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Effects of E-Learning on Students' Performance, Confidence Level and Science Process Skills Acquisition in Basic Science and Technology

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ABSTRACT

The study investigated the effects of e-learning on students' performance, confidence level and science process skills acquisition in Basic Science and Technology in Oju Metropolis. The study utilised a non-randomised pretest-posttest quasi-experimental design. A sample of 107 Upper Basic II students drawn from a population of 803 in Oju using purposive sampling technique was used. The students in the experimental group were taught using e-learning while their control group counterparts were taught using expository strategy. The instruments used for data collection were BPET, BCOT and BPAT which gave reliability coefficients of 0.92, 0.87 and 0.83 using Kuder-Richardson (KR_{21}) and Cronbach Alpha respectively. Three research questions were answered using mean and standard deviation while the three null hypotheses were tested using ANCOVA at 0.05 level of significance. The findings of the study revealed that, there were significant difference between students' performance ($P = 0.00 < 0.05$), confidence level ($P = 0.00 < 0.05$) and science process skills acquisition scores ($P = 0.00 < 0.05$) of the experimental and control groups. Based on the findings, it was concluded that e-learning has enhanced students' performance, confidence level and science process skills acquisition scores better than conventional strategy. It was therefore, recommended that, while school administrators should develop e-learning apps which allow personalised and uninterrupted learning by giving students ample opportunity to repeat multimedia lessons any time; teachers are also encouraged to employ this innovative strategy since it is a factor in students' learning outcomes.

INTRODUCTION

The development of a nation hinges on the level of scientific and technological advancement. To realise this, science education researchers have not rested on the oars of their previous publications but keep searching for new ways of making teaching and learning of science easy, meaningful and exciting to both teachers and students. This is pertinent because, we live in an era characterised by rapid development in science and technology where many innovations have been springing up on daily basis. However, the Nigerian education system is yet to be fully braced up with the technological innovations in teaching and learning; and this has been a nagging pain to educational administrators and other concerned stakeholders. One of the reasons for this lag could be attributed to the persistent use of conventional teaching strategies by the teachers, mostly characterised by chalk-and-talk, overcrowded classrooms, recitation, one-shot-lesson, listening and rote learning (Comino, 2017; Egbodo, 2019). This old system has no doubt, teacher-centric in nature, usually assigning one teacher to many students in an overloaded classroom. Consequently, one teacher with multiple academic tasks in such a classroom may not be able to meet the needs and interests of individual student because every student has different learning styles, interests, needs and cognitive abilities.

In an effort to provide solution to the shortcomings of conventional pedagogy used by science teachers, Samba and Eriba (2011) asserted that teaching must go beyond chalk-and-talk method and it must involve the totality of the student, and the instructions must be prepared in such a way that at any given time, students' learning must make use of more than two senses. It is as a result of the need for these changes, that the researchers suggest a shift from the conventional strategy to a more modern constructivist-based one like electronic learning (abridged as e-learning) for teaching Basic Science and Technology (BST). The major thrust of e-learning strategy is personalised or adaptive learning where a teacher's role is to be a guide on the side instead of a sage on the stage. It is therefore, hypothesised that, e-learning may encourage students in their Upper Basic II to be actively engaged in science learning as they have access to multiplicities of multimedia resources. Upper Basic II students in particular, offering BST were used as the respondents. Upper Basic II students are students in their second year of study in Upper Basic school under the new 9-3-4 system of education in Nigeria.

Basic Science and Technology is a combination of the former Integrated Science and Introductory Technology which a child encounters at the Upper Basic level of education. It is a composite form of science at Upper Basic level of education involving concepts from Chemistry, Physics, Biology, Technology, Physical and Health Education, and Geography. It prepares students at the Upper Basic level for subsequent study of specialised core science courses (Enemarie, Ogbeba, & Ajayi, 2019, Agbidye, 2017; Agogo, & Achor, 2014). The goals of Basic Science and Technology according to Nigerian Educational Research and Development Council (NERDC) (2012) are to develop learners' interest in science and technology; acquire basic knowledge and skills in the subject; apply basic scientific and technological knowledge and skills to meet contemporary societal needs among others. Also, the Federal Republic of Nigeria (FRN, 2013), in release of her educational objectives for secondary schools, emphasises the need to equip students to live effectively in the modern age of science and technology.

