

Educational Development in Africa: Bridging Disability Gap with Distance Learning for the Visually Impaired

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Abstract

It is a known fact that the era of the Covid19 pandemic has further exposed the concept and technology of distance learning as more and more people are now interested in higher education through the distance learning mode. Distance learning courses are possibly an appropriate tool for mainstream students with impairments in education since they rely significantly on digital material and are technology-mediated. However, in the drive to move forward, most structures/systems are typically created without taking into cognizance the unique interface issues those students with disabilities are confronted with while using technology, especially the blind and the visually impaired. Hence, this paper is aimed at creating an enabling examination platform where this vulnerable group would be supported by providing a voice supported application, ODL Visually Impaired Assessment Bot for the blind and the visually impaired to write their examinations. This will further ensure equality and inclusive education in acquiring life-long learning through distance learning. Artificial intelligence technologies were used to develop a Robot that was used for the implementation of the Application. The Robot reads out the examination questions to the blind and visually impaired student and also listens to the student speak and thereafter captures and types out the answers of the student. It is against this backdrop that this paper is written to proffer a solution to the blind and the visually impaired students in Africa, especially, the National Open University of Nigeria. The significance of this ODL Visually Impaired Assessment Bot is aimed at building a sustainable educational system through the use of technology, thus eradicating limiting ideologies in Africa, like 'those with disabilities cannot be educated and the rich only deserve quality education'. This application will create a level ground for all to access life-long quality education, through the open and distance mode. The visually impaired if given proper education cannot constitute any form of liability but an asset to themselves, their families and the society at large.

Keywords: Open and distance learning, disability, visually impaired, artificial intelligence, inclusive education

Introduction

More than one billion people around the world experience one form of disability or the other, be it physical, visual, hearing, mental health or intellectual disability, (WHO & World Bank, 2017). This estimation has over four in five persons living in developing countries of the world, Nigeria inclusive. According to United Nations Educational and Cultural Organization (UNESCO, 2017), people with disabilities confront unique barriers in pursuing their right to education, which results in limited access to mainstream education. At all stages of education, specific measures must be made to ensure their enrolment, retention, and completion of their academic pursuit. The notion that education is one of the most potent and proven drivers for sustainable development, especially in Sub-Saharan Africa, is reaffirmed by achieving inclusive and high-quality education for all.

Open and distance learning (ODL) systems offer learners a flexible learning environment that is not limited by time or location. However, the benefit of flexibility may become a disadvantage if learners are unable to solve problems that arise before, during, or after the learning process. Learner support services are critical in overcoming this deficit. Learner retention and academic success are directly influenced by the quality of support services. The quality of support services is especially important for students with special needs, like the blind and the visually impaired (Genc & Kocdar, 2019).

According to Trines (2018), "Although ODL is a cost-effective technique of mass education, limited availability and access to modern technology can be a significant hurdle in developing countries." The only way it can only be successful, is if it is guided by the socioeconomic and cultural qualities of the students in order to promote active and participatory learning, program diversity, and accessibility for everyone and that the philosophy of ODL is based on openness and flexibility in terms of time and student needs, removal of obstacles and a learner-centred approach (Özgür & Koçak, 2016).

Globalization, population shifts, and the information and communication technology revolution are having an impact on all parts of life, including distant education, in order to fulfill the growing demands of traditionally underserved and varied race and gender student populations (Derica Alba Kotzé, 2021).

The drive for this paper is on the standards of tertiary or Higher Education (HE), focusing on the National Open University of Nigeria (NOUN), for the blind and the visually impaired students, so that education becomes fully accessible to this vulnerable group and thus, helps reduce social exclusion. Specifically, the paper seeks to answer these questions:

- i. How are the visually impaired students evaluated at distance learning institutions?
- ii. What features can ODL visually impaired assessment bots have in an educational context?
- iii. What is the nature of the challenges faced by visually-impaired learners in on-line learning?
- iv. How can the gap of inequality in the educational system in sub-Saharan Africa, especially in Nigeria be bridged?

Statement of the Problem

Traditionally, on the day of the examination, the visually impaired students are made to come to the examination centre with a friend or a family member or the centre provides a staff to assist them in reading out the questions (MCQ, FBQ or essay Questions), while they (the student) supplies the answers. The challenges with this type of process are that (i) the blind student may be left with the burden of searching for a suitable person who he can trust to understand, write fast and clearly while he dictates his answers to the questions. (ii) The environment may not be friendly as other able and disabled students will also be writing the same examination at the same venue. (iii) The visually impaired student would have to read out the answers to the hearing of his assistant, and as a result, the other students close by may also hear what he is saying; so, this constitutes examination malpractice as other students will hear and write as he dictates out the answers. (v) The lecturer or examiner may not know that the student is blind or visually impaired and so, he/she marks all the scripts together with the able-bodied sighted students.

