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The Effectiveness of E-learning Calculus System during the Covid19 and Banditry in North-western Nigeria

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Abstract: Insecurities in the northern part of Nigeria has contributed in depreciating the educational system where boko haram, banditries and kidnapping had become the disturbing factors to the system ranging from primary, secondary and tertiary schools while COVID19 pandemic on the other hand, teachers and students were not allowed to conduct a face-to-face class room teaching/learning which forced the schools closed for quite sometimes. Today both lecturers/teachers and students are afraid of being victim in one way or the other. Electronic learning (E-Learning) uses information and communication technology to facilitate learning by means of internet, computers, mobile phones and other computing/communication resources. This research investigated the usability and effectiveness of the developed calculus e-learning system. The system was evaluated by the lecturers and the students. Thirty-five (35) academic staff (lecturers) that taught calculus and web technology as a course in the tertiary institutions within the north western region of Nigeria performed the usability evaluation on the system where the result showed that the system is usable and recommended for student to use. Fifty two (52) students from different departments in Kebbi State Polytechnic Dakingari participated in the effectiveness evaluation, where the result showed that 32 students scored between (61-70)%, 18 (71-80)%, 1 (51-60)% and 1 (81-90)% respectively. The lecturers responded that the system was very easy to use 34 (97.1%), the difficulties of the examples and exercises in the system for students to learn calculus was easy 31 (88.5%) and students responded also that, they were very satisfied with the way they learned calculus with the system 43 (83%). Both lecturers and the students recommended the calculus e-learning system during COVID19 pandemic and banditry attack, the calculus examples, exercises, videos and audios provided in the system are self-explained.

Keywords: Calculus, E-learning, Covid19, Banditry, YouTube, SoundCloud.

I. INTRODUCTION

Contemporary rural insecurity, otherwise known as rural banditry started in Zamfara around 2011, as a traditional farmer-herder conflict or insignificant rural unrest, changing into full-blown conflict, engulfing most parts of the Northwest. Multiple factors account for the transformation of this conflict. Traditional rulers, politicians, security agencies, gold miners are among the notable actors in the conflict. The first criminal gang was formed by Kundu, and Buharin Daji. It grew from a single cell, mainly operating in Zamfara as of 2011 and expanded to over one hundred and twenty (120) gangs across six states in 2021. These gangs are basically associated with mass killing of innocent people, cattle rustling, kidnapping, gender based and sexual violence (GBSV) and other related human rights abuses. At the beginning they lived in the woods and mountainous areas, from where they unleashed terror on the rural and urban areas in the states. Some of the bandits have become very daring to the extent of operating from their respective villages. Approximately, there are over 10,000 armed bandits operating across different parts of Zamfara state (Rufai, 2021).

Education is among the sectors with devastating impact of COVID-19 pandemic. Before the pandemic, the Nigerian education system has adopted purely, face-to-face approached to teaching and learning in primary and secondary schools. Primary and secondary school learners were not allowed to own any digital gadget such as phone or computer, neither were they allowed to be seen with such in the schools. With the emergence of the lockdown condition and school closure, following the COVID-19 pandemic, both teachers and learners were helpless about how to continue learning in the face of the pandemic (Eze, Sefotho, Onyishi, & Eseadi, 2021).

Electronic learning, or e-learning, is education based on modern methods of communication including the computer and its networks, various audio-visual materials, search engines, electronic libraries, and websites, whether accomplished in the classroom or at a distance. Generally speaking, this type of education is delivered through the medium of the World

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Wide Web where the educational institution makes its programs and materials available on a special website in such a manner that students are able to make use of them and interact with them with ease through closed or shared, networks, or the Internet, and through use of e-mail and online discussion groups. The definition of e-learning centres on its being a learning method and a technique for the presentation of academic curricula via the Internet or any other electronic media inclusive of multimedia, compact discs, satellites, or other new education technologies (Bilal, 2015). E-learning is among the most important explosion propelled by the internet transformation. This allows users to fruitfully gather knowledge and education both by synchronous and asynchronous methodologies to effectively face the need to rapidly acquire up to date know-how within productive environments (Oye, Salleh, & Iahad, 2012). This research aimed to investigate the effect of e-learning in teaching/learning of calculus for students and other users in the Northwest Nigeria.