Despite the aforementioned objectives, Olibie, Ezoem and Ekene (2014) reported that, there is a lack of science process skills acquisition and general underperformance in both internal and external examinations among students which have been attributed to the use of analogue teaching methods, dearth of technological tools, lack of self-confidence, and overloaded classroom with only one teacher who occupied with humongous activity-logs. The influence of e-learning on students may minimise these gaps; and open new eras and trends which require the use of specific tools and new technique to improve children's life in both school and home settings (Akyol, & Garrison, 2019; Newman, Johnson, Cochrane, & Webb, 2018;.Agar, 2010; Jarmon, 2011; DFKI, 2015).

This is because students may learn meaningfully to gain knowledge autonomy as e-learning strategies are predicted to be learner-centered, activity-based, resource-based, interactive, integrative, individualistic and collaborative capable of getting learners fully involved in the learning process (Agar, 2010). In addition, students are given 24 hours opportunity to practice science activities at one's convenience without interruption. E-learning strategies which recognise learners as the primary target beneficiary for curriculum planning and teaching include but not limited to machine-assisted learning, intelligent tutoring, multimedia, computer-aided, flipped classroom, adaptive, social media and virtual science laboratory strategies. Among these, the study only focused on machine-assisted learning. In this strategy the teacher only guides on the side instead of being a sage on the stage, leading the learners to achieve teaching objectives through activities they are engaged in during adaptive classroom interactions (Yoav, & Litvak, 2011; Mampadi, 2011; Olibie, Ezoem & Ekene, 2014; Lam, 2015; Bliss, & Lawrence, 2019).

Besides, e-learning instruction is imperative in education especially at the period of lockdown or shutdown of schools over COVID-19 pandemic and other related cases. In such a situation, homeschooling using e-learning instruction would take the place of conventional classrooms (Broom, 2020; Vedantu, 2020). Thus, e-learning will help children learn uninterruptedly from the safety of their homes even when the school has been shutdown either as a result of outbreak of endemic and pandemic diseases like Coronavirus.

E-learning strategy is the use of electronic tools to supplement instruction. It is a programmed instructional software, website or web app that can mimic human intelligent processes in terms of lesson delivery, test administration, tracking students' progress, giving feedback and display experiments in virtual format (Brynjolfsson, & McAfee, 2013). This learning strategy is not about educational robots taking away jobs from teachers and brainwashing children but it is much more of ordinary application programmes running on tablets, laptops, apples or smartphones used to supplement classroom instruction (Oteyola, Adeyanju, & Egbedokun, 2013). The choice of e-learning is in response to the challenges of conventional system of lesson delivery that has been used for years but has been considered ineffective, inflexible and slow for addressing different learning styles, needs and levels of preparation for labour market in the 21st Century and beyond (Woodfield, 2015). Under this technique, for students to learn meaningfully, the classroom depends on Bring Your Own Device (BYON).

This study was underpinned on two social constructivist theories by Lev Vygotsky (1962) theory of social development; and Garrison, Anderson & Archer (2000) theory of Community of Inquiry. These theories are related to this study because both of them centered on the premise that, learning is fundamentally a social act in addition to personalised instruction via e-learning which is the major thrust of this study. These theories of learning support the use of electronic tools that can mimic human intelligence in lesson delivery, grading students and monitor students' progress.

