The view of the authors is that little research has been carried out based on the combined study involving DLI and NOUN to establish the learners' position on these issues. The purpose of this study is to uncover the perception of the mathematics learners on the issues that concern their mathematics education advancement. This paper tends to answer the following questions: How do the learners appraise learning mathematics through this mode? What are the major challenges the learners experience while learning mathematics through the distance and online mode? What are their perceived improvement strategies that can be employed to ameliorate the challenges they have learning through this mode?

## Literature Review

The review of literature is based on three concepts pertinent to this paper – the learners' perceptions of DOL, learners perceived challenges of DOL, learners perceived improvement of DOL.

### The Learners Perceptions of DOL

Understanding learners' views in DOL is very vital in learning mathematics through this mode. Despite the

notable roles, demand and general acceptance of DOL in most of the higher institutions of learning, many still hold diverse opinions about this mode of learning. The views have affected the administration of DOL in these institutions in many ways. Experience has shown that not all online education is effective due to hindrances associated with learning through this mode. However, institutions are to make deliberate efforts in controlling the hindrances for the benefit of the learners (Aziz, Musa, Aziz, Malik, & Khalid, 2020). By perception, we mean the view and experience the learners have in learning mathematics through DOL. The opinions of learners matter so much in online mathematics learning because, learning through this mode cannot be effective without the learners' acceptance. Studies have shown that learners liked the convenience experienced in online learning, especially when there is no alternative, though the learners show preference for face-to-face if available and affordable (Lowe, Mestel & Williams 2016). In the study on 'online learning experiences of the learners', the researcher indicated that the mental preparedness and willingness to embark on self-development in learners was because of the positive attitude and interest they have with respect to DOL (Kalelioglu, 2017).

Some other researchers have shown that learners' attitudes towards online learning is very encouraging and their passion for this mode of learning has formed the motivation for completing their programmes successfully (Kalman, Macias, & Weston 2020; Zhu, Zhang, Au, & Yates, 2020). Jaradat and Ajlouni (2021) studied undergraduates' perspectives and challenges of online learning during the covid-19 pandemic: a case from the university of Jordan. The study which made use of quantitative method found that despite the challenges the learners had in DOL, they saw learning through the mode very useful and they liked it. Kalman et al. (2020) went further to identify some characteristics that guarantee learners' success to include self-awareness, organisational skills, and adaptability. These distinguished features help to reposition the learners' view of learning through this mode.

**Learners Perceived Challenges of DOL**

Most institutions of higher learning in recent time have actively been into utilizing the potentials DOL technology have in improving the modern-day learning practices. This has brought sharp advancement in education across the globe. In Nigeria, the development in technology has brought about the adoption of online tools necessary in DOL delivery across the tertiary institutions as seen in National Open University of Nigeria (NOUN), Distance Learning Institute (DLI) of University of Lagos among others (Adu, Eze, Salako, & Nyangechi, 2013). Challenges to effective DOL in most of institutions as perceived by the learners include internet connectivity, mental health of the learners, learning platform services, quality of learning materials, technophobia among the tutors and learners, assessment and feedback (Jaladat & Ajlouni, 2021). Aziz et al. (2020) maintain that attitudes and technology skills are the major challenges DOL faces. Their study argue that most learners have negative belief regarding online learning, there is minimal tutor-learner interactions, lack of confidence and fear of self-study especially when complicated calculations (as in the case of mathematics) are involved. They suggest that these problems should not be ignored by the institution administering DOL in order to avoid the lasting negative impact it will create on the learners.

The study of Umoh and Akpan (2014) suggests that there are lack of virtual learning environment and ICT centres

with internet facilities to assist the online mathematics learners. Some researchers have identified irregular power supply, internet facilities, access to computer and technological proficiency as some of challenges perceived by the learners in DOL in Nigeria (Oyeleke & Adebisi, 2015). Furthermore, the learners noted how problematic it could be writing mathematical equations using computer technology. These challenges are similar with the experience of mathematics learners in Philippine (Bringula, Reguyal, Tan and Ulfa 2021). In addition, the learners lack personal learning spaces that guarantee freedom from all forms of distractions, and studying the mathematics content on their own is very challenging, hence, they prefer interacting with their tutors on face-to-face setting.

The researchers Shukla, Hassani and Casleton, (2014) in their study on 'a comparison of delivery methods for distance learning mathematics courses', concluded that methods of delivery (instruction) are not significant in online and face-to-face learning of mathematics, however, one of their findings indicated that online mathematics learners had lower pass rate than the face-to-face learners. They attributed this to lack of proper exposure of learners to modern technology required for online mathematics learning. Lowe, Mestel and Willams (2016) on the other hand, explored the 'perceptions of online tutorials for distance learning in mathematics and computing'. The study reveals that the learners enjoy the convenience of online learning especially when there is no alternative, though the learners show preference for face-to-face if available. The reason for preference is due to the learners' ability to relate with other participants in real time classroom interaction, the quality they considered lacking in online learning.