II. REVIEW OF RELATED WORKS

The country as a nation state is under a severe internal socio economic and security threat. At a more general level, the threat has social, economic, political and environmental dimensions. The security challenges and the socio-economic effects of insurgency and armed banditry in Nigeria was examined by (Mathias & Uwak, 2021). The study that investigated the impact of implementing integral calculus lectures which were originally very suitable in the face-to-face delivery, but during the Covid-19 pandemic situation, these were delivered online through e-learning was presented by (Ramdani, Mohamed, & Syam, 2021). Oye et al. (2021) presented a review paper that discusses on e-learning methodologies and tools. The different categories of e-learning that includes informal and blending learning, network and work-based learning. The research that examines the use of Virtual Learning Objects (VLO) in the teaching of differential calculus in the area of Management Sciences as a teaching strategy to improve the assimilation of the theoretical knowledge acquired in the classroom courses discussed in (Arango, Gaviria, & Valencia, 2015). The effectiveness of online learning in calculus 2 during the Covid-19 pandemic. The study was conducted in a civil engineering study program at a private tertiary institution on Sumbawa Island. The research is a quasi-experimental research design model non-equivalent control group design was presented by (Rukini, Suhaimi, & Susilawati, 2020). Eze et al. (2021) investigated the challenges posed by, and the impacts of COVID-19 on Education in Nigeria. A sequential exploratory mixed method design was adopted for the study. The development of a game-based diagnostic test and learning intervention for freshman engineering students for the course in Differential Calculus was done by (Ilustre & Raqueño, 2020). The Research and Development (R&D) to describe the implementation of m-learning (mobile-learning) in learning calculus II and to determine and obtain an overview of the mobile-based learning process (Sulastri, Lestari, & Hakim, 2018). The research that investigated the repercussions of rural banditry on the educational growth of the nation and the ideas behind rural banditry, the history of rural banditry, the elements that encourage rural banditry activities, as well as the scope of rural banditry in the north western region of Nigeria was presented by (Sanchi, Alhassan, Ajibade, & Sabo, 2022). The roadmap to tackling insurgency, armed banditry and kidnapping in the North West region of Nigeria using thematic study approach. Where the findings from the study revealed that deployment of techno driven surveillance, strengthened collaborative efforts of law enforcement agencies and telecoms operators, genuine activation of good governance and adoption of a community participatory policing strategy can significantly reduce insurgency, armed banditry and kidnapping in the North West region (Mungadi et al., 2020).

III. SYSTEM ARCHITECTURE

A. User Interface

The user interface is divided into two (2) parts:

i. Admin/Lecturer part

The admin/lecturer part provided the features for adding new lesson, videos and audios based on the topics and sub-topics as explained in the domain module, viewing registered users and managing the system in general. Fig. 3 shows where admin/lecturer can add new lesson with examples and exercises.

ii. Students/User part

This are the interfaces where user can create new profile before he/she can access the lessons, videos and audios provided by the admin/lecturer. Figs. 2, 4, 5, 6 and 7 shows the user interfaces for the students/user part.

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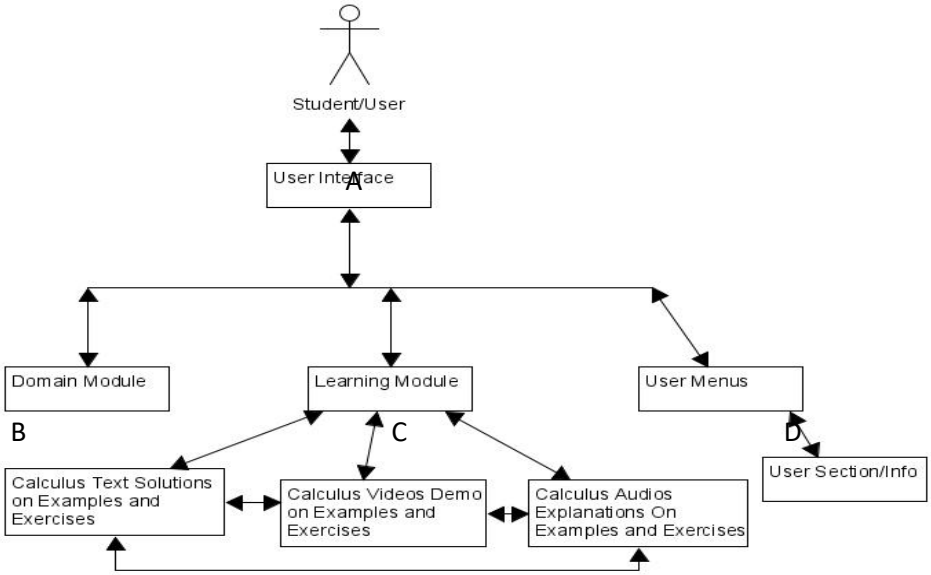

Fig. 1: System Architecture

B. Domain Module

The domain module contained the information that are to be taught to the students/users in the learning module. It is the stage that make the users to understand what he/she expected in the system during learning and how lessons were arranged or presented in the system.