Machine-assisted learning type of e-learning used in this study is a programmed software, website or app designed to supplement classroom instruction. It is an ordinary application programme running on tablets, laptops, apples and smartphones that can teach learners on a one-on-one basis (MBD, 2019). The objective of using machine-assisted learning in education is to help facilitate learning, improve course navigation, simplify the learning process, analyse answers and give prompt feedback to students' response. If students could not understand facts in a specific topic or subject area as often happen in conventional classrooms, machine-assisted learning provides students with web links or search option for further information. It also offers videos for every concept that students study so that in addition to hints and links, there would be videos to help them understand the topic effectively (Downess, 2016). Machine-assisted learning and expository strategies will be compared to determine which one enhances learning outcomes better than the other.

Performance, confidence level and science process skills acquisition were the dependent variables of the study discussed in subsequent sections. Performance is the score obtained by students in a test or an examination. Unimpressive performance in science subjects is usually attributed to ineffective method of instruction, overloaded classroom, dearth of ICT facilities, poor condition of services, negative attitudes of teachers towards ICT-driven trends, lack of laboratory among others (Mohammad, Sarikhani & Salari (2016). The persistent students' poor performance in science, lack of problem-solving skills, ill-confidence and anxieties towards science learning suggest that, there is a need for curriculum planners to support the outcry for changes in instructional technique from conventional to technology-driven strategy like machine-assisted learning.

Students' confidence level could be considered as one of the most influential motivators and regulators of behaviour in everyday life (Wijekumar, Meyer, & Lei, 2017). The authors added that one's perception of ability or self-confidence is the central mediating construct of performance strivings. This could mean that the major influence in the acquisition of expert performance, skills and retention in the school and in the society is the confidence and motivation to persist in deliberate practice for a sustained period of time. Confidence can be defined as one's ability to believe in his/her strength to success or perform a task. Parents and teachers are facing problem in terms of the performance of students as it is considered low; which is also attributed to students' low self-confidence towards science learning. Thus, when students find learning materials difficult, boring or not interesting, they will inherently performance low. On the contrary, positive self-confidence and self-efficacy among students towards science learning will in turn improve their learning outcomes. Therefore, developing students' positive confidence through the use of e-learning strategy may enhance their performance, and development of science process skills because even shy students who may be intimidated by traditional classroom, e-learning or online chatroom may provide them with self-confidence in addition to the development of ability to work independently.

Science process skills acquisition is another vital variable of the study. Achor, Odoh and Abakpa (2018) expressed that students have not sufficiently demonstrated competency in the application of science process skills in examinations and in solving everyday life problem. The result being that, students have not only massively failed in standardised tests but also lack complex problem-solving skills. Science process skills are abilities needed by scientists to carryout scientific investigations while process of science means the procedures followed by scientists to acquire scientific knowledge. This most important learning variable encompasses the skills of psychomotor domain which requires the synchronisation of the head, mind, hands and eyes in the classroom can be developed through e-learning. The essential science process skills which students are trained to acquire through education are identification and statement of problem, observation, formulating hypotheses, making inferences, conducting experiments, measurement, classification, gathering and analysing data, prediction, communication, questioning, drawing conclusion among others. Out of these, the study only measured observation, summarising, inference, communication, interpretation and experimentation. When students are being taught to develop a range of these skills in school, the statement of lesson objectives would include action verbs such as observe, apply, draw, prepare, make, design, set up, assemble, demonstrate, build, classify, manipulate, measure, calculate, plot, infer, predict, arrange and formulate.

Statement of the Problem

Conventional system is usually teacher-centered in nature characterised by overcrowded classrooms primarily for the purpose of examination and certification. The effects of these are lack of practical skills, unimpressive performance, low retention power and little or no confidence among students. Furthermore, others pains of this old system are delays in providing feedbacks to students by one teacher who occupied with heavy academic loads; disruption of children’s learning by lockdown or closure of schools. It would be suggested that, one teacher should be assigned to one student but this also certainly involves exorbitant expenses which the nation may not be able to shoulder at this era of economic crisis (Olibe, Ozoem, & Ekene, 2014).

