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# Digitalization of Science Classroom towards Optimum Teaching and Learning of Science: Implications of Blended Learning and E-learning Approaches in Nigeria

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**Abstract:**

This study examines digitalization of science classroom towards optimum teaching and learning of science: implications of blended learning and e-learning approaches in Nigeria. Quasi-experimental design was adopted for the study and sample comprised of 134 science education undergraduates of Ignatius Ajuru University of Education, Rumuolumeni Port Harcourt, Rivers State, Nigeria. Three research questions and three hypotheses guided the study. The instrument was Science Education Undergraduate Performance Test(SEUPT) with reliability coefficient of 0.86 determined by test retest method. Mean and standard deviation were used to answer research questions and hypotheses tested using Analysis of Covariance at 0.05 level of confidence. Findings revealed better performance of science education undergraduates taught using blended learning strategy compared to those with e-learning approach. There was no gender related difference in performance. It was recommended that teachers should embrace the use of blended learning approach and also incorporate other digital technologies in the process of lesson delivery.

**Keywords:** Digitalization, Blended Learning, Science, Classroom.

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**Introduction**

Digital technologies have become an inevitable and vital aspect of learning, and colleges worldwide have suddenly halted face-to-face teaching and resorted to technology-mediated teaching. The swift migration from conventional face-to-face learning to online learning has been seen as a standard revolution in higher education (Younas et al., 2022). Currently exercise books and other teaching and writing paper materials are replaced by laptops or tablets with almost available academic information. that contain almost all the required. These digitalized devices, interaction, student-centered participatory learning are facilitated as students' exchange views and ideas with classmate and the teachers can view even larger audience. Progress in the current trends of digitalization of the education sector will eventually results in total elimination of handwriting lectures, and all textbooks and notes available online and stored in digital repository (Gbamanja, 2019).

According to IGI Global (2019), digitalization is the process of making digital language or technologies part and parcel of human activities by adopting and integrating digital technology to modify, upgrade, enhance, reorganize and change the way and strategies of carrying out human activities in every sphere of life. Digitalized of education utilize innovative and technology-driven teaching and learning strategies such as flipped learning, blended learning, e-learning, personalized learning (Davis, 2019). Therefore, digitalized of education involves the use of innovative and technology-driven teaching and learning strategies such as flipped learning, blended learning, e-learning, personalized learning (Davis, 2019).

Digitalization of education is the transformation of all types of information such as text, visual, video, and other data from various sources translated into final language (Gbamanja ,2019). It simply means the process of incorporating and intergrading digital technology into education activities and process (Victor-Ishiaku, 2020). It involves the use of digital technology devices such as laptop and desktop computers, mobile devices, software application packages and internet services among others. These digital technologies are communication equipment and devices used in the conversion of digital language into human readable forms such as computer, i-pads, e-books, mobile devices and internet.

Digitalization of education has given rise to digital learning which is student-centered and the learners interest is prioritized. The classroom in this case, becomes fun and friendly, hence the learner takes responsibility for his or her learning and enriched the lifelong learning process because of its high level of popularity and acceptability (Siemens, 2019). Digitalized of education involves the use of innovative and technology-driven teaching and learning strategies such as flipped learning, blended learning, e-learning, personalized learning (Davis, 2019).

E-learning according to Aboderin (2015) encompasses an ample array of systems, from the teacher using visual effects to students accessing academic materials online and teaching delivered entirely with the use of computer. It involves the use of network technologies to create, foster, deliver and facilitate learning. It encompasses face-to-face, distance, mixed and blended delivery models that utilizes electronic means, a unifying term used to describe the fields of online learning, web-based training and technology delivered instructions. Electronic technologies are utilized to access educational curriculum outside of a traditional classroom.

E-learning is a computer based educational system that enables learner to learn anywhere and at any time. e-learning is mostly delivered through the internet, although in the past it was delivered

using a blend of computer based methods like CD-Rom The use of e-learning tools in respect to learning process is critical for the successful implementation of various learning environments. modern classroom, whether online or schools-based, use e-learning tools and learning management systems that capture student cognition and engages them in the learning process via technology, while increasing their need for self-directedness ((Aboderin, 2015; Epignosis, 2014).

