Adopting the ICT Innovation to Administrative and Activity Procedures in a University

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Abstract: *Information Communication Technology (ICT) has made performing administrative tasks more convenient for organisations. This paper discusses the contribution of ICT innovations to administrative effectiveness with respect to the Open University of Tanzania (OUT) and, specifically, their examination process. An analytical study guided by one hypothesis has been applied in this paper to understand the utilisation of ICT at OUT and framed within the timeframe of the COVID-19 pandemic. The hypothesis states that there is no significant difference in the mean response of students, lecturers, and administrators on the effectiveness of ICT in the Online Oral Examination System (OREX) and administrative process of the OUT. The use of both primary data collected through administered questionnaires to the university population and secondary data sourced from existing literature aided in determining the findings. The results revealed that ICT innovations could be effective if well used in university activities and more suitable if adapted in an innovative way for online admission and a perfect fit for online examination system such as OREX, which was developed as a response to the pandemic. The study also inveterate that the students, lecturers and senior administrative Staff (Registry) had very similar responses on the effectiveness of ICT innovation on the administrative process and academics of the OUT. It was recommended, among others, that the university should mobilise resources towards the provision of facilities and training of its ICT personnel for more relevant innovations, particular for online examination processes such as OREX.*

Keywords: ICT Innovation, OREX, ANOVA, COVID-19, Administrative and Activities Procedures.

1. Introduction

Information Communication Technology (ICT) is a diverse set of technological tools and resources used to communicate, create, disseminate, store, and manage information. It has been part of those automation-induced revolutionary changes in education that have changed many organisations' administrative process (Teräs et al., 2020). The current COVID-19 pandemic put the world education systems in check after the almost universal school closure, shining a spotlight on ICT utilisation in education. It was coupled with the fact that "education research in itself can become critical and itself make a change and promote societal change" (Wolf, 2020), ensuring education sustainability may be dependent on ICT. In this line, the study used OUT education systems and processes as a case study under the conditions created by the COVID-19 crisis to investigate the use of ICT as an effective means to enhance the sustainability of university processes. The theory guiding this study is the Adaptive Structural Theory (AST) by DeSanctis and Poole (1994), which is linked to Adaptive Structuration Theory by Anthony Giddens'(1984). According to this theory, developers and users of ICT innovations hold high hopes for their potential to change organisations effectiveness for the better.

Previously, many universities, including the Open University of Tanzania (OUT), adopted different ICT innovations for a high number of their operations, and there is no doubt that these ICT facilities require substantial financial involvement. Among these innovations include the computer-based examinations, i.e., Online Oral examination System (OREX) or the case of The Open University of Tanzania, online registration, e-learning, virtual meetings (Zoom, Google meet), e-transcript, intranets; enterprise resources package (ERP) among others. There are instances

where employees of the university system still prefer to work manually even with the availability of these innovations because of their misperception of the assumed ineffectiveness of ICT (Chaib & Svensson, 2005). Zuhaib and Muhammad (2016) investigated the status of effectiveness of ICT in university administration at Mehran University of engineering and technology, Pakistan and reported that ICT usage in administration was not found to be as effective as it was supposed to be. Identified reasons included the limited availability of appropriate resources, particularly management information system with training and monitoring mechanism.

Bandari (2014) examined stakeholders' attitude towards the introduction of computer-based testing and assessment in the administration of national examinations in Kenya and highlighted the need to review the switching of assessment in schools over to electronic media, thereby enriching the testing experience and making the test results more useful for teachers and students. In the same ways, Tanzanian universities can adopt ICT-based examinations to improve the administrative effectiveness of examinations and other core mandates. The effective use of the Computer Based Trainings (CBT) system can enhance the productivity and gainfulness of scholarly establishments as it diminishes the cost of stationeries and work associated with conducting examinations manually.

Similarly, Abdulkareem & Nathan (2018) designed and implemented a computer-based testing System (CBTS) in Adamawa state university to diminish the delay of student's examination results. The CBTS was designed using the agile model of the software development life cycle (SDLC). Implementation was done by utilising open-source technologies like XAMPP server, SQL, PhP, JavaScript, cascading style sheet, and hypertext markup language. The innovation presented a notice of student's outcome quickly in the wake of taking the examination, enabled the students to retake the exam (where necessary), and give diverse questions. Okon and Agbogun (2015) investigated the software quality and usability for computer-based testing in Kogi state university and discovered that the basic details of students are covered in the software, and it is easy to start. Previous research done by Okon and Agbogun recommended that for a more flexible database, sufficient bandwidth, network structure flexibility, feedback mechanism and backup systems, state of the art computers with high speed are necessary to further enhance the usability of the software for computer-based testing in the institution (Okon & Agbogun, 2015).

However, Abubakar and Adebayo (2014) identified the prospects and challenges that will pose threats to the success of adopting CBT in all examinations, including economic factors, security, software, poor ICT culture, policy and implementation; and power failure. Makewa et al. (2013) investigated whether there was a significant difference between teachers' and administrators' perceptions on the importance of information and communications technologies (ICT) in secondary school administration and evaluated the extent to which administrators used it—finding that administrators are those involved in the day to day running of secondary school duties such as the principal, deputy principal and heads of departments.

