Effects of Google Classroom Blended Learning Strategy on the Academic Performance of Secondary School Chemistry Students in Ekiti West Local Government, Ekiti State, Nigeria

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ABSTRACT: *The study investigated the effects of Google Classroom Blended learning strategy on the Academic performance and Retention of Senior Secondary School Chemistry Students in Ekiti West Local government area of Ekiti State. The study adopted a pre-test-post-test, control quasi-experimental research design. The sample for the study consisted of 50 senior secondary school two (SSII) Chemistry students. Two research questions were generated and four null hypotheses were raised to guide the study. The instrument used for data collection was a Google Classroom Blended Learning Chemistry Performance Test (GCBLCPT) extracted from the West Africa Senior Secondary Certificate Examination (WASSCE). The reliability was determined using Kuder-Richardson 20 which gave a reliability coefficient of 0.87 which shows that the instrument was suitable of this study. The research questions were answered using descriptive statistics of mean and standard deviation while the hypotheses were analysed using T-test at 0.05 level significant. The Findings from the study revealed that the chemistry students who were taught with both the Google classroom and conventional physical classroom performed better than those taught using only conventional physical classroom method. There was a significant effect of the use of Blended Google classroom on the scores of the students over the conventional physical classroom chemistry teaching-learning. The study's findings revealed that using Google Classroom improves students' performance in Chemistry and enhances their retention abilities. Based on the findings, it was recommended that Chemistry teachers should be encouraged to employ the use of Google Classroom in teaching the subject at the senior secondary school level to enhance learning and also improve the performance of the students in chemistry.*

Key Words: *Google Classroom, Chemistry, Performance, retention, Senior Secondary School*

Introduction

Chemistry is a branch of physical science concerned with investigating substance composition, their properties, and the reactions they undergo, including the uses of these reactions in the synthesis of new substances. It also tends to study the relationship between atoms and the reactions in which they engage. This is possible by observing practical phenomena in materials. In addition, chemistry also plays a vital role in developing new materials and in technological development. Likewise, human beings show strong dependence upon natural resources; as a matter of fact, the science of chemistry serves as the basis for their manufacture and extraction. Moreover, chemistry enables the understanding of all processes in terms of matter and energy associated with the motion of atoms. Arokoyu and Ugonwa (2012) identified Chemistry as one of the major ingredients of technology. It is called the central science and it studies the various substances in the world with a particular focus on the processes by which one substance is transferred or converted into another.

Chemistry has been defined by Alan and Melvyn (2021) as the science that deals with the properties, composition and structure of substances, the transformation they undergo and the energy that is released or absorbed during the process. Chemistry is a discipline of considerable significance in Nigeria, holding a central role within the scientific domain and its practical implementations. It can be pursued as an independent subject or in conjunction with other scientific disciplines. Furthermore, it serves as a requisite for entry into tertiary educational institutions in the nation. This subject is made available at both the senior secondary level and within higher education frameworks in the country. It is easy to underestimate the central role of Chemistry in modern society but chemical products are very essential if the world's population has to be fed, housed and clothed. The study of Chemistry has always been of inestimable value to humanity as it has the ability of explaining natural phenomena and plays very significant role in the world's technology development (Ugonwa & Ndioho, 2018). The positive impact of Chemistry on the society as a whole goes beyond doubt as it is evident in the medical, engineering, transport, food and health sectors (Arokoyu & Ugonwa, 2012). It therefore becomes very imperative to

employ very efficient and effective innovative strategies in the teaching and learning of Chemistry from the secondary school up to the tertiary institutions level in order to enable both the teachers and students gain adequate knowledge and skills required in Chemistry for productivity and technological advancement.

In the modern context, there have been increasing varieties of tools in instructional technology that were purposed to enhance the efficiency of teaching and learning Chemistry. However, along its long history, the field of Chemistry has undergone many changes. These relate to the methods used in teaching Chemistry. Thus, there have been shifts from personality-centered methods to rational structures, and from process-type methods to eventually shift from traditional classroom settings to the online environment (Olaniyi and Ajayi, 2020; Okeke et al, 2022). For instance, the embodiment of ICT in teaching and learning in science subjects has become a necessary tool in imparting meaningful scientific literacy to young adults.