The use of e-learning may make learning process a flexible experience for students to uninterruptedly practice science concepts at convenience as well lessening teachers' workloads. To the best of the researchers' knowledge, no research has been done in the area of Upper Basic II in Oju Metropolis in particular to align this new trend in technology with scientific advancement. Therefore, a research into this innovative strategy is needed. One may ask: Do the use of e-learning in BST enhance students' performance, confidence level and science process skills acquisition than conventional strategies? The problem of this study therefore, was to determine the effects of e-learning on Upper Basic II students' performance, confidence level and science process skills acquisition in Basic Science and Technology in Oju Metropolis.

The following research questions guided the study:

1. What is the difference between the mean performance scores of students taught BST concepts using e-learning and expository strategies?

2. What is the difference between the mean confidence level scores of the students taught BST concepts using e-learning and expository strategies?

3. What is the difference between the mean science process skills acquisition scores of the students taught using e-learning and expository strategies?

The following hypotheses were tested at 0.05 level of significance:

1. There is no significant difference between the mean performance scores of the students taught BST concepts using e-learning and those taught using expository strategy.

2. There is no significant difference between the mean confidence level scores of the students taught BST concepts using e-learning and expository strategies.

3. There is no significant difference between the mean science process skills acquisition scores of the students taught using e-learning and expository strategies.

MATERIALS AND METHODS

The study adopted a non-randomised pretest-posttest quasi-experimental design. Both the experimental and control groups received the same treatment and assessments' contents on work, energy and power. Three research questions and three hypotheses were stated and tested using mean and standard deviation, and Analysis of Covariance (ANCOVA) at 0.05 level of significance respectively. A sample of 107 comprising 45 students assigned to experimental group and 62 students to control group drawn from a population of 803 Upper Basic II students offering Basic Science and Technology in Oju Metropolis, Benue State were selected using purposive sampling technique. Three instruments, Basic Science Performance Test (BPET), Basic Science Confidence Test (BCOT); and Basic Science Process Skills Acquisition (BPAT) were used for data collection. BPET is a 2-in-1 instrument developed by the researchers that measured students' performance and confidence level.

Using test-retest, the two groups were pretested to determine the entry knowledge of the students as well as to obtain the reliability coefficients of the instruments. After six weeks of treatment, a posttest was administered and the scores recorded again. These scores were then used for reliability analyses of the instruments using Kuder Richardson (KR_{21}) to determine the reliability coefficients of BPET and BPAT while Cronbach Alpha was used for that of BCOT. To collect the data efficiently using BPET, BPAT and BCOT, two research assistants were recruited and trained for two days who in turn assisted the researchers in teaching the content, administered the pretest and posttest and collected the data for further analysis. BPET has a reliability coefficient of 0.92 while BCOT gave 0.87. BPAT which measured students' science process skills acquisition gave a reliability coefficient of 0.83.

The BPET consisted of 40 items multiple choice questions which were converted to 100%; and BPAT was a 21 items alternative to practical essay questions designed to elicit response from the students. This test also has a total of 100 marks. The BPET and BPAT tests lasted for 60 minutes. To understand the extent of guessing or choosing a correct response for an item of BPET, confidence level rating coded as BCOT was introduced under each item of the questions. In this confidence level rating, the respondents indicated how sure their responses were on a four-point scale of Completely Confident, Moderately Confident, Rarely Confident and Never Confident with ratings of 4, 3, 2 and 1. Each student was expected to rate his/her confidence level with regards to the selected answer to a question. The control group took their treatment and test via paper and pencil mode while the experimental group took theirs on a developed e-learning platform.

RESULTS

Research Question One

What is the difference between the mean performance scores of students taught Basic Science and Technology using e-learning strategy and those taught with conventional strategy?