However, actual changes often do not occur or occur inconsistently due to individuals' usage and adaptation trend. The theory examines the change process from two vantage points (1) the types of structures that are provided by advanced technologies, and (2) the structures that actually emerge in human action as people interact with these technologies (DeSanctis and Poole, 1994). In the views of various research studies such as Ghavifekr, S. & Rosdy, W.A.W. (2015) conducted to evaluate the extent of usage of information and communication technologies in multiple aspects of higher education revealed that heads of faculties utilised technology in planning, and to a large extent in the supervision and evaluation of academic affairs, student affairs, financial affairs and administrative affairs (Krishnaveni & Meenakumari (2010); Waddell, (2015)). In view of Tremblay et al. (2012), it was concluded that information and communication technologies have an impact on the increase of the scientific level of faculty members, students and staff; therefore, to achieve this goal, more professional development is required with a focus on increasing teachers' skills so that they are able to overcome apprehensions associated with using technology.

1.1 Problem of the Study

For the study, the problem being investigated is the relationship between the learning processes and technology. World Bank (2018) reported that there the world is facing a 'learning crisis' worldwide, and recognise there needs to be a shift from a focus on schooling to a focus on learning. Reasons for this learning crisis included realising education promises, including assessing learning to make it a serious goal. With such an environment, the addition of universities closures from the coronavirus (COVID-19) pandemic brought on new challenges. There was a big 'technology rush' with the government and education stakeholders exploring what solutions to school closures technology can offer. With the concept of 'New Normal', institutions of learning, starting from a global perspective, are striving to see how they remain relevant and attain set objectives through effective deployment of available ICT innovations in the management of activities. Therefore, it has become imperative for universities in Tanzania to follow these steps by integrating relevant ICT innovations for service delivery to stakeholders.

There is good evidence that the OUT had conducted computer-based examinations for her students, specifically in all education courses or university-wide courses. However, there is also reported failure and inability of management to satisfactorily address the demand of students in terms of the admission process, notification of results, and delivery of transcripts, registration to The National Youth Service Corps (NYSC), communication and acknowledgement of fees paid, despite these innovations. While these failures can be classed as conventional problems, the outbreak of the COVID-19 pandemic has largely disrupted the continuity of the educational delivery system via these approaches, negating the guiding principle of the AST. The use of the online oral examination system (OREX) as an alternative assessment, which is in line with the needs of digitally enabled future education, is a profound innovation to counter the effects of the pandemic. The concern here is the extent of the administrative benefits of these ICT innovations in the overall university processes. Therefore, this study investigated the effect of ICT innovations on the use of online examination (OREX) and administrative effectiveness at Open University of Tanzania, guided by the hypothesis and research questions outlined below.

1.2 Research Hypothesis

- Ho1: There is no significant difference in the mean response of students, lecturers, and administrators on the effectiveness of ICT in the OREX and administrative process of the Open University of Tanzania COVID-19 pandemic.

1.3 Research Questions

- What is the effectiveness of ICT innovations in the administrative and examination process of the Open University of Tanzania during the COVID-19 pandemic?

- What is the most effective ICT innovation in the online examination and administrative process of the Open University of Tanzania?

2. Methodology

The study is mixed-methods research with the use of descriptive qualitative data and minimal statistical quantitative data generated from questionnaires. This was based in part on the study by Denzin (1970), who advocated for 'the combination of methodologies in the study of the same as a phenomenon' (Denzin, 1970,) which have been adopted as an approach to this study. Apart from documents, such sources include interviews or questionnaires, participant or non-participant observation, and physical artefacts (Yin, 1994). This allowed for a largely descriptive research design to be adopted for the study.

The collection of viewpoints was conducted through the administration of questionnaires titled ICT Innovation and Administrative Effectiveness in Open University of Tanzania Questionnaire (ICTAEOUTQUE). The questionnaire was designed by the researchers and validated by two experts. It was then pilot tested (N = 20, r = 0.87). All the staff and students of the Open University of Tanzania constitute the population of the study. A total of 250 respondents were sampled since the population is indefinite. The sampled population included 149 students, 54 lecturers and 27 Senior Administrative (Registry) staff across the departments and faculties of the university. A Google-online form was designed and used for the administration of instruments and distributed

to the various WhatsApp platforms of lecturers, Registry staff, and Students in the university. Additionally, document analysis of literature concerning the topic was conducted to properly frame the context.

The respondents were requested to rate the ICT innovations and administrative effectiveness in The Open University of Tanzania on a five-point rating scale: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagreed. At the submission of the form, it was received by the researcher through his own email address. Only two hundred and thirty (230), indicating 83 per cent of the sampled population, emailed the inbox of the researcher in this order- 142 students, 44 Lecturers and 14 Senior Administrative Staff. The data collected was descriptively analysed. The hypothesis was tested using ANOVA at 0.5 significance level. For the assessment of the OREX as a focus of examination innovation in response to COVID-19 consequences, the analysis and the design of the system was performed between May and June 2020 to systematically understand the business processes in a real-world context to ensure that the developed solution provides highly secured environment while maintaining confidentiality and quality of examinations and without contravening COVID-19 safety requirements. The issue of research ethics such as protection of identities, recognition of participants consents, among others were observed to protect the researcher and the participants of the study (Omodan, 2021), and the necessary approval for the study was made appropriately.