Essentially, e-learning encompasses information and communication technology on websites, personal computers, portable PCs, mobile phones, learning management System (LMS), radio, and other forms of enhancing teaching and reading. In addition, it requires the application and usage of Information and communications technology (ICTs). E-learning is also a unifying term used to describe the areas of the Network and the technology directions (Elena et al, 2021). The use of e-learning in teaching science arouse students' interest in the learning contents, make learning easy and also allow students and motivate students towards better academic performance (Adebayo (2019). E-Learning increases access to efficient teaching and learning and thereby improve efficiency for students against this backdrop. E-learning encourages multiple students in higher education to pursue related program simultaneously. It enhances high quality in the teaching and higher education of students.

Although, classrooms are considered a face-to-face learning environment, yet the installation of ICT equipment such as web-based tools and other technologies would positively influence students' blended learning situation. This is because there appears to be some consensus that both teachers and students feel that information and communication technology use in the class greatly contributes to students' motivation and engagement in learning.

The unique feature of blended learning is the ability to use refined techniques from both e-learning and traditional method to produce an output which is the best of each method (Almasaed, 2014). The interactions involve face to face and online processes, integrated in such a way that the strengths of each blends into unique learning experience that is congruent with the context and the intended outcome. There are numerous advantages of blended learning in teaching and learning of science. According to Alsalhi et al (2019), blended learning reduces educational costs, increases the number of subjects learned, helps students strive further in particular subjects and allows teachers greater one-on-one relationships with students. Furthermore, blended learning provide scientific materials to student in a fast, easy and clear manner from various forms of e-learning. It makes group lecturing possible and each student can advance at their own pace. Blended learning breaks down the traditional walls of teaching and offers flexible time frames that can be personalized to each person and offer learners ability to learn at their own pace (Ajoku & Chinda, 2020).

The interaction between the learner and learning materials in electronic environment without the presence of a teacher help students to develop self-learning skills which improve the quality of learning (Ajoku & Chinda, 2020). The learning process becomes fun and attractive since the teacher and the learner represents a major part of blending. Blended learning motivates students to learn on their own, at their own pace and in their own time. Proper implementation of blended learning improves students' success, satisfaction, and retention. Therefore, blended learning improve students' attitude towards learning and increase their level interaction (University of Central Florida, 2015).

There are several studies on the effect of e-learning on students' academic performance at various levels of education. Banda et al (2021) examined the effect and challenges of e-learning on students at Mukuba University. The study employed quasi-experimental design. Sample for the study comprised 60 third year students of mathematics studying statistics. Self-made questionnaire and statistics performance tests were used to collect data for the study. Data for the study was analyzed using independent sample t-test statistics. The findings of the study revealed that e-Learning approach improved students' academic performance.

Younas et al (2022) examined the online influencing components for learning among University students in Pakistan during the COVID-19 Pandemic. The population comprised Pakistani University Students in Punjab province who took e- online lessons throughout the epidemic while the instrument was questionnaire survey. Smart PLS 3.0 was used to investigate the suggested study framework using structural equation modeling (SEM). Findings of the study linked e-learning satisfaction to academic success and Pakistani students who utilized e-learning throughout the outbreak reported higher levels of academic satisfaction and achievement. Jawad and Basem (2020) examined the effect of e-learning during COVID-19 pandemic on the students' academic achievement at Al-Quds Open University. The sample comprised 382 students' GPA from the University's official records. The study revealed that there are statistically significant differences in the students' academic achievements during the implementation of the e-learning strategy in COVID-19 pandemic. This study shows that in general the GPA of students increased at about 2.188 points; but in particular the GPA of male students is affected more than female's by just a slight difference of 1.19 point.

Franklin and Nahari (2018) assessed the impact of electronic learning specifically, the influence of web-based learning on academic staff performance at the King Khalid University in Saudi Arabia. The sample comprised 163 respondents as the unit of analyses. Structural equation modeling (SEM) was employed to evaluate the impact of the exogenous variables on the endogenous variables. The study confirmed that acceptance for online teaching (AFOT), Technical competency (TC) and synchronous (SYNC) lectures have indirect influence on performance of academic staff (PERF_ACAD_STAFF). Additionally, acceptance for online teaching (AFOT) and Technical competency (TC) have direct impact on performance of academic staff (PERF_ACAD_STAFF).