**Learners Perceived Improvement of DOL**

The expectation of the learners in DOL from experience are usually high and they believe that the basic need of learning through this mode should be met, but in some cases, their satisfaction is kept at either low or moderate level (Kalelioglu, 2017). Kalelioglu (2017) listed some conditions that guarantee the learners improvement level to include conducive virtual classroom, availability of relevant study materials that can be accessed from different devices, defined course duration, flexible assessment structure with prompt feedback and active learner-tutor interaction. Studies have shown that there will be improvement in online mathematics among the learners if the learning materials are interactive and well-structured to enable self-learning; the learners are mentally prepared for online learning, alongside internet accessibility, prompt and detailed feedback, and tutors with good knowledge of online learning (Kalelioglu, 2017; Hudal, Wahyuni, Fauziyah, 2021). Hudal et.al (2021) opined that learners with good online mathematics learning perception end up with sound and high-quality learning achievement.

## Methods

This research explored students' opinions on the challenges and improvement strategies of learning mathematics through the distance and online method of education at two ODL higher education universities in Nigeria. Qualitative research approach which is exploratory by nature was used in this study (Maguire & Delahunt 2017). This research design in general allows deep studying of fewer population with the aim of generating the individual learners' interaction, reflection, interpretation and perception within the context of the study (Creswell 2014).

## Participants

Two ODL institutions DLI and NOUN third year mathematics education learners participated in this study. This is because the institutions have in place DOL standards, practices and traditions helpful in this study. Purposive sampling approach was adopted because the researchers want to take control and make sure only DOL mathematics education learners are involved in the study. This is different from the study of (Irfan, Kusumaningrum, Yulia & Widodo 2020) whose participants were mathematics teachers from various institutions. The learners from the two institutions that took part in the study have opportunity to attend voluntary weekly and, in some cases, bi-weekly meetings organised by their department. It was observed that about 40 or less learners visit the centres on the scheduled meeting day from both institutions. This forms the basis for sampling a total of sixty (60) (DLI n = 30; NOUN n = 30) learners to participate in the study while only ten (10) consented and participated in the scheduled interviews. The scale of participant's sample enabled a systematic and meticulous study of the learners' opinions on the subject under consideration. Seventy percent (70%) of the participates were male supporting the assertion of UNESCO (2017) that only 35% of female enrol in Science, Technology, Engineering and Mathematics (STEM).

### Research Instrument

The instrument which aimed at collecting data from DOL mathematics education learners was self-designed by the researchers and validated by experts in curriculum. The qualitative data (from interviews) was divided into two major parts. The first part consisted of the learners' basic demographic information such as name of institution, sex, age, marital and job status, and email address. The second part which was based on the challenges and learners' perception of improvement strategies in DOL mathematics education comprised twelve (12) major questions. The semi-structured interview questions were used to allow flexible probing of the interviewees to ensure their challenges and perceived improvements on the subject were well captured while using relatively many fewer participants (Baker, & Edwards, 2012). The instrument was pilot-tested using 8 students from the research universities who were not directly involved in the study and the results indicated that the items in the instrument were credible and dependable.

### Data Collection and Analysis

Data was collected using semi-structured interview. This is because semi-structured interviews have the quality that allowed the researchers to organise the questions in a structured (closed) and unstructured (open-ended) formats to allow unanticipated responses from the learners. This creates flexibility of the interviewer and interviewees to interact with the aim of generating appropriate and suitable data to find an answer to the research questions in this study. In-depth face-to-face interview which took approximately 25 minutes for each participant was conducted in the learners' institutions. They were allowed to narrate and give their views on the challenges and improvement strategies of learning mathematics through the distance and online mode of education. The participants' consent was obtained to record the interviews. The recording was to capture the participants own words for the purpose of the study. The identities of the interviewees were not disclosed in the study to ensure

confidentiality.

Thematic analysis was used for the participants' narrations. It is a suitable approach for seeking to understand thoughts and experiences of participants in a study (Demirel, 2025; Kiger & Varpio, 2020). The six steps in thematic analysis that are pertinent to this study are - becoming familiar with the data, generating initial codes by organising the data in a meaningful and systematic way, getting the theme or pattern that captures important facts in the data, reviewing the theme by formulating sub-themes, refining the sub-themes and doing the write-up (Maguire & Delahunt, 2017). Pseudonyms (sucn as 'Learner A' referring to learners from mathematics education from DLI, university of Lagos and 'Learner B' from NOUN) were used where necessary to capture the learners' narrations.

## Results and Discussion

The study examined the opinions of distance and online mathematics learners on the challenges and improvement strategies meant to enhance effective mathematics learning in this mode. The results presented focused on the data collected from the semi-structured interviews that were conducted by the researchers.