3. Presentation of Results

The session presents the research results based on the research questions and research hypothesis formulated for the study.

3.1 Answering the research questions

Research Question 1: What is the effectiveness of ICT innovations in the administrative and examination process of the Open University of Tanzania during the COVID 19 pandemic?

To answer research question 1, Lecturers, Senior Administrative Staff (registry) and Students were requested to rate the effectiveness of ICT innovations in the administrative process of the Open University of Tanzania on a 5-point rating scale from Strongly Agree to Strongly Disagree. Their responses were descriptively analysed, and results presented in Table 1.

Table 1: *Mean Analysis of Effectiveness of ICT Innovations in the Administration of the OUT* N = 230

Item	N	Mean	Remark
Increased visibility of the university to the world	230	3.60	High
Effectiveness in the general administration of the university	230	3.50	High
Increased Commitment Level of Staff	230	3.53	High
Brought better management of staff and students' information	230	3.60	High
Enhanced Academic Research Activities	230	3.99	High
Increased Quality of Lecture Delivery.	230	3.45	Moderate
Improved Communication and Decisions of Management.	230	3.98	High
Reduced Bureaucratic Process	230	3.45	Moderate
Enhanced Better Transcript Delivery	230	3.45	Moderate
Facilitated Examination Management Process and Notification of Results	230	3.60	Moderate
Reduced Conflict	230	3.45	Moderate
Total Mean		3.60	High

Theoretical Mean = 3.60

According to the data in Table 1, ICT innovation is effective in the administrative process of the Open University of Tanzania, with a total mean score of (3.56). For the item analysis, it has been effective in research and academic activities (3.99), visibility of the university (3.60), management of information (3.60), examination management process (3.60), staff commitment (3.53) and general administration (3.50). Whilst it was ineffective in lecture delivery (3.45), bureaucracy processes (3.45), transcript process (3.45), and then reduction in conflict among staff (3.45).

Research Question 2: What is the most effective ICT innovation in the online examination and administrative process of the Open University of Tanzania COVID 19 pandemic?

To answer research question 2, Lecturers, Senior Administrative Staff (Registry) and Students were also requested to rate the most effective ICT innovations in administration of the Open University of Tanzania on a 5-point rating scale from Strongly Agree to Strongly Disagree. They response were descriptively analysed and result presented in Table 2.

***Table 2:** Mean Analysis of most effective ICT innovations in administration of OUT*

ICT INNOVATION	N	Mean	Remark
Online Admission /Registration Process	230	3.81	High
Online learning/ Attendance Process	230	2.36	Low
Online Examination Process (OREX)	230	3.95	High
Online Result Notification Process	230	2.30	Low
Intranet for mails and memo	230	2.13	Low
Online NYSC Mobilization	230	3.25	Moderate
Online application and delivery of transcripts	230	2.67	Moderate
On line Meeting (Virtual)	230	3.53	High

N = 230, Theoretical Mean = 3.07

According to the data in Table 2, online registration, examination process and Online Meeting (Virtual) recorded the most effective ICT innovation in the administrative process of The Open University of Tanzania with a mean score of (3.81) (3.95) and (3.53) respectively. For the item analysis, intranet for mails/memos and online notification process recorded the lowest mean score of (2.13) and (2.30) respectively.

3.2 Testing of Research Hypothesis

Ho1: There is no significant difference in the mean response of students, lecturers, and administrators on the effectiveness of ICT innovation on administrative process of the Open Universities in Tanzania. The hypothesis was tested using Analysis of Variance at 0.05 level of significance. The result is presented in Table 3.

***Table 3:** Summary of Analysis of variance (ANOVA) on the response of students, lecturers, and administrators on the effectiveness of ICT Innovation on the administration of the OUT*

Sources of variation	Sum of Squares (SS)	Degree of Freedom (df)	Mean Squares (ms)	F-Cal	Critical Value F-tab	Level of Significance	Remark
Between groups SSB	40883	(k-1) = 7	754.49	0.051	2.56	0.05	Accepted
Within groups SSW	6674	K(n-1) = 49	1364.36				
Total	83517.81	56					

According to the data in Table 3, the ANOVA result showed that the calculated F-ratio (F-cal) value was 0.051. On F-table, the critical F-ratio value (F-tab) was 2.56 at 0.05 level of significance. So, F-cal was less than Ftab (F-cal < F-tab) with 56 degrees of freedom at 0.05 level of significance, which is 5% concluding that the effectiveness of ICT at OUT in the mentioned parameters exists, hence the hypothesis of "no significant difference in the mean responses of students, lecturers, and administrators on the effectiveness of ICT innovations on the administration of Open Universities in Tanzania" is accepted. This proved that the students, lecturers and administrators had very similar responses on the effectiveness of ICT innovation on the administrative process of the Open University of Tanzania.