Google Classroom allows teachers to create assignments, quizzes, questions, and short-answer or multiple-choice questions (Ajayi, 2020; Okeke et al, 2022). Each uploaded activity can include an instructional video, Google Slides presentation, Google Books, a worksheet, or any document uploaded to Google Drive. Google Classroom allows students of all diversified backgrounds a greater opportunity to use technology to enhance academic performance throughout the curriculum. Since the study focuses on the effect of Google Classroom on the learners' academic performance and persistence in Chemistry, it was utilized as the facilitating framework for exploring the management of learning variables. Kate (2021) defined the Google classroom as a platform that ties together Google workplace tools (formerly known as G-suite) for teachers and students. it can also be described as a digital organizer where teachers can keep class materials and share them with students, all paperless, from there you can pick and choose the features you want to incorporate. Google classroom enables flexibility and seamless integration with Google popular tools, thus making Google classroom one of the most widely used ed-tech tools today

The integration of technology into all fields, including education is rapidly becoming one of the most progressive and widely discussed issues in the present-day education policy. Indeed, the role of Information and Communication Technology (ICT) as a gateway to enlighten human's perception and creativeness cannot be overemphasized, especially in the teaching and learning of Chemistry and Science Education. Ugonwa and Nwanekezi (2018) opined that a good science education must be directed towards imbibing in the students the need for a thorough understanding of scientific concepts by means of technology. It was therefore necessary for education to take advantage of incorporating ICT in the teaching and learning process in all facets. Blending the teaching and learning of Chemistry within and outside the confines of the physical school or classroom environment will enhance learning, students' interest and familiarity with the subject, thereby de-masking the presumed rigid abstract nature of Chemistry and improve their performance in the subject. According to Nwanekeazi and Ugonwa (2018), a teaching strategy which combines the use of ICT or e-learning and the traditional face-to-face classroom learning is known as blended learning.

The internet is known to play a key role in enhancing the effectiveness of teaching and learning at all levels, particularly with the emergence of e-learning and digital tools. Chemistry being one of the main science subjects learnt in schools and a major tool for projecting science and technology in Nigeria should be given a high precedence in the choice of the teaching methodology by employing the most effective and innovative strategies in its teaching and learning. Use of ICT and internet being an innovative tool and efficient strategy for teaching and learning provides numerous learning opportunities and closes the gap and deficiencies that exist in teaching and learning process. Thus, the internet plays a major role in enhancing the effectiveness of teaching and learning at all levels, particularly with the emergence of e-learning and digital learning tools. Dike and Ugonwa (2021) stated that innovative technologies are participatory and easy to use and can be incorporated easily into the science classroom with other technologies for more efficient and interesting instruction. The internet and ICT has given rise to the emergence of new concepts such as virtual classroom, e-courses, web-based learning and learning management systems, Shana, Alyatim, Alkhazaleh and AlShalabi (2021). The internet has obviously become a platform for not only information and knowledge creation but electronic educational media such that new platforms of participatory and interactive learning are made possible. Based on the affordances of the internet based and e-learning program–applications, recommendations have been made by various institutions at scientific conference levels for educational institutions to pay attention to and embrace the modern technology and internet-based e-learning tools in the teaching and learning process. There is also increased interest in the use of digital technologies in teaching and learning overtime since the post Covid-19 era, due to their ability in helping the learners accomplish their learning tasks and also interact with the teachers regardless of place and time. Al-Raheely (2013) in Shana, et al. (2021) observed that such

technologies have also changed the role of the teacher to guide, plan, direct, facilitate and coordinate the teaching and learning process. One of these digital technologies is the Google Apps for Education (GAFE) platform of cloud-based computing apps (Shana, et al., 2021). The Google Apps for Education platform is a group of online applications that give room for sharing and enhancing social presence in e-learning providing solutions for the use of technology in learning.

Taking into cognizance therefore the difficulty in meeting up with the coverage of Chemistry syllabus as it is in the secondary school curriculum and considering the inconsistencies in the Nigerian education and economic system lately, there is need to consider the teaching and learning of science-subjects, Chemistry in particular, using a blended learning approach to incorporate the use of Google classroom. This will make teaching and learning of Chemistry more realizable and cover more topics in the syllabus as well as improve the performance of the Chemistry students.