Elena et al (2021) examined the correlation between e-learning and the academic achievement of students in higher learning. A set of 150 author's observational studies, carried in Russian educational institutions (both in the period before and during the COVID-19pandemic), was used to measure the impact of e-learning on academic performance using Cohen's formula that focused on a rigorous sampling method. The findings revealed that information and communication technology have a major statistically favourable effect on the academic success of students in e-learning and a substantial positive effect on the total success of students in universities.

Balakamakshi and Savithri (2021) examined the effect of e-learning on students' academic learning performance at college level. The sample comprised 250 Women students from various Chennai Colleges selected by convenient sampling technique. The data was analyzed using the Percentage analysis and Chi- square test. The study found that E-learning provides time flexibility to the student, effective time management and motivates students to learn independently.

Adebayo (2019) investigated the effect of e–learning tools on the students' academic performance in secondary schools in Ilorin metropolis, Nigeria. Descriptive research design of survey

type was adopted. The sample comprised three hundred and thirty (330) teachers drawn from 10 public and private schools each. The instrument for the study was a -twenty (20) items questionnaire. The study found a positive and significant relationship between the use of e-learning tools and students' academic performance. students' use of e-learning tools has significant effect on their academic performance.

Alsalhi et al (2019) investigated the effects of blended learning on ninth grade students' achievement in science and their attitudes towards using it. The study was conducted using a quasi-experimental design case study and the sample was 116 students of United Arab Emirate (UAE), while the instruments were achievement test and questionnaire. Findings of the study revealed that there were statistically significant differences between the experimental and the control groups, in favour of the experimental group, and the experimental group's attitudes were also more positive towards the using of blended learning.

Utami (2018) investigated the effect of blended learning model on senior high school students' achievement. Experimental research method with randomized control group pretest-posttest design was adopted. The sample comprised 63 students attending information and communication technology course, representing 31 students in the experimental group and 32, the control group. The instrument was a 35-item objective test. Results showed that blended learning enhanced students' achievement. Students in the experimental group obtained higher scores than the those in the control group.

Aslam (2018) compared the use of blended learning in middle school science with traditional teaching. This study was conducted with one hundred and fifty grade eight science students studying at local private schools of Lahore. Mixed method research approach was adopted. Results of the study showed that students who were taught with the blended learning model had better scores than those who attended traditional instruction. There were statistically significant differences in students' performance based on the results of pre-test and post-test of the two groups (control and experimental). Students were not only enjoying the blended environments but it also leads to critical thinking.

Gambari et al (2017) explored the effectiveness of blended learning and e-learning modes of instruction on the performance of undergraduates in Kwara State Nigeria using 85 students and Quasi experimental design and Educational Materials and methods Performance Test (EMPT). Result of the study showed the undergraduates taught using blended learning mode of instruction performed better than their counterparts taught using e-learning and traditional teaching method. There was no significant difference between the male and female undergraduates exposed to blended learning and e-learning.

Obiedat et al (2017) investigated the effect of blended learning on achievement of students in university of Jordan. Quasi experimental design was adopted and the sample comprised 427 students from King Abdulla11 School for Information Technology at University of Jordan. Results of the study showed that there was a significant and positive impact of blended learning on academic achievement of the students in the University of Jordan. Lecturers and students found that blended

learning enjoyable and stimulating while having positive effect on students' study process and addressing the problem of lack of possibilities for some students.

Alajab and Hussien (2015) investigated the impact of proposed blended learning strategy for teaching English among Khartoum University in Sudan Therapeutic and health and nutrition students. Mixed research design was adopted and the sample of the study comprised of 137 college students in Faculty of Education. Results of the study showed a significant effect of the proposed blended learning strategy on subjects' achievement in English for science. The experimental group students reported a high degree of satisfaction with blended learning experience in scientific English.

Cobanoglu and Yurdakul (2014) examined the effect of blended learning on students' achievement, perceived cognitive flexibility levels and self-regulated learning skills. Mixed method specifically concurrent mixed method design was adopted and the sample comprised 65 senior students in "IT and Ethic" course of Computer Education and Instructional Technology programme at Faculty of Education, Ege University. Result of the study showed that blended learning based progamme implementation caused students to gain deep understanding and critical reasoning useful for the transfer of theoretical knowledge to real life situations. Students were also able to think, inquire, explore the subject matter and share their opinions and discuss others' opinion.