3.3 Oral Final Examinations (OREX) Benchmarking

Being imperative innovation during the COVID-19 pandemic, the OREX, which perceived to be effective of ICT innovation on administrative process OUT examinations activities with a theoretical mean of 3.95 values, provides an alternative assessment system for the adoption by higher learning institutions with new insights on sustainable digitally-enabled future education. This was proven even during the global outbreak of the COVID-19 pandemic complimented by our hypothesis two. Several Higher Learning Institutions (HLI) tried to develop solutions to maintain online learning and assessment for their students. Although the implementation mechanism and technicalities of OREX system differ from other sources, the whole idea of using oral assessment has been benchmarked by other Universities such as University of Twente (University of Twente, 2020) which used video conferencing tools and Iowa State University (ISU, 2020) with mode of participation via telephone or videoconference.

3.4 Software Functional Requirements

The design of the software is based on the well-established business processes as defined in the main OREX proposal approved by the University Senate (OREX, 2020) and mapped in the existing OUT Rolling Strategic Plans (OUT, 2018). Specific features of the software as per the defined business processes include:

- The audiences of the OREX session compose of four participants, a candidate, two examiners and one independent observer.
- The two examiners are named chief examiner (CE) and the second examiner (SE), and must be the subject experts.
- The independent observer, also called exam observer (EO) can be any academic staff.
- The CE/SE/EO pairing is randomly decided by the software.
- The session allocation to the examiner should consider the convenience and availability of examiners.
- The maximum number of available sessions per course per instructor per day is 10.
- The OREX session lasts for a maximum of 60 minutes.
- Each course is divided into two parts, with each part having six comprehensive oral questions.
- The blueprint of the OREX question paper design has two questions, with question one from part 1 and question two from part 2.
- CE will ask question 1, and SE will ask question 2.
- CE and SE will mark both questions based on the OREX marking rubric.
- The average computation of the scores by CE and SE is automatically done by software.
- The question paper and mark sheet are both generated from the software as per the examination timetable, bearing student details such as name, registration number, course code, and date of exam.
- Candidate demographic and academic details are included in the OREX Visa Card (OVC) as a printout from the software.
- The software should capture student data, exam data bank based on question blueprint and marking schemes based on marking rubric.
- Each marker to view webpage as per the assigned role and privilege.
- The online link for the virtual exam room should be accessed by students through the OREX system.

3.5 Scheme Testing and User Trainings

The performance testing of the OREX Scheme was conducted in two phases. The first phase was during the exam registration, where the main actors were students. The second phase was during examination sessions, where the main actors were examiners and students. The registration testing was conducted for 12 days from June 18 2020 to June 30 2020, while the examination phase was conducted in a period of 19 days from July 20 2020, to August 14 2020. Both phases were conducted on the very first OREX event administered at the Open University of Tanzania (OUT). On each day, there was a maximum of 10 slots of OREX sessions. However, the total number of sessions in a single slot depended on the number of students registered.

In each session, only one student was assessed with two examiners (CE and SE) and one exam observer (EO). Candidates were uniquely identified in the system using student registration numbers, while the examiner was uniquely identified using their staff personal file number (PF number). Table 3 below indicates recorded data at the registration and examination phases for both examiners and candidates.

Table 3: Recorded Data in OREX Registration and Examination Phases

SN	OREX Item/Aspect	Participation		Registration Phase		Examination Phase	
		N	%	N	%	N	%
1	Courses	879					
2	Candidates			1,994			
3	Chief Examiners	295	85				
4	Second Examiners	295	85				
5	Exam Observers		85				
6	Exam Sessions			9,380			
7	Question Papers			8900	94.9		
8	Assessed Sessions					7,479	84.03
9	Observer Reports					7,697	86.5

The staff participation rate in testing the framework was 85%, with about 95% of question papers generated from the system. However, despite this level of acceptability, the fear, panic and technophobia dictated the first three days of running live OREX sessions. As part of sensitising this innovation among examiners and candidates, several online workshops training were coordinated at the institutional level. Generally, the training package covered the use, functionalities and procedures to administer OREX sessions using the communication app (zoom) facility. Various OREX guiding tools for the user training sessions were used. These include a quick short guide for students, guide for examiners, guide for zoom settings and roles of CE/SE/EO, OREX marking rubric and procedures, and observer's report.