The domain module in this calculus e-learning system covers the following:

- Limit
  - Evaluating limit
  - Just put the value in
  - Factors
  - Conjugates
  - Formal Definition
  - Delta and Epsilon
- Continuity and Discontinuity
  - Continuity
  - Discontinuity
  - Jump Discontinuity
  - Infinite Discontinuity
  - Point Discontinuity
- Differentiations
  - Derivatives
  - Differentiation from the first principle
  - Standard derivatives of some basic function
  - Rules of differentiations
  - Implicit function
- Integrations
  - Constants of integration
  - Standard integral
  - Integrating a sum/difference of a function
  - Integrating a simple trigonometric function
  - Integration by substitution
  - Integration involving powers of sine and cosine
  - Integration by parts
  - Integration by partial fraction
- Maximum and Minimum

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- Maximum and minimum

C. Learning Module

Learning module conveyed the actual lesson of the calculus to the students/users inform of textual explanation, video instruction/demonstration and audio explanation for each topic and sub-topic as in domain module above. The videos physically show the step-by-step examples and exercises as explained textually, while audios provided the sound explanation which corresponded to the texts and videos explained. Therefore, students/users learn calculus by reading text or viewing instructional videos or audio explanation, users can also use both at the same time during learning process. The videos are uploaded on the YouTube while the audios are uploaded on the SoundCloud and all are embedded in the system.

D. User Menus

The user menus contained information about registered students/users, date and time the user login or logout of the system and access for materials and resources that help user during learning.