Our Solution: ODL Visually Impaired Assessment Bot

ODL Visually Assessment Bot is proposed as a solution that will help the visually impaired student write their exams independently, the major support being the Robot that reads out the questions and the student in turn, speaks out his answers to the Robot, and the answers are typed out on the screen accordingly. The option of revisiting answered questions is available in cases when there is the need for the student to update or delete his already supplied answers. More so, the Robot automatically turns on the camera to capture the student and to ensure that there is no human interference. The speed of the Robot can also be controlled by the student. The Robot also knows when the student is talking to himself, like thinking a loud and when the student is giving instructions to the Robot. When the student is satisfied with his/her responses, an instruction is issued to the Robot to submit, and as soon as a submission is done, the Robot says so, and it is disconnected. The functionality of the proposed ODL Visually Assessment Bot is designed after examining the various evidences of the assessment challenges encountered by visually impaired students in literature and practice.

Literature Review

Despite the widespread use of Information and Communication Technology (ICT), literature shows that problems with technology and information access for people with visual impairment still exist (Arslantas & Gul, 2022). The Literature review section gives a clear view of the challenges faced by the blind and visually impaired students when writing their exams or taking their assessments, otherwise known as Tutor Marked Assignment (TMA). Although, this review did not include the digital skills of the students needed to help them to answer their assessments.

Vision impairment may have been a voided in at least 1 billion of these cases, or about half of all cases. Uncorrected refractive errors and cataracts are the major causes of visual impairment and blindness (WHO & World Bank, 2017). The majority of persons who suffer from vision impairment or blindness are over the age of 50; however vision loss can affect people of any age". The yearly global costs of productivity losses related with vision impairment from untreated myopia and presbyopia alone are estimated to be US\$ 244 billion and US\$ 25.4 billion, respectively, due to vision impairment. (Al, 2017).

Many more studies have been conducted by many academics in an effort to give intelligent services in the e-examination for the visually impaired in a traditional voice-based examination system; for example, Azeta et al. (2009) came up with a multimodal user interface for an intelligent voice-based eLearning system known as Case-based Reasoning (CBR), was used as an intelligent subsystem, allowing the system to reason based on previous experience. Course registration, voice learning tutorial lectures, and examinations were all conducted via the technology. The system was created for the traditional testing situations when students live on campus and stay in their dorms (Azeta, 2018)

The traditional education system, which is characterized by face-to-face interactions between teachers and learners, structured courses of study, fixed locations for learning, fixed time schedules, and a certification system, has been identified as the major agent for the implementation of educational policies in Sub-Saharan African countries. However, it has been stated that none of the countries in Sub-Saharan Africa have implemented the promise of providing education for all within the traditional or conventional education system (Onwe, 2013); according to him, the emergence of the Open and Distance Learning (ODL) system in Sub-Saharan African countries is due to the search for alternate implementation agents for educational policy. The role of open and distance learning is becoming more widely recognized, according to the Nigerian National Policy on Education, which was amended in 2004.

The most recent development in this sector of inclusive education is the UNESCO 2009 Policy Guidelines on Inclusion in Education; obviously, international consensus is that children with disabilities have the same rights as others to a fair and meaningful education (Lyons & Arthur-kelly, 2014).

In truth, inclusive education aims to meet the educational requirements of all learners in a non-threatening and supportive learning environment, allowing learners who were previously disadvantaged and excluded from education due to "barriers to learning" to participate. Physical, mental, neurological, mental, emotional, psychosocial, beliefs, color, racial, religious, socioeconomic, and gender obstacles may exist (Adetoro, 2014).

As an ODL institution, the National Open University of Nigeria (NOUN) is an equal opportunity university determined to meet the following objectives that necessitated the establishment of open and distance education in Nigeria; NOUN is committed to providing access to education to all segments, communities, and individuals in our society and beyond, equipping them with skills to improve their circumstances. In particular, we seek to reach disadvantaged and marginalized, populations, including those living with disabilities, and open access to university education to all Nigerians and in the sub-region (NOUN, 2021); Accordingly,

- Provision of Education for All (visually impaired inclusive) and promotion of lifelong learning
- Filling the gap created by the closure of outreaches/satellite campuses
- Cost effectiveness