3.6 The State of Computing Infrastructure

The software accessibility was tested by evaluating the network availability and power reliability. The testing environment was set from both the server-side and the client-side. From the server-side, the initial setup of Internet speed (bandwidth) was 150 Mbps. However, the bandwidth was increased to 300 Mbps after the first week of the testing exercise. The server's physical memory (RAM) size was 8 GB on the first week, and the capacity was increased to 32 GB to improve the system accessibility and for handling concurrent processes. During the whole period of framework testing, backup systems for power supply were put in place to ensure no power cutoff between the live OREX sessions. Users were examiners (CE/SE), exam observer (EO), and candidates from the client side.
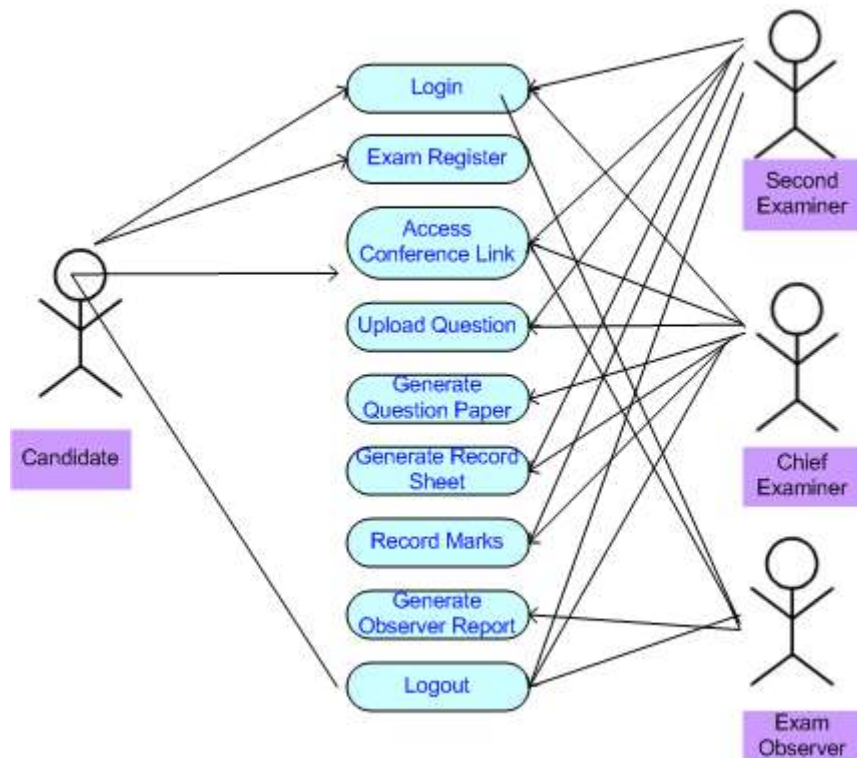
Fig. 1: Use case diagram for OREX System

For better access of the OREX video conferencing service, all client users were required to use electronic devices with the minimum specifications in terms of Internet connection, Microphone, Built-in headset jack from laptop or desktop, Webcam, use of supported operating systems such as Mac OS X with MacOS 10.6.8 or later, MS Windows (10, 8 or 8.1, 7, Vista), and any Linux based distributions such as Ubuntu 12.04 or higher, Mint 17.1 or higher, Red Hat Enterprise Linux 6.4 or higher, CentOS 6.4 or higher, Fedora 21 or higher, OpenSUSE 13.2 or higher, etc. and use of supported web browsers such as MS Windows (IE7+, Firefox, Chrome, Safari5+), Mac (Safari5+, Firefox, Chrome) and Linux (Firefox, Chrome).

3.7 User Entities and Roles

Generally, the software consists of four primary users: candidate, second examiner, chief examiner, and exam observer. Each user is responsible for certain activities, as shown in the figure below. The CE is responsible for the creation of the online session link and sharing it with all the other participants of that specific OREX session (SE, EO, and candidate) at least two days before the exam date. The session link is shared by uploading it on the OREX software accessible from www.orex.out.ac.tz. Other CE roles include making an announcement on the virtual exam room and checking the candidate's particulars by asking interrogative questions, verifying and confirming the student OREX Visa Card (OVC) in the first 5 minutes of the session. The OREX announcement is well structured and intends to remind the student to observe University examination guidelines and rules by reading the following instructions to the candidate.

The CE is also responsible for asking question one, marking both questions as per the marking rubric, reporting an alleged examination irregularity, and to record, save, keep and share the OREX session in MP4 file system with the course coordinator or head of the department using this naming format: *coursecode-regno-examdate* (OCP100_U19-515-1234_170620). On the other hand, the SE assumes all roles of CE when the CE is not available. Otherwise, the SE is responsible for asking question two and marking OREX questions as per the marking rubric. The EO is responsible for facilitating the smooth conduct of online OREX session, from the creation of zoom link to the entire administration of the exam session. The EO functions in close coordination with the CE and the SE.

3.8 Sequence of Activities

Based on the defined functional requirements of the system, each user follows a specific pattern of activity sequences. The sequence is vital for the smooth conduct of online oral examinations.

User	Sequence of Activities
CE	Create Link and Upload→Open Student Info→Activate Question Paper→Record MP4 file→Asking Oral Questions→Marking & Recording of Student Scores
SE	Get Link→Open Student Info→Activate Question Paper→Asking Oral Questions→Marking & Recording of Student Scores
EO	Get Link→Fill Observer Report
Candidate	Get Link→Respond to Oral Questions→Record MP4 file→Asking Oral Questions→Marking & Recording of Student Scores

The online OREX registration process depends on the defined eligibility criteria. The system checks if the candidate has performed online course registration on that particular academic year, paid the required University fees and are computer literate. Once registration is successful, a candidate will be able to generate and print OREX visa card bearing all-important details owned by the
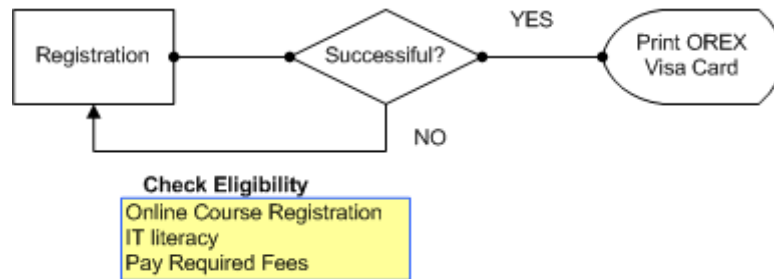
student.