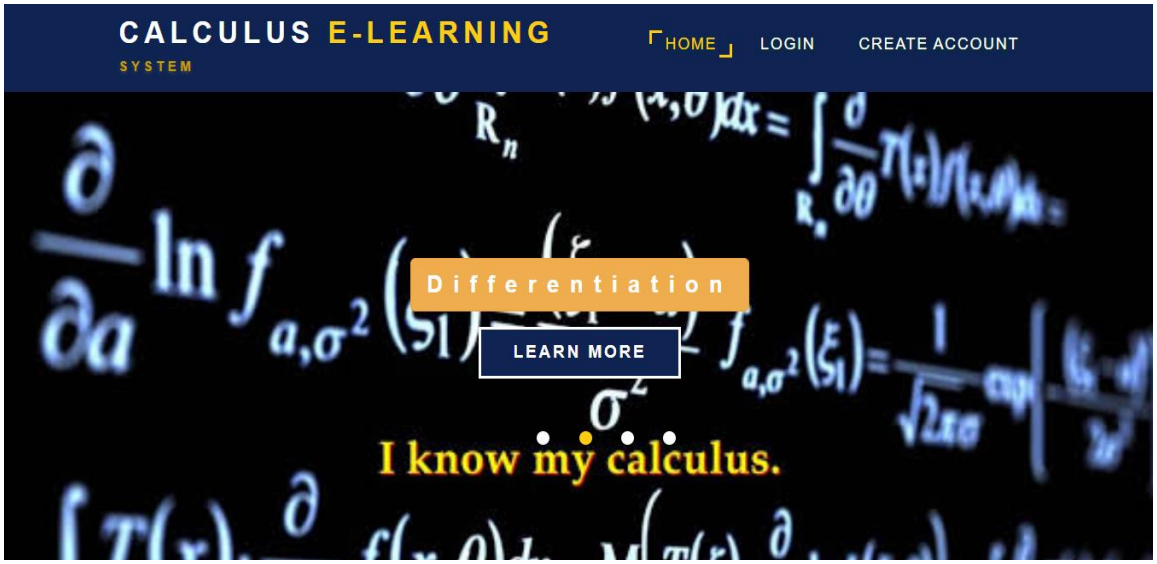

Fig. 2: Home Page

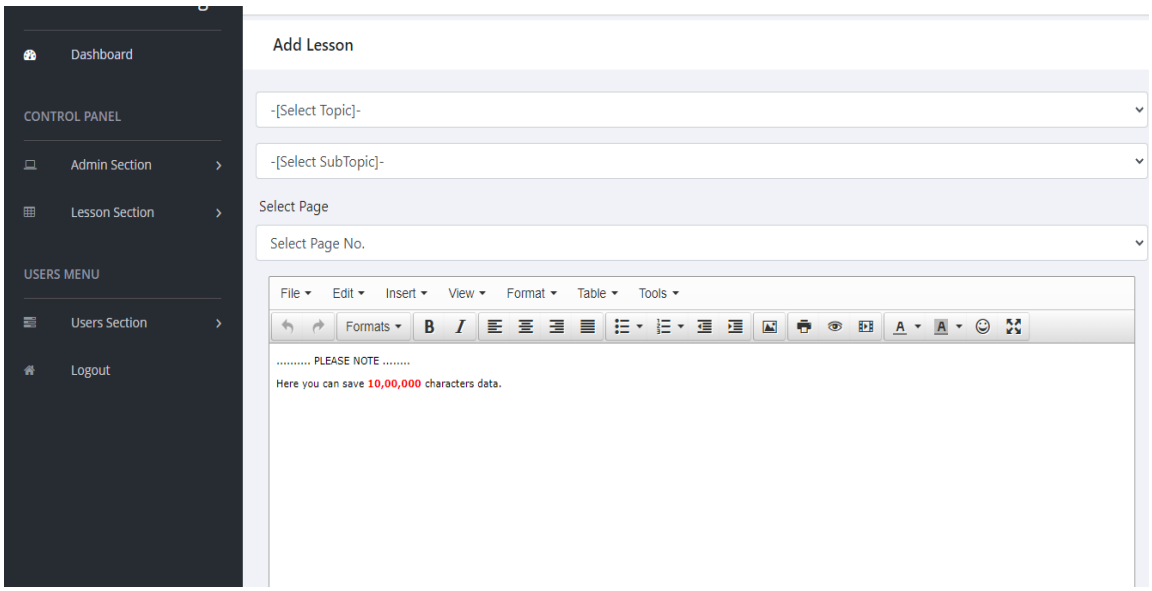

Fig. 3: Admin/Lecturer to add lesson, examples and exercises

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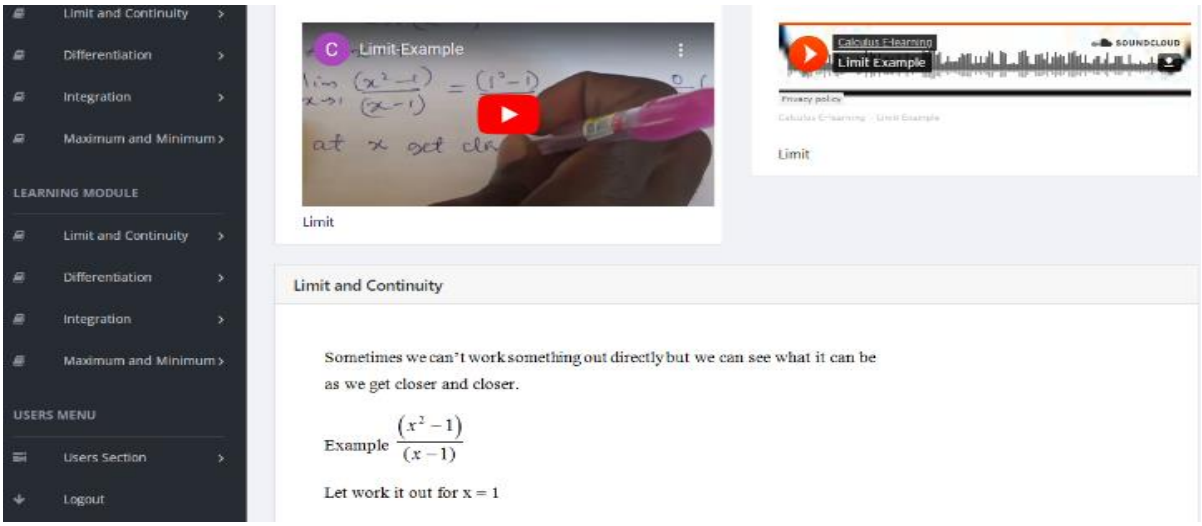