- Improved economies of scale
- Flexibility of delivery system
- Maximum utilization of academic personnel
- On-the-job teacher training
- Poverty eradication, vocational and lifelong education
- Provision of non-formal education
- Reaching the unreached
- Propagation of national orientation

The method of instruction for most open and distance institutions is by the distance learning mode within an open learning environment. In other words, open learning is defined as "any style of learning in which the process allows individual learners to exercise choice over any one or more of a variety of learning characteristics. Furthermore, distance education is also defined as "an educational process in which a significant portion of the teaching is conducted by someone who is separated from the learners in location and/or time from the learners." Distance education involves the use of a range of media such as print, audio, video, computer-based media and networks as well as multimedia facilities for presentation of information and for communication between the university and her students. (NOUN, 2021)

This instructional method allows working people to gain knowledge, skills, and procedures that may be useful in their current job or future career prospects. As a result, distance education allows people to increase their academic qualifications without having to leave their occupations or relocate. The approach also allows people to be taught regardless of where they live or what they do for a career. The approach is extremely adaptable in terms of age and time, allowing students to enroll at any time and at any age, and at their own speed.

The Impact of Visual Impairment (VI) on Learning

Visual impairments refer to a loss of vision. Reduced vision caused by eye disorders, accidents, or birth defects is referred to as visual impairment. As a result of visual impairments, students at educational institutions face several challenges and problems, which have a negative impact on their academic performance. Blindness and poor vision are two types of visual impairment. Students are restricted by their loss of vision. Visually impaired students are a diverse group of people with a wide range of problems and challenges that necessitate careful attention in the implementation of curriculum and instructional systems in order to succeed academically (Kapur, n.d.).

Visual impairment (VI) is more than a sensory condition in the context of learning disabilities. The phrase "visual impairment" refers to a loss of eyesight that can range from blurry vision to complete blindness (Soumia et al., 2021). For the blind and visually impaired, Braille material is the primary tool used by students for reading and writing.

Unfortunately, one of the obstacles that students with visual impairment (SVI) face is the nature of writing abilities. For example, their slow writing speed makes it difficult to complete writing tasks. This scenario arises as a result of delayed motor skill development, which alters the mechanical character of Braille handwriting (Soumia et al., 2021). For example, when a student with low vision writes, there is the need for them to grasp their hand precisely. (Tulumović et al., 2017). More so, the lack of grammar knowledge is the outcome of poor spelling performance. These issues and many more are caused by a lack of visual memory, a problem with spatial orientation, a problem with the structure of letters or words, and a problem with visual perception capacity (Tulumović et al., 2017).

The academic performance of visually challenged students tends to be poor; they have difficulties not just in grasping academic concepts, but also in completing assignments and taking examinations. The obstacles and difficulties that these students face necessitate the hiring of more special education teachers who are skilled and proficient in carrying out their jobs (Soumia et al., 2021), and adopting a technological approach that will aid in writing examinations with ease, hence the ODL examination Robot is highly needed.

How ODL Visually Impaired Assessment Bot works

ODL Visually Impaired Assessment Bot was developed using Artificial Intelligence to produce a Robot for the visually impaired. With this Bot, the instructions for writing the examination are read out by the Robot. Thereafter, the different questions are read out to the visually impaired student by the Robot, and the student gives out the answer by speaking back to the Robot. When a particular question is answered, the Robot types out the student's answers and these answers are displayed on the screen. For the Robot to read out the next question, the student would have to say the word 'Next Question', and the Robot reads out the next question, until the entire questions are asked and answered. Instructions can be repeated by the Robot, if asked to do so. The student may also wish to listen to his/her answers after answering all the questions to be sure that his responses were correctly captured by the Robot; and if there is any need to either delete or edit/update any of the existing answers, he speaks to the Robot to do so. When everything seems fine to the student, he instructs the Robot to submit the answers, the Robot responds by saying 'Answers are submitted, bye bye.' As soon as the answers are submitted by the Robot, the student is disconnected from the Robot. To further add security measures to the application and to avoid any form of examination malpractice, the camera is activated on the student's laptop/system. This is to ensure that the student's environment is monitored to ensure that the student is all alone while writing the examination.