Fig. 2: OREX Registration process

The following is the sample OREX Visa Card.

The Open University of Tanzania
Directorate of Examination Syndicate
P.O.Box 23409
Dar Es Salaam, Tanzania
Direct Line: +255-22-2668835

Student OREX VisaCard

Student Name:	SIMON , JERONIMO -	**Index No:**	S0406/0076/1994
Registration No:	ug2016988530	**Sponsor:**	Private
Address:	7540139779	**Birth Date:**	1974-05-25
Regional Center:	Kilimanjaro	**Printed Date:**	22 Jun 2020
Programme: Bachelor of Arts in Sociology			

	Exams Registered		
S/No	**Course Code**	**Course Name**	**Exam Date**	**Time**
1	OSS 321	Sociology of Knowledge	Monday 20th July, 2020	08:00hrs - 09:00hrs
2	OSS 322	Poverty, Wealth and Inequality	Tuesday 21st July, 2020	08:00hrs - 09:00hrs
3	OSS 323	Globalization and Social Problems	Friday 24th July, 2020	08:00hrs - 09:00hrs
4	OSS 327	Social Policy Analysis	Wednesday 22nd July, 2020	08:00hrs - 09:00hrs
5	OSS 328	Gender and Development	Thursday 23rd July, 2020	08:00hrs - 09:00hrs
6	OSS 329	Social Planning and Evaluation	Tuesday 28th July, 2020	08:00hrs - 09:00hrs

This ticket is valid from to . I declare the information provided above is correct

Signed by SIMON , JERONIMO -   Approved by DES

3.9 Observer Report

The observer report is strictly confidential to capture information about four profiles: *student, session, infrastructure,* and *academic* profiles.
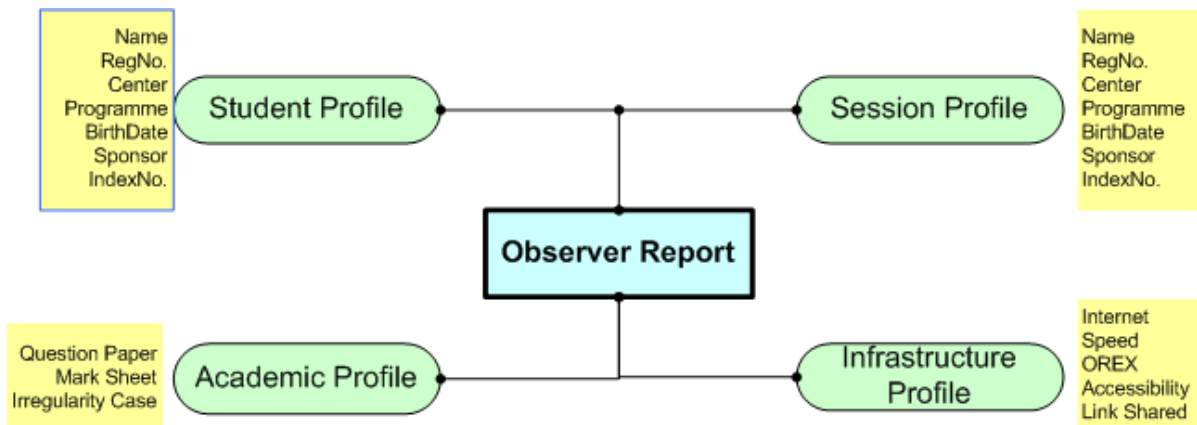

Fig. 3: Attributes in the Observer Report

The general student profile includes student name, examination centre, registration number, programme, birth date, sponsor, and form four index number. The observer's report aims to capture each participant's attendance status (CE, SE, EO, and candidate), check whether or not the candidate was verified; question paper generated, CE/SE worked independently, and if there were any unfair treatments among participants. The report also captures the number of *follow-up* questions asked by examiners and the adequacy of physical arrangements in the virtual exam room, including participant's dress code, noise and interference, Internet reliability, accessibility, and availability of the OREX software session break and disconnects.

3.10 Question Paper Design

The OREX question paper design consists of two types referred to as *Type 1 and Type 2* templates. In both blueprints, the questions tend to test higher-order levels of Bloom Taxonomy and are prepared to carry equal weight and difficult level. The questions are prepared from the course objectives and learning outcomes to focus on the concepts, theories and procedures, applied problem solving, interpersonal competence, intrapersonal qualities and integrated practice. The OREX questions are created to assess various aspects, including application and problem solving, creativity, knowledge and understanding, problem-solving, and communication skills. While validity evaluates the extent to which the student has achieved the learning outcomes, reliability ensures that the assessment is fair to all students.