Fig. 4: Limit and Continuity

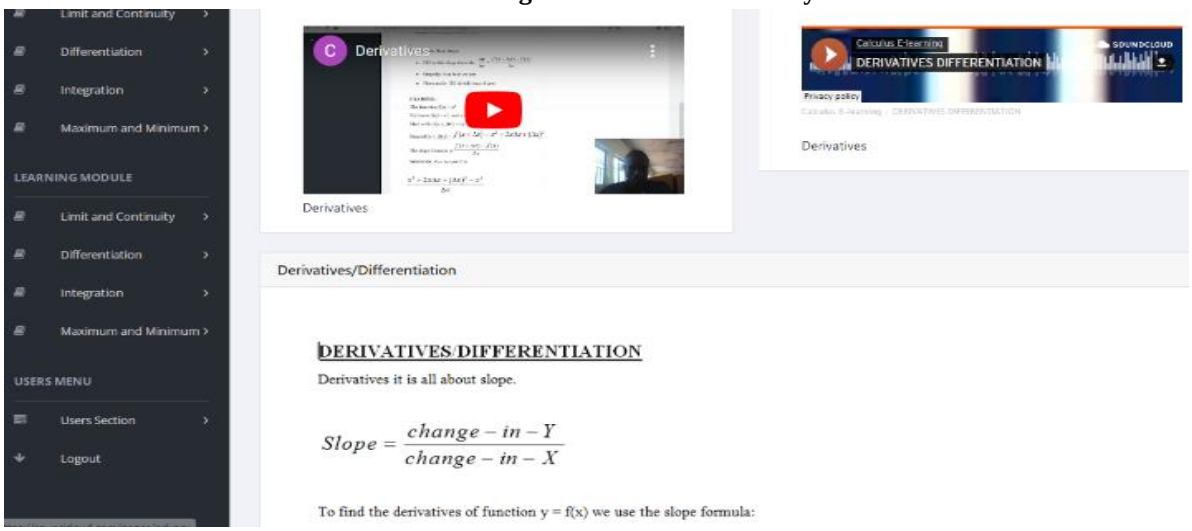

Fig. 5: Derivatives/Differentiation

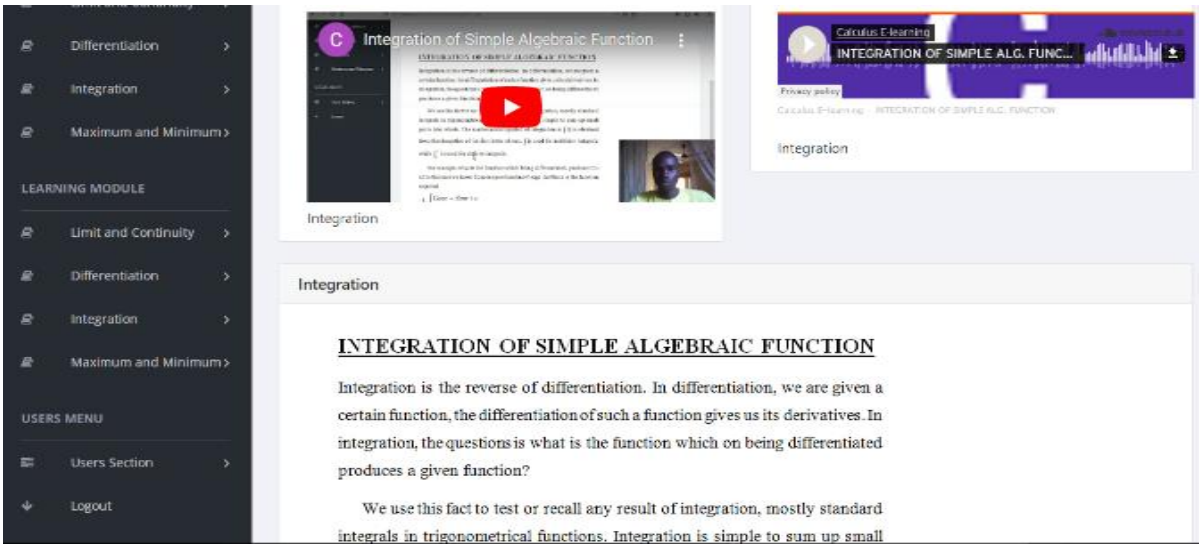

Fig. 6: Integration

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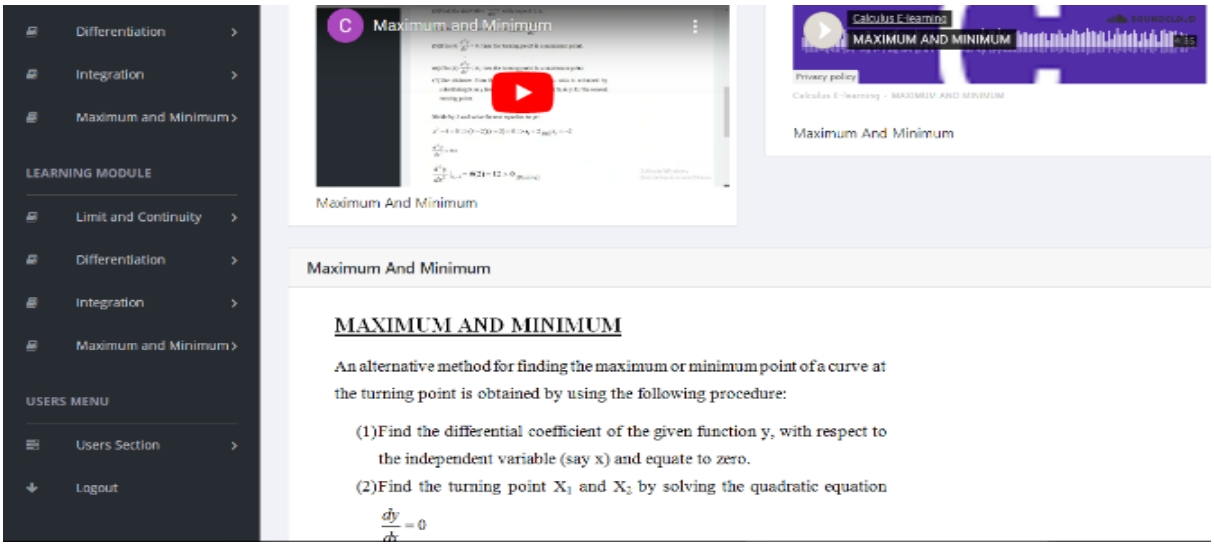

Fig. 7: Maximum and Minimum

IV. SYSTEM DEVELOPMENT

HTML, CSS, JAVASCRIPT and JQUERY scripting languages was used to developed the front-end of the calculus e-learning system while MySQL Database was used to developed the back-end and PHP programming language was used to communicate information between the front-end and the back-end and the vice vasa.