Table 1: Mean and Standard Deviation of Students' Performance Scores in E-learning and Expository Strategies

Group	N	Pretest		Posttest		Mean gain
		Mean	SD	Mean	SD	
Exp. (ELS)	45	61.33	11.21	72.95	7.54	11.62
Ctrl (ES)	62	57.64	6.24	64.24	5.93	6.60
Mean Diff.				8.71		5.02

Note: Exp. *Denotes experimental group and ELS denotes e-learning strategy;*

Ctrl denotes control group and ES denotes Expository strategy.

Table 1 shows the mean and standard deviation of students' performance scores in experimental and control groups. The table reveals that the pretest mean performance scores of students in the experimental group was 61.33 with a standard deviation of 11.21 while the students in the control group had mean performance score of 57.64 with a standard deviation of 6.24. Table 1 also reveals that, the posttest mean performance scores of students in the experimental group was 72.95 with a standard deviation of 7.54 and a mean gain of 11. 62 while the students in the control group had 64.24 with a standard deviation of 5.93. The mean difference between the two groups was 8.71 in favour of experimental group. Thus, the experimental group performed better than their control group counterparts because the use of e-learning strategy encouraged students to participate actively in the lessons as they had 24 hours access to packaged science activities.

Hypothesis One

There is no significant difference in the mean performance scores of students taught Basic Science and Technology using e-learning strategy and those taught with conventional strategy.

Table 2: ANCOVA Test of Students' Mean Performance Scores in Machine-Assisted Learning and Expository Strategies

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	2695.39[a]	2	1347.69	35.63	.00
Intercept	5618.65	1	5618.65	148.55	.00
PrestestPerformance	715.60	1	715.60	18.92	.00
Groups	**1442.80**	**1**	**1442.80**	**38.15**	**.00**
Error	3933.68	104	37.82		
Total	500038.00	107			
Corrected Total	6629.07	106			
a. R Squared = .407 (Adjusted R Squared = .395)					

*denotes F is significant at 0.05 alpha level.

The result in Table 2 shows one-way ANCOVA test of Basic Science and Technology students' mean performance scores in e-learning and conventional strategies. Pretest scores were used as covariate to control the initial difference in the two strategies. This result reveals that $F_{1,106} = 38.15$, $P = .00 < .05$ for the main treatment. Therefore, the null hypothesis which stated that, there is no significant difference in the mean performance scores of the Upper Basic II students taught using e-learning strategy and those taught by conventional lecture strategy was rejected. This means that there exists a significant statistical difference in the mean performance score of the Upper Basic II students taught using e-learning and conventional strategies.

Research Question Two

What is the difference in the mean confidence level scores of students taught Basic Science and Technology using e-learning and conventional strategies?

Table 3: Mean and Standard Deviation of Students' Confidence Level Scores in E-Learning and Expository Strategies

Gender	N	Pretest		Posttest		Mean gain
		Mean	SD	Mean	SD	
ELS	45	57.80	15.49	72.82	6.57	15.02
ES	62	58.11	7.12	63.84	8.56	5.73
Mean Diff.		0.31		8.98		9.29

Table 3 shows the mean and standard deviation of students' confidence level scores in the experimental and control groups. The result reveals that the pretest mean confidence level scores of students in the experimental group was 57.80 with a standard deviation of 15.49 while their control group counterparts had 58.11 mean with a standard deviation of 7.12. The mean difference between the two groups was 0.31 in favour of experimental group.

The result in Table 3 also reveals that the posttest mean confidence level score of students taught with e-learning strategy was 72.82 with a standard deviation of 6.57 while their control group counterparts had a mean confidence level score of 63.84 with a standard deviation of 8.56. The mean difference between the two groups was 8.98 in favour of experimental group students. Also, the mean gain of students in experimental group was 15.02 and that of the control group was 5.73; and the difference between their mean gains was 9.29 in favour of experimental group. This shows that the experimental group had higher confidence level scores than their control group counterparts in the test; meaning that the use of e-learning boosted students' self-confidence than conventional strategy.