The OREX questions are submitted through a special question submission form. The question submission form must bear basic details such as *faculty, department, course code, course title* for easy uploading and registering questions into the software databank. Based on the nature of the subject, OREX software accepts question blueprint and specification matrix for primary questions in the form of *type 1* and *type 2*. The OREX course is divided into two parts (P1 and P2) and six knowledge areas (KA1 to KA6) regardless of the course unit and the number of lectures. Part 1 consists of the first three knowledge areas (KA1 to KA3), while part 2 covers the second part of the course, which covers knowledge area 4 to 6 (KA4 to KA6). In all types, the questions are developed from the six (6) knowledge areas (KA), which represent course learning outcomes.

In the type 1 blueprint, the questions are comprehensive and integrated in such a way that each question covers three knowledge areas. For part 1, all questions cover knowledge area 1 to knowledge area 3, i.e., KA1 to KA3, while for part 2, all questions cover knowledge area 4 to knowledge area 6, i.e., KA4 to KA6. Before registering the question into the databank, each question must be assigned a unique question code (Q-Code) using this nomenclature system: CourseCode-Part-QuestionSerialNumber. For instance, the OBS100P2Q5 indicates a question five from part 2 of

the course (covers KA4-KA6) for the course OBS 100. The following is the sample oral question for type 1 blueprint from the business subject:

Q-Code	Q-Text (The question covers KA4 to KA6)
OBS206P2Q5	"Assume that you are a business analyst, select an economic or financial management issue in the public or private sector that has faced your country during COVID-19 pandemic, and has a direct impact on the productivity and competitiveness of the country economy, and develop recommendations to address the problem. Your analysis should address strategic management or policy issues related to the topic, and you have to provide support for your rationale."

In the type 2 blueprint, the questions are not inclusive of assessing the broad aspect of the subject. Instead, they are prepared to test a particular aspect of the topic. That is, each question is designed with subparts that cover a specific knowledge area. For this reason, each question is further subdivided into three questions based on the specific knowledge area. For instance, the code OCP100P2Q4 comes with three sub-questions K4, K5, and K6, because it assesses the second part of the course. The code OCP100P1Q6 indicates a sixth question from the first part of the course OCP 100 with three sub-questions, each representing K1, K2, and K3.

Q-Code	KA	Q-Text (The question is divided into three sub-questions to cover each KA)
OCP100P1Q6	K1	Assume that you want to establish a small business and you want to buy a personal computer to help you become more organised, work more efficiently and to accomplish many tasks. Briefly tell us, how are you going to assess the computer needs for your business?
	K2	Computer is an electronic device with high speed, accuracy and storage capabilities used to process data into information with assistance of several peripheral devices working as input and output devices. Briefly describe how the computer works.
	K3	Briefly explain all basic procedures for setting up a new computer including installation of operating system, office applications, antivirus software, creating user accounts and connecting the new computer to the Internet for the first time.

The choice for whether type 1 or type 2 blueprint is adopted for use is left to the respective department and faculty to decide and to communicate with their students. The software prototypes accept both templates. The questions printed from the system are referred as *primary* questions. They are well structured and printed based on the institutional policy. For this specific study, two primary questions were asked by examiners in each session. The CE was responsible for asking the first question while the SE asked the second question. Considering the fact that both questions are printed instantly on the same webpage, the question navigation style is *free mode.* This flexibility provides an opportunity for a candidate to decide on which question to start with. In addition to primary questions, the system provides an opportunity for the examiners to ask *follow-up* questions.

3.11 Marking Rubric and OREX Malpractices

The OREX assessments were not meant to change the course grading system as outlined in the University prospectus. The marking rubric and criteria were set to guide examiners on the assessment exercise. The average score (in %) taken from two examiners was considered as the final OREX score. Students from all disciplines were assessed on four items based on the following marking rubric:

- Content (25x2=50%)
- Communication Skills (5%)
- Creativity (5%)
- Knowledge and Understanding (5%)
- Problem Solving (10%)

- Understanding of Learning Outcomes (15%x2=30%)
- Confidence (Fluency & Accuracy) (10%x2=20%)

The marking is accomplished on the spot, before the close of the OREX session. In the event that a student seeks a review of a mark, such a record is essential. An appeal to any OREX exam is accepted, provided it is made within a period of three months. Other University appeal procedures remain as usual. The general examination malpractices and irregularity regulations listed in the University prospectus apply as usual regardless of the examination mode i.e., written or oral examinations.

3.12 Student Guiding Procedures

For smooth conduct of the exam session, students need to be well guided on the proper processes and personal behaviour. Students are reminded to observe the code of conduct before and after the session. Other requirements included the choice of the quietest available space to avoid audio disruption, such as background noise, fragmented audio, and the awful echo in the conference room. Students were also required to test and calibrate the speaker's volume at the correct level. For online verification purpose, students were reminded to possess a Student ID, OREX Visa Card, and any one of the following acceptable IDs (Voters ID, Driving License, National ID, and Passport). The candidate not having an OREX Visa Card was debarred from appearing in the OREX examination.

3.13 Virtual Exam Room

The virtual exam room is created by CE using audiovisual conferencing tool. The session is accessed from the OREX software by all participants. The standard accepted settings for creating a session link include the setting of all basic parameters for scheduling an online meeting. Some of these settings are *topic, date and time, duration, time zone* (EAC), and password. As per the OREX standards for virtual exam room, the video option should be set *on* for both host and participants. Participants should be allowed to join before the host, and the link should be set to record the session automatically on the local computer.