Table 1: Emerging issues from the Semi-Structured Interviews

| **Study questions, themes, sub-themes and categories** | | | |
|---|---|---|---|
| **Study Questions** | **Themes** | **Sub-themes** | **Categories** |
| How do the learners appraise learning mathematics through this mode? | Learners' evaluation of mathematics through DOL | Motivation for learning mathematics through this mode | • Convenience and flexibility (work and learn) |
| | | Opinions of learners in learning mathematics through DOL | • Lack of sponsorship |
| | | | • Failure to meet up with the conventional university admission requirements |
| | | | • There are difficulties in learning mathematics in this mode |
| What are the major challenges the learners experience while learning mathematics through the DOL mode? | Mathematics Learners' challenges in DOL | Instructional delivery | • Limited and difficulty in accessing mathematics learning materials online<br>• Not easy to study mathematics learning materials on your own |
| | | Assessment methods | • Traditional Face2Face and online assessment<br>• Mode of examination<br>• Feedback |

| | | | |
|---|---|---|---|
| | | Supports services | • Absence of well-trained e-tutors<br>• Issues with the learning platform<br>• Limited resources to facilitate mathematics learning |
| | | Technology for learning | • Non availability of modern technology to learn mathematics in this mode such as internet connectivity, computer, multifunctional calculators, screen sharing, audio and video classes<br>• Lack of introduction of technology at the lower level of education<br>• Limited knowledge of the modern technologies and their usage |
| What are the learners' perceived improvement strategies that can be employed to ameliorate the challenges they have learning through this mode? | Learners' suggestions to enhance learning mathematics in DOL | Instructional delivery | • Making course material available<br>• Simplifying learning materials and making it learners friendly |
| | | Assessment methods | • Well-defined mode of assessment and examination<br>• Providing feedback promptly<br>• Improved Internet connectivity at the university |
| | | Supports services | • Provide trained mathematics tutors<br>• Make resources available for effective learning<br>• Provide study centres for all round supports |
| | | Technology for learning | • Funds to provide modern technologies like Internet, CDs/DVDs, computers<br>• Introduction of technology at the lower level of education<br>• Funding |

The views of the learners were captured to answer the questions raised in the study. The learners' choices and opinions on learning mathematics through this mode were captured and presented in Table 1. The challenges and improvement strategies as perceived by the learners after organising the data methodically, are categorised in sub-themes: instructional delivery, facilitation/support services, assessment procedures and technology for learning as in Table 1. The themes, sub-themes and categories that emerged from this study are also presented in Figure 1 for easy and better understanding of the analysis of the study.

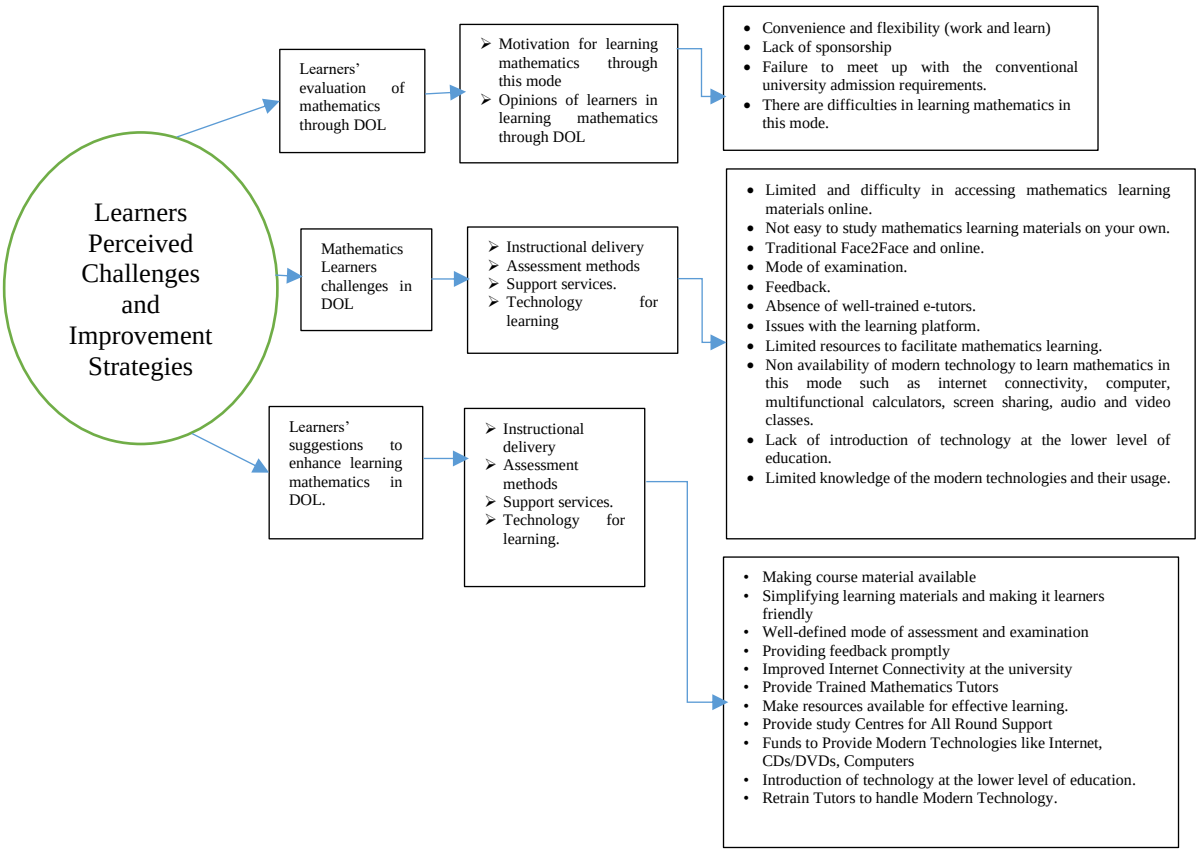


Figure 1. Key Themes, Sub-Themes and Refined Sub-Themes of Learners Perceived Challenges and Improvement Strategies of Online Mathematics Learning