Statement of the problem

The academic performance of Students in Chemistry has been a major concern to researchers and parents. Despite several efforts put on ground by the government, all stakeholders and researchers to ensure better performance in Chemistry, finding showed that appreciable improvement is yet to be achieved in the learning output in Nigeria secondary schools. Though, different teaching methods and strategies have been employed by the Chemistry teachers with the hope of changing the scenario but the situation is still far below the expectation. Most methods did not take into consideration individual differences among the students in the area of their learning rate. Some students require reading, hearing or practicing repetitively several times before any concept can be assimilated but in Chemistry Education, Several methods and strategies currently being used only pass information and lessons once to the student during the classroom teaching and make no provision for lesson recast outside the class. Students are left with the notes copied during the short classroom lesson. Consequently, this current prevailing situation prompted this research intending to introduce an online classroom to the teaching of Chemistry to provide the students the opportunities to record and replay the lesson or revisit the Google Classroom at any time to replay the lesson of choice. Google Classroom could also give privileges to students who are not able to attend the physical classroom as they can connect from whatever location they are during the period of classroom teaching. This research therefore was embarked upon to investigate the effects of Google Classroom on Academic Performance and retention of Senior Secondary School Chemistry Students in Ekiti State, Nigeria.

Aim and Objectives of the Study

The aim of this study is to determine the effect of using Google classroom blended learning strategy on the performance of Chemistry students in Ekiti West Local Government Area of Ekiti State. Specifically, the objectives of the study are to;

(1). Investigate the relative effect of the use of Google classroom blended learning strategy over the use of physical classroom (Conventional method of teaching) only,

(2). Ascertain if there is any differences in the mean performance scores of male and female SS2 Chemistry students who were taught Electrolysis in Chemistry, using Google classroom blended learning strategy.

Research Questions

The research questions that guided the study are:

(1) What is the mean performance score of SS2 Chemistry students taught with Google classroom and those taught in the physical classroom in Chemistry?

(2) What is the difference in the mean performance score of male and female SS2 Chemistry students taught using Google Classroom blended learning strategy?

Hypotheses

1: There is no significant difference in the pre-test mean performance scores of Chemistry students taught with Google classroom blended learning strategy and those taught only in the physical classroom.

2**:** There is no significant difference in the post-test mean scores of Chemistry students is no significant difference in the pre-test mean performance scores of

Chemistry students taught with Google classroom blended learning strategy and those taught only in the physical classroom.

3: There is no significant difference between the post-test mean scores of male and female students when taught Chemistry using Google Classroom
4: There is no significant difference in the retention mean scores of Chemistry students in experimental and control groups after the treatment

Methodology

Research Design

This research adopted a pre-test-post-test control quasi-experimental research design. The population for the research comprised all Senior Secondary School two students offering Chemistry subjects in Ekiti West Local Government Area of Ekiti. The sample consisted of 50 Senior Secondary School two students offering Chemistry as part of their subject from two schools in Ekiti West Local Government Area of Ekiti. Purposive sampling technique was used to select two co-educational secondary schools from the target population. In each of the schools selected, simple random sampling was used to select one arm which is an intact SS2 science class, to obtain a total of 50 SSII Chemistry students (24 males and 26 females) for the study. One of the classes selected was used as the experimental group while the other class was used as the control group. The Chemistry topic used for the treatment in this study was Electrolysis. A 20 multiple-choice test item titled Google Classroom Blended Learning Chemistry Performance Test (GCBLCPT) was used for the study.

The instrument used for this study was a Google Classroom Blended Learning Chemistry Performance Test (GCBLCPT) extracted from the West African Senior Secondary School Certificate Examination (WASSSCE) questions covering five recent years. The instrument comprises 20 multiple-choice items. Each correct item chosen by the students attracted 1 mark while the wrong choice attracted 0 marks. The test items were subjected to face and content validity by some experts in Chemistry Education and Test, Measurement, and evaluation. The reliability was determined using Kuder-Richardson 20 which gave a reliability coefficient of 0.87 which shows that the instrument was suitable of this study.