3.14 Institutional Experiences from First OREX Administration

The administration of the OREX system brought about the unique experience to the University community. Development of this assessment scheme has shown that Universities in developing countries can provide state-of-the-art software solutions to global problems. Most of the educational institutions in the world of academia were closed during the COVID-19 pandemic. The OREX innovation is proof that University can come up with innovative and realised ideas. Throughout the implementation of the OREX scheme, staff got to know each other by active online participation with examiner or observer roles. The OREX system has helped provide a real-time view of how staff can manage their time well and be responsive to real-time activities within specified time constraints. With this system, it is easy to get a quick picture of staff workload and the level of engagement. Online testing of the framework provided an opportunity to evaluate the strength of the computing infrastructure. This was possible because, through OREX, both staff and students were required to log in to the system concurrently.

Furthermore, OREX administration is a participatory exercise where all academic staff can participate in invigilation and marking activities. Over 300 staff and 1,990 students participated in this new mode of online oral examinations during the COVID-19 pandemic. The introduction of the OREX system has also resulted in an efficient examination budget. Unlike traditional pen/paper examinations, this system has never added any additional cost to the institution as all cost items are constrained within the OREX fee.

4. Discussion of Findings

The study revealed that ICT innovations are effective in the administrative process of the Open University of Tanzania. It has facilitated the visibility of the university, enhanced the general administrative process, increase commitment of staff and equally enhanced research and academic activities, student information/data management and then notification of results in the university, facilitation of examination through online examinations. This is quite expected as ICT innovations have been adjudged to facilities activities of academic institutions in the world.

The findings of this study are in agreement with Zuhaib and Muhammad (2016); Abdulkareem & Nathan (2018); (Okon and Agbogun, 2015); Abubakar and Adebayo (2014). However, there is still room for improvement to ensure effective usage in the areas of e-learning, intranets and communication of decisions, transcripts request, and hostel allocation to students and then meetings in the university. Being an imperative innovation during the COVID-19 pandemic, the OREX Scheme provides an alternative assessment system for the adoption by higher learning institutions with new insights on sustainable digitally-enabled future education. The structural design of the OREX Scheme provides a viable assessment solution that overcomes the limitations of traditional physical oral, and written examinations while ensuring the continuity of the education delivery even at this time whereby the world is faced by COVID-19 pandemic. Meanwhile, online admission/registration and examinations were revealed to be the most effective in the administrative process of the university. It, therefore, validates the report of Agbogun (2015); (Okon and Agbogun, 2015) and Abubakar and Adebayo (2014).

The hypothesis revealed that the students, lecturers and administrators had very similar responses on the effectiveness of ICT innovation on the administrative process of the Open University of Tanzania. This indicates that ICT innovation has had a positive impact and increased effectiveness of the university's administration to the benefit of all stakeholders. This study, therefore, confirms the report of Makewa, Meremo, Role and Role (2013) that lecturers, students and administrators are the major users of ICT in the school system and in a better position to assess its effectiveness. Developers and users of ICT innovations should hold high hopes for its potential to change organisations effectiveness for the better.

5. Conclusion and recommendations

Oral examinations have been in use as one of the assessment modes for many years. Although its vast benefits, such as the provision of better retention of concepts, academic performance, and immediate feedback to learners, the use of this assessment system is still limited to postgraduate courses, especially when assessing viva voce examinations. With the outbreak of the COVID-19 pandemic, the OREX innovation developed by the Open University of Tanzania has proved significant benefits for the wide use of this model to assess both undergraduate and postgraduate levels. The developed OREX has exceeded its established expectations. The structural design of the OREX provides viable assessment solutions that overcome the limitations of traditional physical oral, and written examinations while ensuring the continuity of the University processes and education delivery.

Unlike other university whereby, ICT is used mostly to display information about the university on its websites, making it easy to showcase the university, management of student records, e-learning,e-notifications regarding admission, course schedules, and billing procedures and continues till the end of the course including online publication of results. The OUT had gone further and implemented OREX for examinations activities which is a pivotal part of University activities, particularly during this time around where the world is facing challenges of COVID 19 with no expectation of how this one problem of the COVID-19 pandemic might play out. This study is in consonance with the experimental results, which proved positively in our findings on OREX. Based on the findings and discussions, the following recommendations were made:

- That the university should mobilise resources towards provision of facilities and training of its ICT personnel for more relevant innovations.
- That there should be intensive training of staff and students specifically for ICT introduction and its effectiveness in administrative affairs. This could be achieved through regular workshops, seminars and interactive sessions.
- With the rise of digital education, it is recommended that other educational institutions, practitioners and decision-makers, both from conventional and ODL institutions, can adopt this system as an additional or alternative assessment to administer their examinations. The scheme of OREX assessment is ICT enabled, fully flexible, cost-effective to the adopting organisation, candidates and examiners.
- The Government should further scrutinise the appropriateness of this framework and integrate it into the existing assessments schemes.

- Lastly, the university needs to extend its request to relevant governmental and non-governmental organisations to assist them in the procurement of relevant ICT materials for the university.

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