Hypothesis Two

There is no significant difference in the mean confidence level scores of students taught Basic Science and Technology using e-learning and conventional strategies.

Table 4: ANCOVA Test of Students' Mean Confidence Level Scores in Machine-Assisted Learning and Expository Strategies

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	2794.81[a]	2	1397.41	25.59	.00
Intercept	11954.51	1	11954.51	218.94	.00
Prettest	690.49	1	690.49	12.65	.00
Groups	**2137.03**	**1**	**2137.03**	**39.14**	**.00**
Error	5678.48	104	54.60		
Total	497681.00	107			
Corrected Total	8473.29	106			

a. R Squared = .330 (Adjusted R Squared = .317)

* denotes F is significant at 0.05 alpha level.

Table 4 shows ANCOVA test results of students' mean confidence level scores in the experimental and control groups. The result shows that $F_{1, 106} = 39.14$; and *P*-value = 0.00 for e-learning ($P = 0.00 < 0.05$). The significant *P*-value was less than the set significant value of the study ($P < 0.05$). Therefore, the null hypothesis that there is no significant difference in the mean confidence level scores of the experimental and control group students taught with e-learning and conventional strategy was rejected. This shows that there was a significant statistical difference between the mean confidence level scores of students in the experimental and control groups.

Research Question Three

What is the difference between the mean science process skills acquisition of the students taught using e-learning and those taught using expository strategy?

Table 5: Means and Standard Deviation of Students' Science Process Skills Acquisition Scores in E-learning and Expository Strategies

Group	N	Pretest		Posttest		Mean gain
		Mean	SD	Mean	SD	
Exp.	45	60.49	10.6 6	72.98	7.55	**12.49**
Ctrl	62	57.31	6.54	66.23	7.48	**8.92**
Mean Diff.			3.18		6.75	**3.57**

Table 5 shows the mean and standard deviation of students' scores in experimental and control groups. The table reveals that the pretest mean science process skills acquisition scores of students in the experimental group was 60.49 with a standard deviation of 10.66 while the students in the control group had mean of 57.31 with a standard deviation of 6.54. Table 5 also reveals that the posttest mean science process skills scores acquisition of students in the experimental group was 72.98 with a standard deviation of 7.55 while the students in the control group had 66.23 with a standard deviation 7.48 and a mean gain of 12.49. The mean difference between the two groups was 6.75 in favour of experimental group. Thus, the experimental group acquired science process skills better than the control group because the use of e-learning strategy stimulated and encouraged students to participate actively in the lessons as they had 24 hours access to simulated science activities.

Hypothesis Three

There is no significance difference between mean science process skills acquisition scores of the students taught using e-learning and those taught using conventional strategy.

Table 6: ANCOVA Test of Students' Mean Science Process Skills Acquisition Scores in E-Learning and Expository Strategies

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1889.95[a]	2	944.97	18.83	.00
Intercept	5742.45	1	5742.45	114.44	.00
Prestest Process Skills	701.22	1	701.22	13.97	.00
Groups	**843.51**	**1**	**843.51**	**16.81**	**.00**
Error	5218.59	104	50.18		
Total	517502.00	107			
Corrected Total	7108.54	106			

a. R Squared = .266 (Adjusted R Squared = .252)

Table 6 shows ANCOVA test results of students' mean science process skills acquisition scores in the experimental and control groups strategies. The result shows that $F_{1,\ 106}$ = 16.810; and *P*-value = 0.00 for science process skills acquisition (P = 0.00 < 0.05). The significant *P*-value was less than the set significant value of the study (P < 0.05). Therefore, the null hypothesis that, there is no significant difference in the mean science process skills acquisition scores of the students taught using e-learning and those taught using conventional strategy was rejected. This shows that there was significant statistical difference in the mean science process skills acquisition scores of the two groups. By implication, the use of e-learning strategy motivated children to learn and practice science uninterruptedly irrespective of geographical location.