Gambari et al (2017) explored the effectiveness of blended learning and e-learning modes of instruction on the performance of undergraduates in Kwara State Nigeria using 85 students and Quasi experimental design and Educational Materials and methods Performance Test (EMPT). Result of the study showed the undergraduates taught using blended learning mode of instruction performed better than their counterparts taught using e-learning and traditional teaching method. There was no significant difference between the male and female undergraduates exposed to blended learning and e-learning.

**Statement of the Problem**

Recent advancements in information and communication technology has led to the development of innovative and technology-based instructional strategies which utilize online digital facilities to that facilitate effective lesson delivery and quality learning. These technology-based strategies provide a major lead way towards providing solution to the problem of students' difficulty in understanding of science concepts and has attracted the attention of researches in all disciplines of the education. Many researchers explored the effectiveness of strategies that utilize only online-based digital technologies and the conventional lecture teaching method while others center their studies on the combination of traditional face-to-face and online learning approaches and lecture teaching method. There seems to be limited studies that compare the level of effectiveness of these strategies leaving a gap in the knowledge to be filled. This study therefore, focus on the comparative effectiveness of e-learning, which is online-based strategy and blended learning approaches which combine the online-based technology and face-to-face conventional lecture method of teaching.

**Objectives of the Study**

This study examined the effect of e-learning and blended learning approaches on the academic performance of university student in Rivers State. Specifically, the study tends to determine the:

1. Academic performance of university students taught using e-learning learning approach and lecture teaching method in Ignatius Ajuru University of Education.
2. Academic performance of university students taught using blended learning approach and lecture teaching method in Ignatius Ajuru University of Education.
3. Academic performance of university students taught using e-learning and blended learning approaches in Ignatius Ajuru University of Education.

**Research Questions**

1. What is the academic performance of university students taught using e-learning learning approach and lecture teaching method in Ignatius Ajuru University of Education?
2. What is the academic performance of university students taught using blended learning approach and lecture teaching method in Ignatius Ajuru University of Education?
3. What is the academic performance of university students taught using e-learning and blended learning approaches in Ignatius Ajuru University of Education?

**Hypotheses**

**$H_{O1}$:** There is no significant difference between the academic performance of university students taught using e-learning learning approach and lecture teaching method in Ignatius Ajuru University of Education.

**$H_{O2}$**: There is no significant difference between the academic performance of university students taught using blended learning approach and lecture teaching method in Ignatius Ajuru University of Education.

**$H_{O3}$**: There is no significant difference between the academic performance of university students taught using e-learning and blended learning approaches in Ignatius Ajuru University of Education.

**Significance of the Study**

Findings of this study will provide lecturers a wider scope of innovative approaches for effective lesson delivery in line with current trends of the revolution in information and communication technology. The use of online platform for assignment delivery will offer students the opportunity to study without stress and at their own pace while at home and even submit assignments without the stress going to school. Furthermore, it saves the students the burden of carrying text books form their houses to the school. Lecturers will also deliver their lessons, give students assignment and administer test and examinations online through the online platform. Furthermore, the use internet guarantees safety storage of information and easy retrieval at all times to both students and lecturers. The findings will be very useful to stakeholders in education as it will provide a useful means providing solution to the problem of academic dishonesty such as cheating and plagiarism.

**Methodology**

Quasi-experimental research design was adopted in this study with 134 3rd year science education students of Ignatius Ajuru University of as the sample. The instrument was a-25-item Performance Test tagged Methods of Teaching Science Performance Test(MTSPT) developed by the

researcher and validated by two other Science Education lecturers. The reliability coefficient of 0.86 for the instrument was determined by test-retest method. Mean and standard deviation were used to answer research questions and the hypotheses tested at 0.05 level of significance using Analysis of Covariance(ANCOVA). The 3rd year students in the intact class were divided into three groups with proper representation of high, medium and low academic performance levels. The three groups were randomly assigned control, experimental group 1 and experimental group 2. Students in control group were taught with lecture teaching method, experimental group 1 students were taught with blended learning approach while group 2 learnt with e-learning approach. Hypotheses were accepted when the calculated value of F-ration is less than the table or critical value and rejected when the calculated value is greater than the table or critical value.