The first theme which is learners' evaluation of mathematics through DOL is divided into the sub-theme - motivation for learning mathematics through this mode and opinions of learners in learning mathematics through DOL The views of the learners A and B in the theme and sub-themes are parallel. Seven (7) out of ten (10) learners interviewed indicated that they opted for this mode of learning due to its convenience, balancing studies with work. The popular feeling is captured as "*it is the most flexible and convenient way to combine my work with learning since some of us do not have sponsor, I have to work to sponsor myself and to achieve my educational goal*". This showed how much these learners' hunger and value their educational development. The assertion affirms Kalman et al. (2020) who claim that self-awareness and adaptability are central in learners' success in the distance and online education.

Many opted to this mode due to inability to meet the conventional admission requirements (meeting the set cut-off mark of each university and limited universities' capacity to admit all the applicants in each session). Another response was: "*If I have had a better means I would have gone for fulltime because this mode is more tasking and it consumes a lot of money than when learning mathematics full time*". The learners also admitted there is difficulty learning mathematics in this mode: "*there is no way mathematics learning can be restricted online only and you expect everything to be fine*". It is generally accepted by the learners that mathematics should not be limited to online because of the peculiar nature of the subject, thus affirming the view of Han (2020) that "Teaching should not be based on what knowledge the tutors can impart, but instead on what learners need".

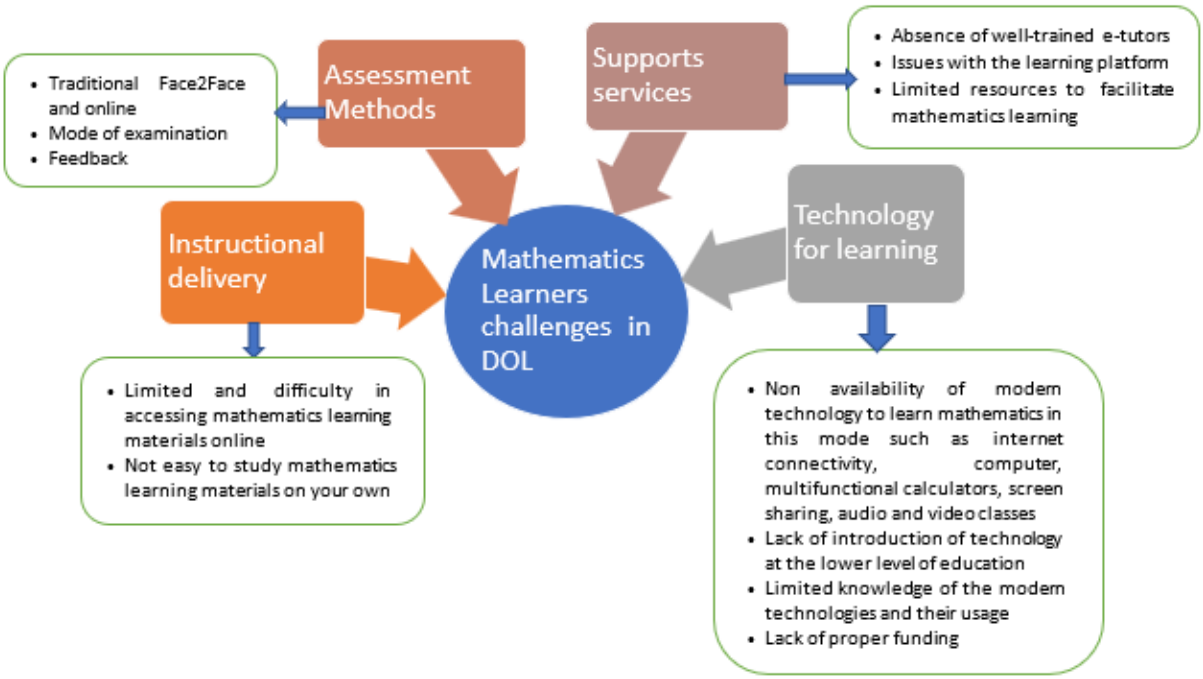


Figure 2. Learners Narrated Challenges of DOL

The theme (mathematics learners challenges in DOL) described the learners' narratives on the present challenges they have in online mathematics education in DLI and NOUN. The sub-themes derived from this theme were: instructional delivery, assessment methods, support services and Technology for learning. The categories of each sub-theme are determined from the learners' interview responses. For instructional delivery, two categories emerged, namely: limited and difficulty in accessing mathematics learning materials online and the challenge of self-studying of mathematics learning materials.

The learners (A and B) indicated that they have limited course materials and they have difficulty accessing the limited available mathematics education learning materials. The experience they shared in this regard seemed to have affected their mathematics learning in this mode. Learner A stated that:

> *"There are no enough course materials available for our study, even though some are available but good number of them are not available. We try consulting with our colleagues in other universities to assist us".*

The point raised by learner B is captured in the statement:

> "*Access to mathematics education course materials is very difficult. You queue endlessly to get these course materials even after you have fully paid for them. Imagine the queue right there (pointing to the direction the learners were queuing for the materials), you waste all time doing that*".