Functionalities of ODL Visually Impaired Assessment Bot

- i. voice recognition technology
- ii. listen to the guidelines/instructions on how the student can use the Bot
- iii. navigation around the questions and provide answers
- iv. listening to the exam instructions multiple times
- v. listening and capturing the answers provided by the student
- vi. editing already provided answers
- vii. controlling the speech rate of the Bot
- viii. allowing the blind to plan his answer, talk to himself, think aloud without the system capturing his utterances; the Bot only captures the student's utterance when he wants it captured
- ix. submission of the answers provided by the student
- x. flexibility in the commands given to the Bot (e.g. the user can say: next question, show me next question, next question please, etc.,)
- xi. camera is automatically activated to monitor the student for any form of examination malpractice

Technical Requirements ODL Visually Impaired Assessment Bot

- i. A system with a camera installed
- ii. Microphone activated system
- iii. Browser installed (Mozilla Firefox, Chrome, Safari, Opera, Internet Explorer, Microsoft Edge, etc.,)
- iv. Internet Connectivity

The table 1 summarizes the Operating system requirements of ODL Visually Impaired Assessment Bot

Table 1: OS requirements for ODL Visually impaired assessment bot

S/N	Browser	Version	Platform
1	Microsoft Edge	25.10	Microsoft Windows
2	Microsoft Internet Explorer	11	Microsoft Windows
3	Mozilla Firefox	55	All OSs supported by Firefox
4	Chrome	61	Windows
5	Safari	8.0.x	Mac

Results and Discussion

The unified theory of acceptance and use of technology (ATAUT) Model was used for the pilot testing of ODL Visually impaired assessment Bot. This is to test the acceptability level of the Bot. Understanding how users embrace technology and how it influences every aspect of learning and education is critical to successful e-learning adoption (Abbad, 2021). Accordingly, various aspects relevant to higher education must be addressed in order to promote the successful adoption of technology, the most important of which are those that impact levels of student acceptance.

A total of 65 students were invited for the piloting of ODL visually impaired Bot. Of the 65 students, 10 of them were blind, while the remaining 55 students were able sighted students, but they were advised to blindfold their eyes, which represents 15.4% and 84.6% respectively of the total number of students used for the pilot test. There were 45 men and 15 women. The figure 1 displays the instructions as programmed to be read by the Robot to the hearing of the student. While figure 2 is the response from the student as captured by the Robot and as was submitted to the lecturer, Figures 3 and 4 displays the console for the answers submitted by the student with a zero-based array. Table 2 displays the responses from the students after the piloting of ODL visually impaired assessment Bot. The reviews from the students' show that ODL Visually impaired assessment Bot is 99.9% efficient as displayed in Table 2.