Intelligent tutoring systems consist of four basic components based on a general consensus amongst researchers those components are Domain model, Student Model, Tutoring (Pedagogical) Model and User Interface Model (Sivarasan & Rameshkumar, 2017).

The calculus e-learning system in this research was developed using the four (4) modules but not the fully Intelligent Tutoring System (ITS) rather the E-learning approach. Therefore, this system has Domain module, Learning module, Student/User Menus module and User interface module.

V. SYSTEM EVALUATION AND RESULT DISCUSSION

The evaluation of the calculus e-learning system was conducted in order to test the usability and effectiveness of the system for learning calculus during covid19 and banditry attacks in the northwest region of Nigeria. The usability and effectiveness evaluation was carried out by the lecturers and students respectively.

Table 1 below, shows the distributions of the lecturers participated in the system evaluation. Table 2 also shows the students participated in the effectiveness evaluation.

Table 1: Academic staff (Lecturers) participated in the evaluation

#	Name of Institutions	No. of lecturers
1	Abdu-Gusau Polytechnics, Talatan Mafara, Zamfara State.	4
2	Ahmadu Bello University (ABU), Zaria, Kaduna State.	1
3	Bayero University Kano (BUK), Kano State.	2
4	Federal Polytechnic Kauran Namoda, Zamfara State.	10
5	Federal University Birnin Kebbi (FUBK), Kebbi State.	1
6	Kebbi State Polytechnic Dakingari (KESPODAK), Kebbi State.	7
7	Kebbi State University of Science and Technology Aliero (KSUSTA), Kebbi State	1
8	Umaru Ali Shinkafi Polytechnic, Sokoto, Sokoto State.	4
9	Usmanu Danfodiyo University, Sokoto, Sokoto State.	2
10	Waziri Umaru Federal Polytechnic, Birnin Kebbi, Kebbi State.	3
	Total	**35**

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Table 2: Students participated in the evaluation

#	Name of Institution	Department	No. of students
1	Kebbi State Polytechnic Dakingari	Computer Science	18
2	Kebbi State Polytechnic Dakingari	Science Lab. Tech.	29
3	Kebbi State Polytechnic Dakingari	Electrical Engineering	5
	Total		**52**

A. USABILITY EVALUATION

Table 3 outlines the lecturer's evaluation questions and its rating percentage. Fig. 8 shows the chart on each question and its percentage.

Table 3: Lecturers evaluation questions

ID	Questions	% Rating
LEQ1	How easy it is to use the calculus e-learning system?	VE = 34 (97.1%)
LEQ2	How Comprehensive the quality of the calculus lessons and examples in the system.	C = 28 (80%)
LEQ3	Does the examples provided in the E-learning System comprehensive for learning calculus?	FC = 26 (74.3%)
LEQ4	How do you rate the examples demonstrated in the videos and audios provided in the system?	VS = 29 (82.9%)
LEQ5	How important are the topics covered for learning calculus in the system?	VI = 35 (100%)
LEQ6	How do you rate the quality of the Calculus E-learning System design	VS = 35 (100%)
LEQ7	Would you recommend using the Calculus E-learning System in this COVID19 pandemic and Banditries attacks in the North-western region of Nigeria to other students?	Y = 28 (80%)
LEQ8	How do you rate the difficulties of the exercises in the system?	NE = 17 (48.6%)
LEQ9	Would you like to see similar E-learning system in other courses?	Y = 28 (80%)
LEQ10	How do you rate the difficulties of the examples and exercises in the system for students learning?	E = 31 (88.5%)
Evaluators Comments	Good, Okay, It's very important and useful, An easy way to learning calculus, It is understandable and clear, This e-learning in calculus is very useful to the societies.	

NOTE: LEQ = Lecturer Evaluation Question, VE = Very Easy, E = Easy, FC = Fully Comprehensive, C = Comprehensive, VS = Very Satisfied, VI = Very Important, S = Satisfied, Y = Yes, NE = Neutral.