With the learners' responses on the ease of studying the mathematics course materials on their own, both learners A and B disapproved the assertion. Buttressing their point, "*If they say our course materials are our lecturers, then they should be developed in a very simple way, put every detail down that will help us to self-learn*". This agrees with Jaladat and Ajlouni, (2021) which indicated that quality and quantity of learning materials (more

severe for mathematics) are one of the challenges DOL learners face. The challenges the learners experience here make them feel the online mathematics learning is not optimal, contrary to the finding of Kabashi, Shkurti, Sofiu, Leka, and Selimaj (2022) which indicated that "online education is an effective way of education in the field of mathematics"

The learners were displeased with assessment practices in their schools. In their own words:

> *They want to restrict assignments and assessment online alone. That cannot be easy for mathematics education learners and it can't really help at all. We will not be able to express our mathematical skills well. Is it even easy to type those mathematical symbols? What about Internet issues?*

The learners that participated in Bringula et al. (2021) study also stated how problematic it could be writing mathematical equations and symbol using computer technology. The expectations of the learners in receiving instant feedback on their assessments are far from reality. Learners A and B expressed similar opinions: "*I think they have a lot to do in the area of giving feedback on assessment to the students. I will suggest that if they will not give us feedback, it's better the assessments should be done Face2Face*". The learners seem to be disappointed with lack of feedback when online assessment is conducted and submitted. The respondents in Jaladat and Ajlouni, (2021) study similarly reported that the instructors' feedback in their online mathematics assessments are inadequate.

Leaner A admitted that most assessment is done online and wondered why the examination cannot be done online as well: "*Why can't we do our examination online and at our convenience? It is not so easy to secure permission from work to write those exams*".

The categories that result from support services include absence of well-trained e-tutors, issues with the learning platform and limited resources to facilitate mathematics learning. The issues here are prominent and they pose challenges to mathematics learners.

Learner A:

> *The mathematics tutors are not in constant training in the use of recent technology that will enhance proper delivery of the subject, most of the tutors cannot design social media platform for mathematics learning. The people that understand teaching with modern technology are lacking in the system and that affect our learning in this mode*.

Learner B:

> *This is called distance and online learning please. We lack well-trained and mathematics teachers certified in technology who can design mathematics websites or even social media platform for our online mathematics learning*.

The learners were dissatisfied with the state of their tutors' technological knowledge of the use of modern technology and development in mathematics teaching. This supports Aziz et al. (2020) who stated that technology

skills are the major challenges DOL faces.

The learners admit there is learning platform in each of the universities where learning takes place. The statement that captured their feelings on this is:

> *They claimed supports are given through LMS (learning management systems) but the LMS is not working well and so, it is not easily accessible to students. The system should enlighten the lecturers on how to use the online platform to facilitate the students learning regularly, even we ourselves because most of us don't know how to use it also. I see a lot of people asking questions on how to use the LMS. Eh! the LMS has not just been functioning well may be because they have not put down the right structure. The modules are made available to us on the LMS but not all the courses that have their materials on LMS; it is only some of them that are there. Apart from uploading the course materials and leaving occasional information on the LMS, many of the mathematical activities are not available on the platform. That's the reason the desired interaction between the learners and the tutors are not effective.*

The learners concern in their comments show that serious improvement is needed in the support system of these universities for efficient and valuable mathematics learning to take place through this mode. This finding is consistent with the result of Aziz et al. (2020). The learners are demotivated by limited resources available for their learning.

> *"I source Internet by myself whether in school or at home. There is no reliable Internet especially in this part of the world and getting access to it on your own is very expensive in Nigeria. It is frustrating. Learners and learners alone provide all the technology they study with".*

Learner B:

> *You mean meeting tutors online? That one is absolutely zero. To start with, we don't even have tutors in mathematics not to talk of meeting them online. They are not available. There is no tutor–learners' collaboration online among mathematics education learners. No one supports us, lecturers are not available. They may have video conferencing, radio programme, and others for other courses they run here but not in mathematics education as it were.*

The learners are displeased with the trend of things surrounding support services. Aziz et al. (2020) echoed that there are minimal tutor-learner interactions especially in a complicated calculation (as in the case of mathematics). This might be the reason Lowe, Mestel and Willams (2016) resolved in their study that learners prefer Face-to-Face mathematics classroom due to the learners' ability to relate with their tutors and other participants in real time classroom interaction. The categories from the sub-theme technology for learning sheds light on how the DOL mathematics learners experience technology for learning. The categories are: non availability of modern technology to learn mathematics in this mode such as internet connectivity, computer, multi-functional calculators, screen sharing, audio and video classes; lack of introduction of technology at the lower level of education; limited knowledge of the modern technologies and their usage and funding (see Figure 1).