The instrument was administered on the students during the first week of the exercise to obtain the pre-test for the two groups. Thereafter, the treatment was carried out on the experimental group. The students in the experimental group were introduced to Google Classroom through the available internet-ready devices provided for the purpose. They were given orientation on the use of Google Classroom for academic purpose. The lesson for the day began by introducing the students to where they could retrieve and make use of the learning materials both in the classroom and at their leisure for continuous study. The treatment lasted for four weeks. During the four weeks, the control group was left to their regular Chemistry teacher without any interference from the researcher nor introduction of the treatment to this group. At the end of the treatment on the experimental group, the instrument was administered to the two groups again to obtain the post-test performance scores. The entire exercise lasted six weeks. To obtain the retention scores for the two groups, the instrument was re-administered on the students after two weeks from the post-test week.

Results and Discussion

Research Question 1

What is the mean performance score of SS2 Chemistry students taught with Google classroom and those taught in the physical classroom in Chemistry?

To answer research question 1, the Pre-GCBLCPT and Post- GCBLCPT scores of students taught using Google classroom Blended Learning and that of those taught in conventional physical classroom were subjected to descriptive statistics. The results obtained were presented in table 1.

Table 1: Mean and standard deviation on the performance score of SS2 Chemistry students taught with Google classroom BL and those taught in physical classroom.

Treatment	N	Pre-test Mean	SD	Post-test Mean	SD	Gain Mean	SD
Google classroom BL	22	37.61	6.80	77.80	9.22	40.19	10.26
Physical classroom	28	34.20	7.02	62.94	7.64	28.74	11.07

Pre-test mean score for Google Classroom Blended Learning was 37.61, SD = 6.80, post-test mean score was 77.80, SD = 9.22. Learning gain mean was 40.19, SD = 10.26. The pre-test mean score for physical classroom was 34.20, SD = 7.02, their post-test mean score was 62.94, SD = 7.64. Learning mean gain was 28.74, SD = 11.07.

Research Question 2

What is the difference in the mean performance score of male and female SS2 Chemistry students taught using Google Classroom blended learning strategy? This research question 2, was answered by using the Pre-GCBLCPT and Post-GCBLCPT scores of the male and female students taught using Google classroom Blended Learning were subjected to descriptive statistics. The results obtained were presented in table 2.

Table 2: Mean and standard deviation on the performance score of SS2 Chemistry students taught with Google Classroom BL, analysed based on sex

SEX	N	Pre-test Mean	SD	Post-test Mean	SD	Gain Mean	SD
Male for Google `Classroom BL	24	33.60	6.90	73.80	6.80	40.20	10.27
Female for Google `Classroom BL	26	30.90	7.02	70.20	9.60	39.30	11.04

Pre-test mean score of the male students for Google Classroom Blended Learning was 33.60, SD = 6.90, post-test mean score was 73.80, SD = 6.80. The learning mean gain was 40.20, SD = 10.27. The pre-test mean score of the female students for Google classroom BL was 30.90, SD = 7.02, post-test mean score was 70.20, SD = 9.60. The learning mean gain was 39.30, SD = 11.04.

Hypotheses

All the hypotheses were tested at 0.05 level of significance using t-test

1: There is no significant difference in the pre-test mean performance scores of Chemistry students taught with Google classroom blended learning strategy and those taught only in the physical classroom.

Table 1: te-test analysis on the pre-test mean scores of experimental and control groups

Group	N	Mean	SD	df	T	P
Google `Classroom BL Experimental group	22	9.58	2.10	91	0.10	0.90
Physical classroom Control group	28	9.54	1.70			

p>0.05

Table 1 showed that p (0.90) > than the α (0.05). This indicates that there was no significant difference between the academic performance of both experimental and control groups before the treatment. Therefore, the hypothesis was not rejected. Both groups performed almost equally. This shows that the two groups were homogeneous.

2: There is no significant difference in the post-test mean scores of Chemistry students is no significant difference in the pre-test mean performance scores of Chemistry students taught with Google classroom blended learning strategy and those taught only in the physical classroom.

Table 2: t-test analysis on post-test mean scores of students in both experimental and control group

Group	N	Mean	SD	df	T	P
Google Classroom BL Experimental group	22	16.50	2.50	93	10.36	0.00*
Physical classroom Control group	28	11.60	2.10			

*P<0.05

Table 2 revealed that p (0.00) < α (0.05). This indicates that there was a significant difference between the academic performance of both experimental and control groups after the treatment. Therefore, the hypothesis was rejected. The experimental group performed better than the control group

3: There is no significant difference between the post-test mean scores of male and female students when taught Chemistry using Google Classroom

Table 3: t-test analysis on the post-test mean scores of male and female students when taught Chemistry using Google Classroom

Group	N	Mean	SD	df	T	P
Male	14	16.00	1.60	40	1.13	0.27
Female	8	15.56	1.50			

p>0.05.