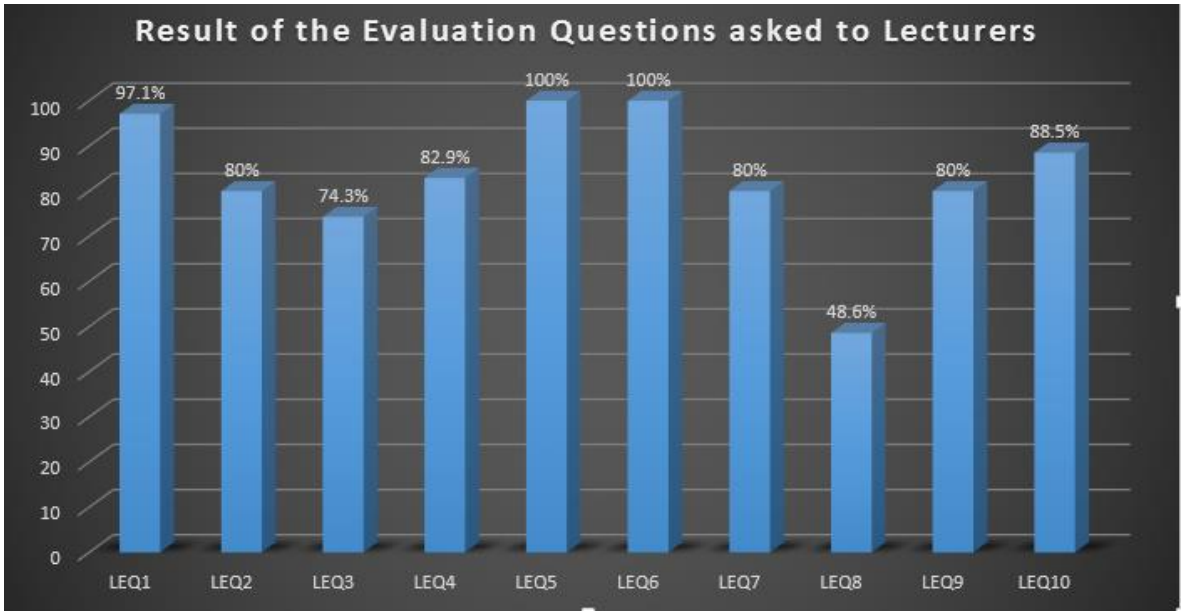

Fig. 8: Result of the lecturers evaluation

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Usability evaluation were carried out by lecturers that teaches calculus and web technology as a course in tertiary institutions within north western region of Nigeria. The universal resources locator (URL) of the system was shared to the academic lecturers in Table 1. A questionnaire in Table 3 was asked to filled out by the evaluators. A total of 35 lecturers evaluated the system, Table 3 and Fig. 8 showed that, the adaptive features in the system was very easy to use 34 (97.1%) of the respondents, the difficulties of the examples and exercises in the system for students to learn calculus was easy 31 (88.5%) of the respondents, the evaluators recommended that the system was usable during covid19 pandemic and banditries in the North-western region of Nigeria 28 (80%) of the respondents. Other responses by the respondents are presented in Table 3 and Fig. 8.

B. EFFECTIVENESS EVALUATION

Fig. 9 shows the students test score distribution after learning calculus with the system. Table 4 shows the evaluation questions and its rating percentage by the students. Fig. 10 shows the bar chart on each question and its percentage.

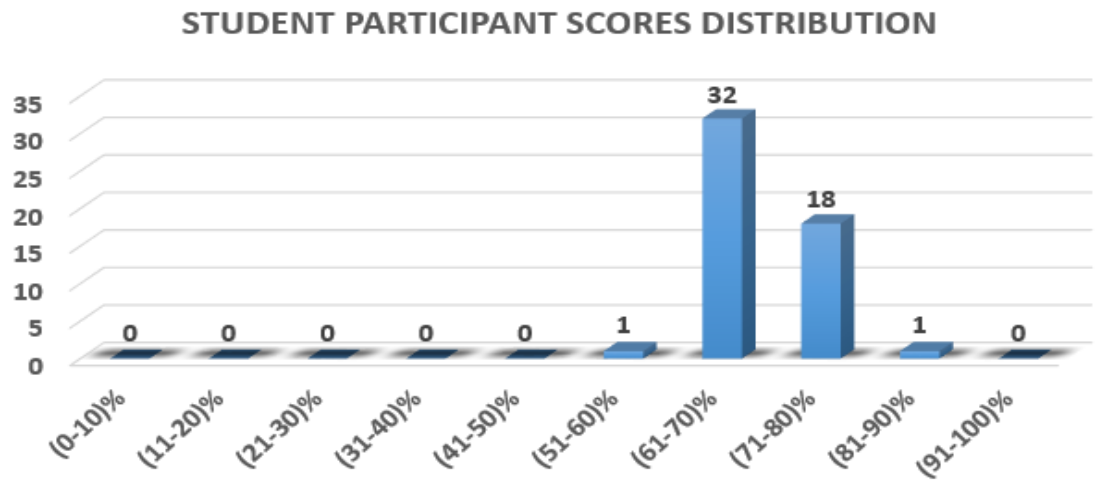

Fig. 9: Student test score distribution

Table 4: Students evaluation questions

ID	Evaluation Questions	% Rating
SEQ1	Did you enjoy learning calculus with the Calculus E-learning System?	VS = 43 (83%)
SEQ2	Do you find the Calculus E-learning System easy to use?	VE = 50 (96%)
SEQ3	Did you enjoy the lessons, videos and audios provided in the Calculus E-learning System?	Y = 51 (98%)
SEQ4	Do you benefit from using the calculus e-learning system?	Y = 52 (100%)
SEQ5	Would you recommend using the Calculus E-learning System in this COVID19 pandemic and Banditries in the North-western region of Nigeria to other students?	Y = 52 (100%)
SEQ6	Would you like to see similar E-learning system in other courses?	Y = 52 (100%)
SEQ7	How do you rate the difficulties of the examples and exercises in the system?	E = 34 (65%)
SEQ8	Do you agree to recommend the Calculus E-learning System for leaning calculus in the Polytechnic National Diploma programme as a supportive tool?	A = 37 (71%)

NOTE: SEQ = Students Evaluation Quetions, VS = Very Satisfied, VE = Very Easy, E = Easy, Y = Yes, A = Agree.