The learners stated that non-availability of Internet connectivity is a problem that affects everything they do in

this mode of learning. The learners' views are alike and are captured in the following statements:

> *"The first problem we have in learning mathematics in this mode is the Internet issue. The network is so bad. If I don't have Internet connection, how do I collaborate online even if the platform is there? The first thing first".*

Lack or limited introduction and knowledge of learning through modern technology at the lower educational level in Nigeria is one the views the learners shared as a challenge. For learner A, "*Using technology at this level is difficult because, we did not use them in secondary school. We have that phobia in learning mathematics with it because, it seems to be a new thing to us*". In learner B narration: "*we are not exposed to practical use of the resources, like how to get our materials from the LMS and navigate to do our studies during the orientation, they just assume we are adults and know it all*".

The learners' dissatisfaction can be seen in the opinion shared with the researchers in this study. The study of Shukla, Hassani and Casleton, (2014) assert that online mathematics learners had lower pass rate than the Face-to-Face learners which was attributed to lack of proper exposure of learners to modern technology in online mathematics learning.The perceived improvement strategies as identified by the learners are captured in the sub-themes: instructional delivery, assessment methods, support services and technology for learning. Figure 3 diagrammatically reveals the four sub-themes and associated categories.

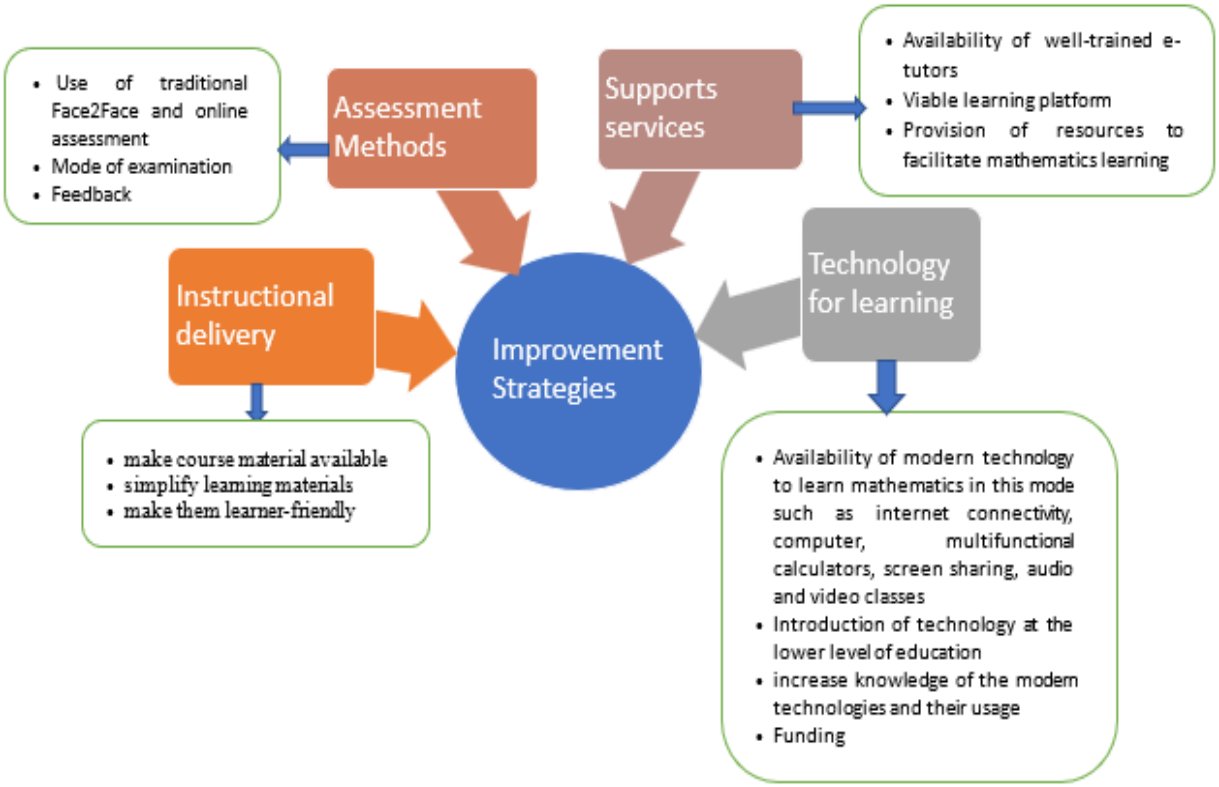


Figure 3. Improvement Strategies

The categories emanating from the sub-theme instructional delivery are: make course material available, simplify learning materials, and make them learner- friendly.

The opinion of mathematics learners (A and B) to have an improved learning experience was described by the learners from the institutions used for the study. The learners have the following to say:

> *I think the course materials as well as the modules should be made ready even before the official resumption of the school, to enable us to prepare ahead of time. They should devise the means of getting the course material across to us, to avoid queuing for long to get it. The courses we don't have the modules available, the tutor should recommend books we can use. That will help us*.

Learner A has this to say about simplifying the learning materials and making them learners' friendly:

> *They should make all our learning materials to be self-explanatory. The mathematics modules especially should be made very simple and easy for us to study on our own and understand since they are our teacher.*

Similar suggestion was made by learner B:

> *It is only few of our mathematics modules that are simple. They should just work in making all simple and learner friendly. They said our course materials are our lecturers, yes, the content in the course materials is enough but they should make them simple.*

The submission of the learners calls for involvement of experts in the design of mathematics learning materials for the DOL learners.