Discussion of Findings

The purpose of this study was to determine the effects of e-learning on students' performance, confidence level and science process skills acquisition in Oju Metropolis. Based on the results of the data analysis, there was a significant difference between the performance of the students taught using e-learning and their peers taught the same content using expository method. Thus, the experimental group performed higher, developed desired self-confidence and acquired more science process skills scores than their control group counterparts taught the same content.

On the basis of the data analysis, the first finding of the study was that, students taught using e-learning performed better than the same level of students taught using conventional strategy. This implies that, e-learning enabled students to remain connected with science concepts outside the classroom by engaging in electronic environment prepared by teachers. Inside the classroom, teachers took advantage of class time to discuss appeared ideas. This finding was supported by the study by Holstein and Cohen (2016) who concluded that there was significant difference in the learning outcomes of learners when taught with e-learning technique. This could be that e-learning classroom has created a deep learning environment that assisted students' higher performance. This is also buttressed by Cajimat (2015) who revealed that, the use of technological tools had improved learning outcomes and encouraged students to become more active learners.

This improved performance was possible because, e-learning adapted to the learning pace of the individual and constantly offered tasks which accelerated learning outcomes. This brought both the fast and slow paced learners to the same level of learning; and the students were encouraged to repeatedly practice science concepts and experiments at home and in school. Convenience is also a chief significance of e-learning instruction which allowed the students to study at one's own pace, thereby improving performance. The strategy lessened the pressure on students and this gave them better opportunity to perform and recall what they have learnt. A study of Agar (2015) revealed that, those who learn through e-learning outperformed and retained knowledge more than their counterparts who use conventional approach to teaching. This happened because, children of nowadays enjoy digital media because it provides them with the choice to study at their comfort. Neither teachers nor parents force students to study in e-learning environment and this facilitates productivity and performance.

The second finding of the study indicated that, there was a significant difference in the mean confidence level scores of the students taught using e-learning and those taught with conventional strategy. This finding is in consonance with the conclusion drawn by Mampadi (2011); DEFKI (2015), Chun-Yen, ChangChun-Yen and ChangWei-Ying (2018); Akyol and Garrison (2019) who revealed that, the utilisation of the e-learning has improved students' confidence and satisfaction level. This implies that students' self-confidence which is an important element in the teaching and learning process was boosted by the use of e-learning. This is because learning at one's own convenience gives courage and confidence as students repeat learning process as many times as possible even if they fail at first attempt. The use of technology-driven strategy enabled the students to really understand the concept and thus, rote learning is discouraged. Interestingly, developing students' positive confidence through the use of e-learning has enhanced students' confidence level because even shy students who were intimidated by traditional classroom, online chatroom provided them with self-confidence in addition to the development of ability to work independently.

The third finding of the study showed that, there was a considerable statistical difference between the students taught Basic Science and Technology using e-learning strategy and those taught using conventional strategy. Thus, the students in the experimental group acquired more science process skills than their control group counterparts taught the same content using conventional strategies. The finding the study was supported by Downes (2016) and Derilo (2019) who concluded that e-learning strategy has positive impacts on students' science process skills acquisition. Similarly, according to Olibie, Ezoem and Ekene (2014), electronic-based environments allowed interactions and active participation of the learners. The reason for the enhanced science process skills acquisition of the experimental group could be that, the students had been frequently and uninterruptedly exposed to various forms of multimedia science activities. The method measured six different science process skills which the indicators showed in order of observation, communication, interpretation, experimentation, summarising and inferring. On the whole, the six skills measured were rated above the cut-off mark of 50.

The implication of this is that, the students were stimulated to learn science by the use of e-learning strategy which spawned their interest, excitement and total involvement in teaching and learning process, and encouraged them to work at their own pace at home and in school. This could be that when learners are being provided with adequate information and technological tools to scaffold learning, especially when working in electronic environment, they will learn at their pace and also collaboratively generate meanings through their interactions with each other and with the tools. The results of the study begged for adoption and development of e-learning strategy.