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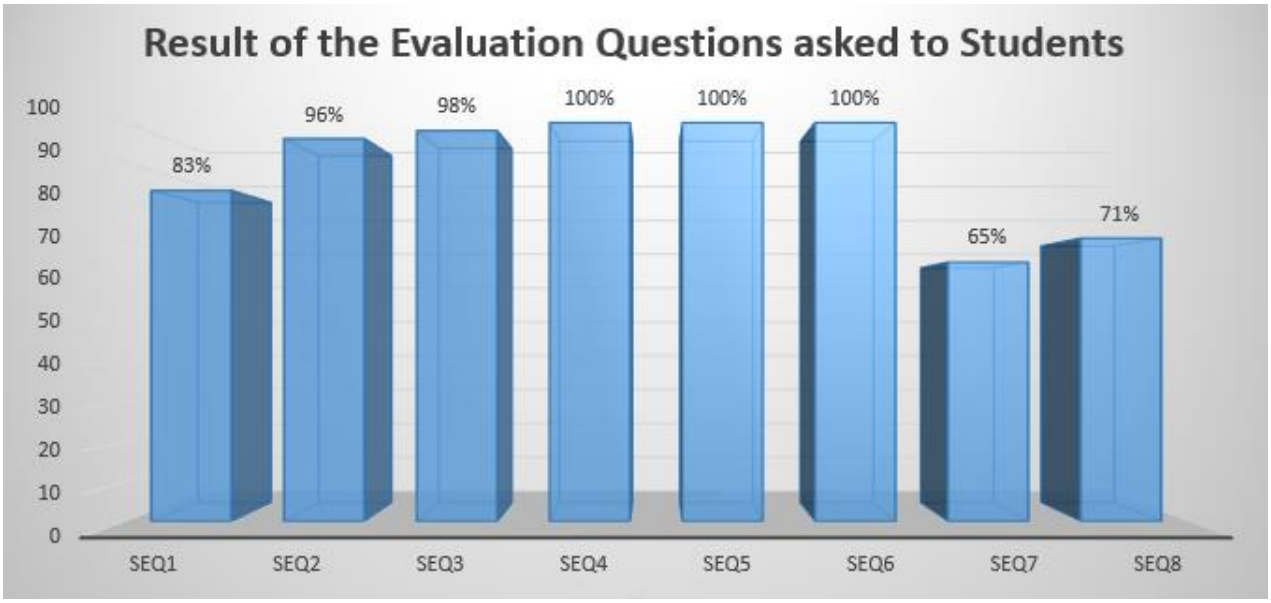

Fig. 10: Result of the students' evaluation

The effectiveness evaluation of the system was carried out by the students of Kebbi State Polytechnic Dakingari whose enrolled in the MTH 231 (Introduction to Calculus) in National Diploma II (ND II) 2021/2022 academic session, the URL of the developed calculus e-learning system was shared to the evaluators for them to access the system online to learned calculus. The system URL was shared to the students during early May 2022, while at the mid of July 2022, the authors invited the students for a written test. Fig 9 shows the effectiveness result of the 52 students participated in the test; those are the students that learned calculus using calculus e-learning system. 32 students score between (61-70)%, 18 (71-80)%, 1 (51-60)% and 1 (81-90)% respectively. This shows that the system was effective for learning calculus online. Immediately after the test they were asked to provide their feedback about the system through filling the questionnaire which consisted of seven (7) questions as outlined in Table 4. Their responses shows that, the system was very easy to use 50 (96%). Equally, the lessons in videos and audios are welled explained 51 (98%), students also recommended that the system was effective during pandemic such as COVID19 and insecurities such as banditries, kidnapping, boko haram and so on 52 (100%).

VI. CONCLUSION

The e-learning method, due to the period of banditry attacks and COVID-19 pandemic, it has made teaching and learning processes easier without face-to-face contact, that reduces the kidnapping of lecturers and students when going or coming back from schools.

Based on the responses by the evaluators, the following conclusions were drawn:

1. The developed calculus e-learning system was an acceptable tool for learning calculus.
2. The calculus e-learning system was usably and effectively recommended to use during pandemic such as COVID-19 and Insecurity such banditry.
3. The calculus topics treated in the system were very satisfied for learning calculus.
4. This calculus e-learning system is a cost route minimization of educational activities to the entire societies

VII. ACKNOWLEDGMENT

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