The sub-theme on assessment methods presents the following categories: use of traditional Face-to-Face and online assessment, mode of examination and feedback. For an improved DOL mathematics education, the learners further suggested enhancing the mode of administering assessment in their institutions. "*Assessment should be done both Face-to-Face and online to allow us express our mathematical skills. If examinations cannot be done on our own time, it should be fixed during the weekends since most of us are workers and busy during the week*". The learners also emphasised the need for prompt feedback, stating that it will be a motivating factor to do their online assignments. In their words, "*the level of feedback given for online assessments should be improved, improve the Internet connectivity to ease the problems we have in submitting the online assignments. We need efficient and affordable Internet to effectively learn*".

The suggestions that emanated from support services include making available well-trained e-tutors, viable learning platform and provision of resources to facilitate mathematics learning. Learner A opinion was captured in the following statement: "*I mean the tutors should be engaged in constant training on how to design and teach online mathematics learners. They should be available online to assist the learners*".

Learners B had this to say about the non-availability of tutors: "*They should employ mathematics education tutors, train and equip them with modern technologies in order for them to have a good online delivery skill to teach the learners in this mode*". The learners and the tutors should be trained on how the platform works for effective mathematics learning to take place. "*Resources other than modules should be made available for learning. Learning in this mode can be easy and interactive if the management can provide necessary resources like*

*computer, strong internet, audio and video mathematics recordings*". According to Kalelioglu (2017), the basic need of the learners should be made a priority for effective learning.

The sub-theme on technology for learning considered suggestions made by the learners on the best strategies to improve DOL mathematics. The categories derived from the sub-theme are: availability of modern technology to learn mathematics in this mode such as Internet connectivity, computer, multi-functional calculators, screen sharing, audio and video classes; introduction of technology at the lower level of education; increase knowledge of the modern technologies and their usage; and funding.

The learners identified internet facilities as the key issue that must be tackled by their institutions for studying in this mode. Learner A: "*number one thing is to provide Internet facilities for us to be able to access learning platform, our learning materials and other things*". And for learner B, "*all that I can say is that the school should improve Internet connectivity and other technologies that we need to learn in this mode and make them available for us. Leaving it in the hand of the learners to get is not the best approach*". The learners further suggested using technology to teach students in lower levels to get them used to learning with it already. "*They can even start teaching children in lower educational level with technology, make mathematics very simple and interesting to attract the learners*". Furthermore, "*In my own thinking, mathematics learners and the tutors should be equipped in all these modern technologies, apply them for our effective learning. This can be extended not only to tertiary institutions but even at secondary school levels*".

In the case of funding, the learners expressed similar opinion. Learner A emphasised the need for "*government to provide fund and make scholarship available. They should invest more in education so that more people will enrol to improve themselves and get educated*". In the opinion of Learner B, government should invest in the online learning of mathematics: *"I will say it again, the government should support distance and online programmes in Nigeria by providing costless accessible personal computers for the students and library facilities in all the study locations for effective learning of mathematics. The school also should improve Internet connectivity and other technologies that we need to learn in this mode and make them available for the students*". The perception the participants in the improvement of the online mathematics education in their universities are supported by Kalelioglu (2017) and Hudal, Wahyuni, and Fauziyah (2021).

## Conclusion

This study has provided insight into the learners' perception of challenges and improvement strategies of DOL of mathematics in Nigeria. The learners' stories signified there are issues associated with the learning of mathematics in this mode. Various issues the learners stated are themed under instructional delivery, assessment methods, support services and technology for learning. Some scholars (Bringula, Reguyal, Tan and Ulfa 2021) confirmed and supported this finding. The implication of these results is that despite increase in the use of DOL in mathematics learning, there is still much to do to attract more students to learn mathematics through this mode. The improvement strategies the learners expressed agreed with that of Aziz et al. (2020), Kalelioglu 2017) and Hudal, Wahyuni, Fauziyah (2021). Third year mathematics learners at DLI and NOUN were used in this study,

future research could focus on using mathematics learners across the years.

## References

Adu, E. O., Eze, I. R., Salako, E. T., & Nyangechi, J. M. (2013). E-learning and distance education in Nigeria. *International Journal of Science and Technology*, *2*(2), 203-210.

Ashby, J., Sadera, W. A., & McNary, S. W. (2011). Comparing student success between developmental math courses offered online, blended, and face-to-face. *Journal of Interactive Online Learning, 10*(3), 128-140.

Aziz, N. A. A., Musa, M. H., Aziz, N. N. A., Malik, S.A. & Khalid, R. M. (2020). A Study on Barriers Contributing to an Effective Online Learning among Undergraduates' Students. *Open Journal of Science and Technology, 3*(Issue 1), 17-23.