Conclusion and Recommendations

The major thrust of this study was the need to develop a personalised electronic-based environment that can encourage learning outcomes through uninterrupted learning. Based on the findings, it was concluded that, the students taught using the e-learning strategy outperformed their counterparts taught with conventional strategy in terms of performance, confidence level and science process skills acquisition. The role of the teacher in this type of electronic environment is to be a guide on the side instead of being a sage on the stage, facilitating learning experience for greater students' productivity, higher retention power, uninterrupted learning and accessibility to pool of learning resources.

Based on these findings, it was recommended that:

1. Basic Science and Technology teachers should employ e-learning strategy and develop the necessary e-tools as it has been found to encourage students to be consistently engaged in virtual science activities as grooming ground for real laboratory.

2. School administrators, governments and non-governmental organisation (NGOs) should provide adequate e-learning resources such as websites, high speed internet connection, laptops, routers and other digital facilities to motivate schools to integrate this technique into everyday teaching and learning, since it gears towards students' uninterrupted learning as a remedy for lockdown measures as well as acquisition of the 21st Century skills.

Contributions to Knowledge

Based on the findings of study research, the following contributions to knowledge banks were made:

1. The study entrenched that e-learning has positive effects on students' performance, confidence level and science process skills acquisition.

2. This study has provided useful information on the needs to encourage science teachers and students to adapt to trends and innovations in science and technology education.

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APPENDIX

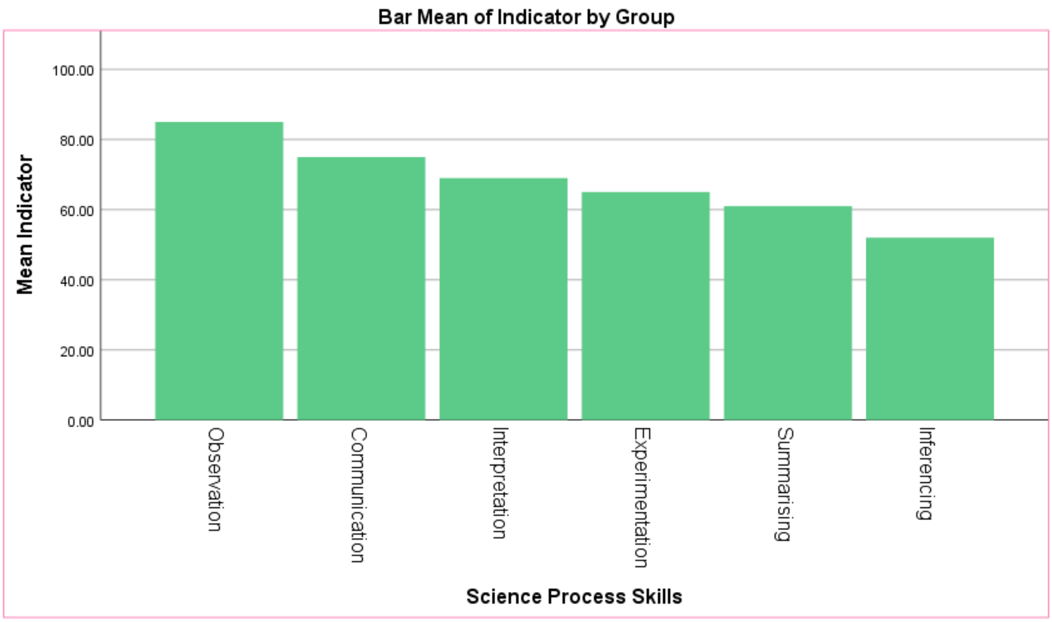

Fig. 1

Cut Off Mark = 50%

Observation = 85

Communication = 75

Interpretation = 69

Experimentation = 65

Summarising = 61

Inference = 52