Table 4 revealed that p (0.27) > α (0.05). This indicates that there was no significant difference between the post-test mean scores of male and female students when taught Chemistry using Google Classroom. Therefore, the hypothesis was not rejected. Male and Female students in the experimental group performed equally.

4: There is no significant difference in the retention mean scores of Chemistry students in experimental and control groups after the treatment

Table 4: t-test analysis on the retention mean scores of Chemistry students in experimental and control groups

Group	N	Mean	SD	df	T	P
Google Classroom BL Experimental group	22	13.23	1.78	94	14.33	0.00*
Physical classroom Control group	28	8.55	1.25			

*P< 0.05

In Table 4, it can be seen that p (0.00) < α (0.05). This indicates that there was a significant difference between the retention mean scores of students in both experimental and control groups. Therefore, the hypothesis was rejected. The experimental group performed better than the control group

Discussion

The findings of this study revealed that there was a significant difference between the post-test performance of students in the experimental and the control groups. The experimental group that was treated with Google Classroom had a better academic performance than the control group that was not treated with Google Classroom. This indicated that Google Classroom which is one of the online teaching strategies has a better potential to enhance students' academic performance. This is supported by Olaniyi and Ajayi (2020) who in their work revealed that the use of online and computer-based teaching strategies enhances students' performance in science subjects. This might be attributed to the fact that learning through digital devices makes students stay glued to what they learned as they were originally used to interacting with digital devices for socialization. This finding agrees with the opinion of Dike and Ugonwa (2021) which stated that innovative technologies are participatory and easy to use and can be incorporated easily into the science classroom with other technologies for more efficient instruction.

The study further showed that there was a significant difference between the retention mean scores of the experimental and control groups. The experimental group has higher retention mean scores when compared with the control group. This was in agreement with Okeke et al 2022 who discovered that the use of Google Classroom enhances students' academic achievement in Mathematics.

Conclusion

The findings of the study revealed that the use of Google Classroom has positively enhanced and improved students' academic performance and retention in Chemistry. It could inferred that Google Classroom Blended Strategy is a veritable tool and pedagogy that enhance student's high performance and retention. Though there are still some stumbling blocks like computers, cost of data, power source etc to the use of Google classroom blended learning in most of the schools in Ekiti State in general and Ekiti West Local Government in particular. The findings revealed that the chemistry students taught using this innovative strategy showed a higher learning gain score over their counterparts who were not exposed to this strategy. This implies that the Google classroom Blended Learning strategy has positive significant effects on the performance of the chemistry students. However, there was no significant effect of gender on the performance of the chemistry students, despite the treatment given to them. Both the male and female students demonstrated higher performance and positive mean gain in the Post GCBLCPT scores. This shows that gender has no significant influence on the performance of chemistry students taught Electrolysis in Chemistry irrespective of the treatment given or the learning setting. The study therefore concluded that Google Classroom Blended learning strategy is an effective teaching-learning strategy in fostering meaningful learning and enhancing students' performance in Chemistry.

Recommendations

Based on the findings, the following were recommended;

1. That the use of Google Classroom should be incorporated into the teachers' and students' pedagogical process in Chemistry classrooms in Nigeria and all Chemistry teachers should be encouraged to use Google Classroom by ensuring that they are all digitally literate and equipped.
2. The science teachers should be equipped and compelled to embrace the use of ICT and digital technology such a Google classroom as one of the skills needed to teach and to utilize technology maximally.
3. Government and parents/guidance should provide the necessary tools and computers for learners to make internet accessibility for Google classroom for integration of computer and internet technology into their learning for improved performance.
4. Faculty of Education and the Ministry of Education should organize workshops and in-service, training for both staff and students where they will learn the use of internet in classroom learning and be able to integrate it in a blended learning situation.
5. Google classroom should be adopted as a Blended learning technique in the teaching and learning of chemistry at the senior secondary school level to enhance learning and also improve the performance of the students in chemistry.

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