Baker, S. E., & Edwards, R. (2012). *How many qualitative interviews is enough? Expert voices and early career reflections on sampling and cases in qualitative research.* National Centre for Research Methods. https://eprints.ncrm.ac.uk/id/eprint/2273/4/how_many_interviews.pdf

Bringula, R., Reguyal, J. J., Tan, D. D & Ulfa, S. (2021). Mathematics self-concept and challenges of learners in an online learning environment during COVID-19 pandemic. Smart Learning Environments, 8(22). 1-23. https://doi.org/10.1186/s40561-021-00168-5

Burns, K., Duncan, M. Sweeney II, D. C., North, J. W., & Ellegood, W. A. (2013). A longitudinal comparison of course delivery modes of an introductory Information Systems Course and their impact on a subsequent Information Systems course. *MERLOT Journal of Online Learning and Teaching, 9*(4), 453-467.

Demirel, A. (2025). Sanat Eğitiminde Eğitsel Eleştiri Modeli ile Çok Kültürlü Sınıf Yönetimi Analizi [Analysis of Multicultural Classroom Management with the Educational Criticism Model in Art Education]. *Bilim, Eğitim, Sanat ve Teknoloji Dergisi (BEST Dergi) [Science, Education, Art and Technology Journal (SEAT Journal)], 9*(2), 82-99.

Drennan, J. A., Kennedy, J., & Pisarski, A. (2006). Factors affecting student attitudes toward flexible online learning in management education. *Journal of Educational Research*, *98*(6), 331-338.

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approach* (4th ed.). Los Angeles: Sage Publications.

Han, H. (2020). How to make the switch to online teaching more effective. https ://www.unive rsity world news.com/post. php?story =20200 31713 47454 6. Accessed 5 Apr 2023

Hudal, N., Wahyuni, T. S. & Fauziyah, F. D. (2021). Students' Perceptions of Online Mathematics Learning and Its Relationship Towards Their Achievement. *Advances in Social Science, Education and Humanities Research,* 529, 522-529.

Irfan, M., Kusumaningrum, B., Yulia, Y., & Widodo, S. A. (2020). Challenges during the pandemic: Use of e-learning in mathematics learning in higher education. *Infinity*, 9(2), 147-158.

Jaradat, S. & Ajlouni, A. (2021). Undergraduates' Perspectives and Challenges of Online Learning during the COVID-19 Pandemic: A Case from the University of Jordan. Journal of Social Studies Education Research, 12(1), 149-173.

Jones, S.J. & Long, V.M. (2013). Learning equity between online and on-site mathematics courses. *MERLOT*

*Journal of Online Learning and Teaching*, 9(1), 1–12.

Kabashi, F, Shkurti, L, Sofiu, V, Leka, H. and Selimaj, M. (2022). Difference between Online and On-site Mathematics Courses in Higher Education. *IFAC Papers Online 55-39,18–23.*

Kalelioglu, F. (2017). Online Learning Experience of the Learners: Their Readiness, Expectations and Level of Satisfaction. International Journal of Management and Applied Science, 3(3). 12-16.

Kalman, R., Macias Esparza, M., & Weston, C. (2020). Student views of the online learning process during the COVID-19 pandemic: A comparison of upper-level and entry-level undergraduate perspectives. *Journal of Chemical Education, 97*(9), 3353–3357. https://doi.org/10.1021/acs.jchemed.0c00712

Kiger, M. E. & Varpio, L. (2020): Thematic analysis of qualitative data: AMEE Guide No. 131, Medical Teacher. DOI: 10.1080/0142159X.2020.1755030

Lowe,T., Mestel, B. & Willams, G. (2016). Perceptions of online tutorials for distance learning in mathematics and computing. Research in Learning Technology, 24, 1-14.

Maguire, M. & Delahunt, B. (2017). Doing a Thematic Analysis: A Practical, Step-by-Step Guide for Learning and Teaching Scholars. AISHE-J, 8(3), 3351-33514.

National Universities Commission (NUC) (2009). *Guidelines for Open and Distance Learning in Nigerian Universities*. Retrieved from http://nuc.edu.ng/wp-content/uploads/2015/01/GUIDELINES-FOR-OPEN-AND-DISTANCE-LEARNING-IN-NIGERIAN-UNIVERSITIES.pdf

Oyeleke, O. & Adebisi, T. A. (2015). Distance Education Modes in Nigeria: Students' Perceptions and Preference. *Ife Journal of the Humanities and Social Studies* (IJOHUSS), 2(2), 81-99.

Shukla, N. J., Hassani, H., & Casleton, R. (2014). A Comparison of Delivery Methods for Distance Learning Mathematics Courses. *SoTL Commons Conference*. 75.

Strategic Review of Online Education (2015). Report of the Faculty Council on Teaching and Learning, Princeton University.

Umoh, J. B. & Akpan, E. T. (2014). Challenges of Blended E-Learning Tools in Mathematics: Students' Perspectives University of Uyo. Journal of Education and Learning, 3(4), 59-70.

UNESCO (2017). New UNESCO report sheds light on gender inequality in STEM education. https://www.unesco.org/en/articles/new-unesco-report-sheds-light-gender-inequality-stem-education,

Zhu, Y., Zhang, J. H., Au, W., & Yates, G. (2020). University students' online learning attitudes and continuous intention to undertake online courses: A self-regulated learning perspective. *Educational Technology Research and Development*, 68(3), 1485-1519. https://doi.org/10.1007/s11423-020-09753-w

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