**Results**

**Research Question 1**

What is the academic performance of university students taught using e-learning learning approach and lecture teaching method in Ignatius Ajuru University of Education?

**Table 1: Mean and standard deviation of the performance of university students taught using e- learning and those taught with lecture teaching method**

| Treatment | N | Pre-test | | Post-test | |
|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD |
| **E-Learning** | 44 | 47. 78 | 1.68 | 62.21 | 1.24 |
| **Lecture Method** | 40 | 44.26 | 1.45 | 43.12 | 1.04 |

From Table 1, the post-test mean score shows university students taught using e- learning approach obtained higher score (62.23) than those taught with lecture method (43.12) in the performance test. This infer that university students taught with e- learning approach performed better than those taught with lecture method after treatment.

**Research Question 2**

What is the academic performance of university students taught using blended learning approach and lecture teaching method in Ignatius Ajuru University of Education?

**Table 2: Mean and standard deviation of the performance of university students taught using blended learning and those taught with lecture teaching method**

| Treatment | N | Pre-test | | Post-test | |
|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD |
| **Blended Learning** | 50 | 45 .34 | 1.05 | 85.15 | 1.11 |
| **Lecture Method** | 40 | 44.26 | 1.45 | 43.12 | 1.04 |

From Table 2, the posttest mean score shows university students taught using blended learning approach obtained higher score (85.15) than those taught with lecture method (43.12) in the performance test. This infer that university students taught with blended learning approach performed better than those taught with lecture method after treatment.

**Research Question 3**

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What is the academic performance of university students taught using e-learning and blended learning approaches in Ignatius Ajuru University of Education?

**Table 3: Mean and standard deviation of the performance of university students taught using e-learning and blended learning approaches.**

| Treatment | N | Pre-test | | Post-test | |
|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD |
| **E-Learning** | 44 | 47. 78 | 1.68 | 62.21 | 1.24 |
| **Blended Learning** | 50 | 45 .34 | 1.05 | 85.15 | 1.11 |

From Table 3, the posttest mean score shows university students taught using blended learning approach obtained higher score (85.23) than those taught with e-learning (62.21) in the performance test. This infers that university students taught with blended learning approach performed better than those taught with e-learning approach after treatment.

**Hypothesis 1**

There is no significant difference between the academic performance of university students taught using e-learning learning approach and lecture teaching method in Ignatius Ajuru University of Education.

**Table 4: Analysis of Covariance (ANCOVA) of difference between the academic performance of university students taught using e-learning learning approach and lecture teaching method**

| Source | Type 111 sum of squares | Df | Mean square | F | Sig. |
|---|---|---|---|---|---|
| **Corrected Model** | 2257.316 | 2 | 21021.098 | 43.865 | .000 |
| **Intercept** | 5632.172 | 1 | 1.382 | 154.325 | .00 |
| **Pretest** | 1.2267 | 1 | 3211.1320 | .0311 | .673 |
| **Treatment** | 1244.126 | 1 | 38.421 | 114.0121 | .00 |
| **Error** | 10123.662 | 81 | | | |
| **Total** | 702134.000 | 84 | | | |
| **Corrected Total** | 23651.301 | 80 | | | |

**(*P*<0.5)**

From Table 4, F(1, 81) = 114.0121, p<.05 is greater than the table or critical value. Therefore, the null hypothesis which states that there is no significant difference between the academic performance of university students taught using e-learning learning approach and lecture teaching method is rejected. This infer that, there is significant difference between the performance of university students taught using e-learning and those taught with lecture method.

**Hypothesis 2**

There is no significant difference between the academic performance of university students taught using blended learning approach and lecture teaching method in Ignatius Ajuru University of Education.