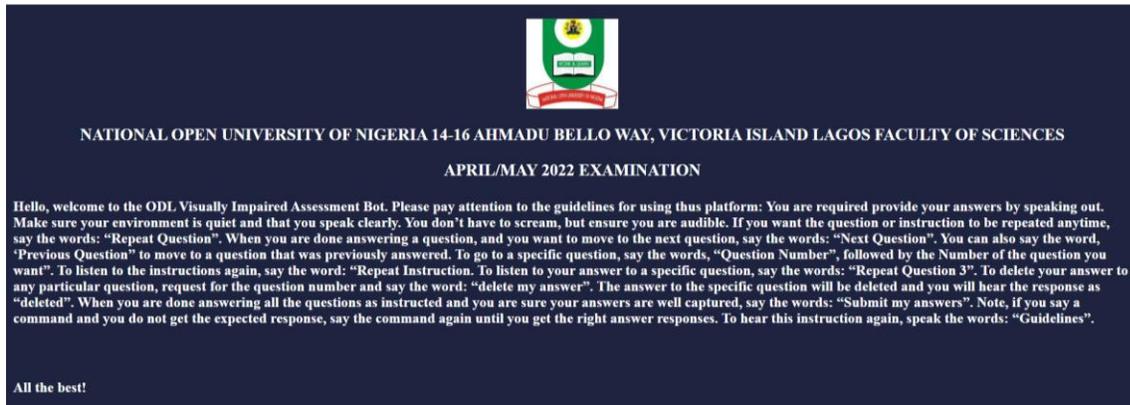


Figure 1: Instructions as was read by the Robot

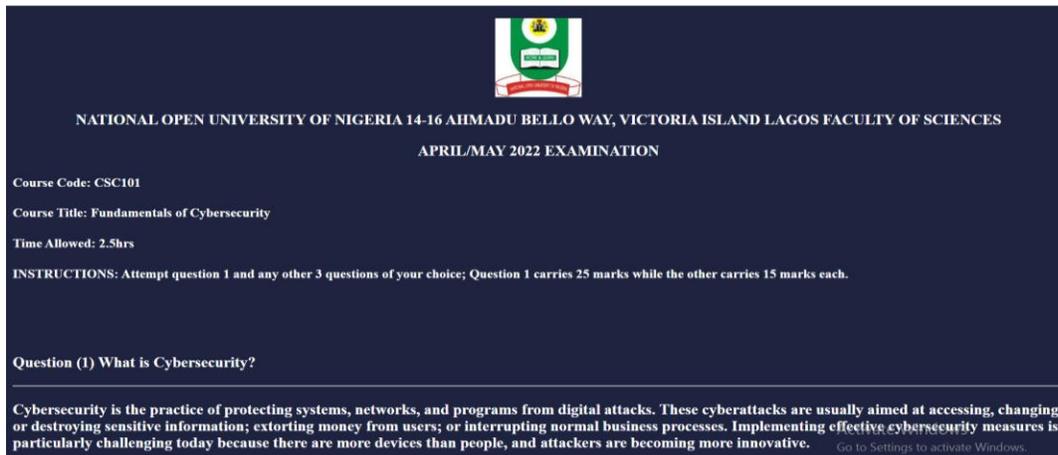


Figure 2: Student's answers as was captured by the Robot

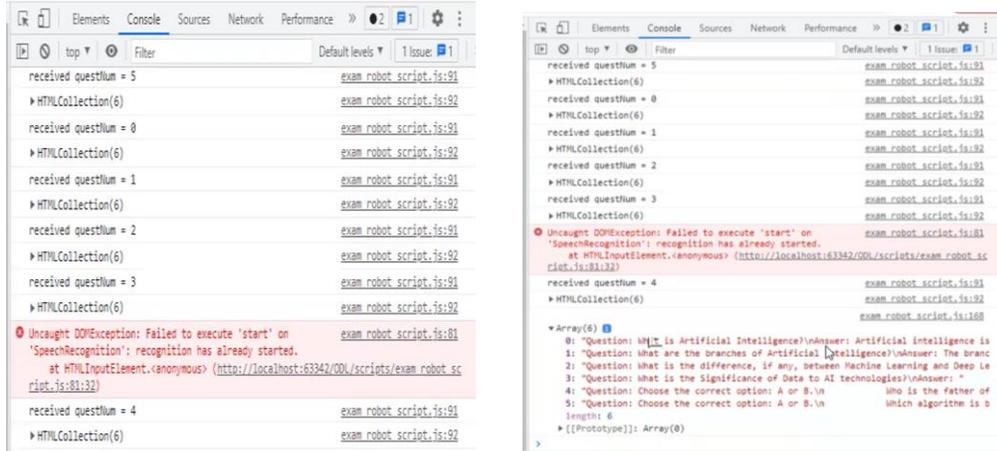


Figure 3 and 4 showing the console of ODL visually impaired assessment Bot

Table 2: Interview Results

S/N	Parameters	No of Responds	% of Respondents
1	USER SATISFACTION		
	The Instructions were clear enough	60	92.3
	I was able to complete my examination successfully with ease	60	92.3
	The system worked the way I expected in the conversation	58	89.2
	The Robot responded to my commands	63	97
2	EFFICIENCY		
	The system was able to understand what I said	62	95.3
	The pace of interaction with the Robot was appropriate in the dialogue	61	93.8
	The total time given for the examination was sufficient	62	95.3
	I was able to answer the expected number of Questions	63	97
3	EFFECTIVENESS		
	The voice response from the system was audible and clear	63	97
	I was able to familiarize myself with the system when I used it for the first time	60	92.3
	I would recommend the application for the blind and the visually impaired to write their examinations	60	92.3
	My answers were successfully submitted	65	100
	The performance of the system was satisfactory	62	95.3

Conclusion and Recommendation

This paper is focused on a voice supported application for the blind and the visually impaired to write their examinations to dictate to the hearing of the student, the examination instructions, the questions and then captures the responses from the student, and submits the answers for the student after attempting the questions, while at the same time automatically monitoring the activities and the environment of the students to avoid any of examination malpractice.

In order to demonstrate Nigeria's commitment to inclusive education, policy reform is required. This would entail the removal of the notion of "special schools" from Nigeria's National Policy on Education, allowing for full social integration of disabled students into regular schools and society. In addition, an immediate census to detect every Nigerian's impairment is required to ensure proper planning for inclusive education in Nigeria. The federal government's literacy programs should be strongly pushed to ensure the elimination of prejudice and stereotypical behaviour toward disabled individuals/students. It is therefore recommended that institutions, organizations and other examination bodies adopt this ODL Examination Robot for their blind and visually impaired staff and students so as to enable them write their examination in confidence, and without hitches, thereby making education accessible to all and to further ensure equality and inclusion in acquiring life-long learning. Artificial intelligence technologies were used to develop a Robot that was used for the implementation of the Application.

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