**Table 5: Analysis of Covariance (ANCOVA) on difference** between the academic performance of university students taught using blended learning approach and lecture teaching method

| Source | Type111 sum of squares | Df | Mean square | F | Sig. |
|---|---|---|---|---|---|
| **Corrected Model** | 3247.316 | 2 | 21021.098 | 43.865 | .000 |
| **Intercept** | 5612.172 | 1 | 1.382 | 154.325 | .00 |
| **Pretest** | 1.1267 | 1 | 3211.1320 | .0311 | .673 |
| **Treatment** | 3244.126 | 1 | 38.421 | 87.113 | .00 |
| **Error** | 10123.662 | 87 | | | |
| **Total** | 702134.000 | 90 | | | |
| **Corrected Total** | 13651.301 | 80 | | | |

**(*P*<0.5)**

From Table 5, F(1, 87) = 87.113, p < 0.05 is greater than the table or critical value. Therefore, the null hypothesis which states that there is no significant difference between the academic performance of university students taught using e-learning learning approach and lecture teaching method in Ignatius Ajuru University of Education is rejected. This infer that there is significant difference in performance between students taught using e-learning and those taught with lecture method.

**Hypothesis 3**

There is no significant difference between the academic performance of university students taught using e-learning and blended learning approaches in Ignatius Ajuru University of Education.

**Table 6: Analysis of Covariance (ANCOVA) of the difference between the academic performance of university students taught using e-learning and blended learning approaches.**

| Source | Type 111 sum of squares | Df | Mean square | F | Sig. |
|---|---|---|---|---|---|
| **Corrected Model** | 3247.021 | 4 | 13171.512 | 27.428 | .000 |
| **Intercept** | 5439.197 | 1 | 54362.121 | 156.325 | .000 |
| **Pretest** | 1.613 | 1 | 1.102 | .0311 | .673 |
| **Treatment** | 3223.126 | 1 | 3524.211 | 65.132 | .000 |
| **Error** | 10092.121 | 91 | 35.431 | | |
| **Total** | 702134.000 | 94 | | | |
| **Corrected Total** | **13651.301** | **80** | | | |

From Table 6, F (1, 91) = 65.132, p <.05 is greater than the table or critical value. Therefore, the null hypothesis is accepted which infer that there is no significant difference between the performance of university students taught using e-learning and blended learning approaches

**Discussion of Findings**

Results of this study showed that, the use of e-learning teaching approach caused a significant improvement in the academic performance of university students than the lecture teaching method (Table 4). Higher performance scores of students taught with e-learning approach was obtained in contrast to the poor academic performance of the students that received lectures with conventional

lecture method(Table1). This results corroborates the findings of independent studies of Younas et.al. (2022); Banda (2021), Jawad and Basem (2020); Franklin and Nahari (2018); Elena et al (2021); Balakamakshi and Savithri (2021) and Adebayo (2019) which revealed improved students' academic performance on teaching with e-learning approach than lecture method. Also, there was a significant difference between the academic performance of university students taught using blended learning approach and those taught with lecture method (Table 5). These results agree with the findings of the studies conducted at various universities by Alsalhi, Eltahir and Al-Qatawneh (2019); Utami (2018); Aslam (2018) and Gambari et al (2017); Obiedat, et al (2017) Alajab and Hussien (2015) as well as Cobanoglu and Yurdakul (2014) where similar improvement in academic performance of university students taught with blended learning approach compared to lecture method was obtained.

Comparative study of e-learning and blended learning approaches revealed a significant difference between the academic performance of university students taught using e-learning and blended learning (Table 6). Students taught using blended learning approach performed significantly better with higher scores in the performance test than those taught with e-learning approach. This results agree with that of Gambari et al (2017), which showed that undergraduates taught using blended learning mode of instruction performed better than their counterparts taught using e-learning and traditional teaching method in Kwara State, Nigeria. This results validates the effectiveness of blended learning approach most especially, in the tertiary institutions where quite a large number of students are exposed to learning at the same time. The implication therefore, is that although the use of online-based teaching strategies has been adjudged effective when compared to conventional lecture method, a proper integration of these two strategies will produce more effective and unique teaching strategy. This supports the assertion of Alsalhi et al (2019) that, blended learning provides scientific materials to student in a fast, easy and clear manner from various forms of e-learning making group lecturing possible as each student can advance at their own pace.

**Conclusion**

Blended learning approach is an effective strategy for teaching science compared to e-learning and other online approaches of teaching.

**Recommendations**

1. Lecturers should embrace the use of blended learning strategy for teaching science and related concepts.
2. Government should ensure availability of well-equipped information and communication technology centers in university campuses to enhance students access to only teaching materials.
3. Information and communication technology courses should be made compulsory at all levels of the university education to ensure high level of competencies of students in handling online courses.

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