

**EFFECTS OF BLENDED LEARNING ON BIOLOGY
STUDENTS' ATTITUDE AND ACHIEVEMENT IN
COLLEGES OF EDUCATION IN KWARA STATE, NIGERIA**

Ph. D. ORAL DEFENCE

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CERTIFICATION

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AND ACHIEVEMENT IN COLLEGES OF EDUCATION IN KWARA STATE,
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90/022018

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DEDICATION

This research is dedicated to God Almighty, the all sufficient one, who has given me the grace and strength to do all things through Christ Jesus.

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I thank my author and finisher, for granting me the opportunity to be alive and be able to pursue my dreams, despite all odds. All praises are ascribed to Him. I am whole heartedly grateful to my amiable, meticulous, and highly efficient Supervisor Prof. I. O. Abimbola who always took pains to read, correct, and gave series of professional advice, and most importantly, his fatherly words of encouragement required for the completion of this thesis. I pray that the Lord Almighty bless him and his household, and grant him the desires of his heart. (Amen).

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ABSTRACT

Continuous increase in population of students in higher institutions of learning in Nigeria often results into overcrowded lecture rooms and laboratories, leading to poor performance of Biology students. Several strategies had been employed in previous studies to address the problem without much improvement in students' achievement problem in Colleges of Education in Kwara State, Nigeria. There is, therefore, a need to find out if a method such as blended learning would address the problem. Moreover, there has been paucity of studies on students' achievement in Biology using blended learning strategy. Hence, the objectives of this study were to investigate the: (i) effect of blended learning on students' attitude towards Biology; (ii) effect of blended learning on students' achievement in Biology; (iii) attitude of Biology students to blended learning based on gender ; (iv) attitude of Biology students to blended learning based on score level ; (v) difference in the achievement of Biology students exposed to blended learning based on gender (vi) difference in the achievement of Biology students exposed to blended learning based on score level; and (vii) interaction effect of treatment, gender and score level on attitude and achievement of Biology students.

A quasi-experimental design was adopted for the study. Purposive sampling technique was used to select two Colleges of Education in Kwara State. The study involved (115) Biology students (experimental group = 48; control group = 67) comprising 82 females and 33 males. Attitude questionnaire, Achievement test, and an internet application, entitled, "Biology Blended Learning Package Application" were used. They were validated by two experts in Biology and four Educational Technologists. The attitude questionnaire had a reliability co-efficient of 0.83, using Cronbach alpha, while the

achievement test had a reliability of 0.82, using split-half technique. Inferential statistics was used to analyze the data at 0.05 level of significance.

The findings of the study were that:

- i. Biology students in Colleges of Education had positive attitude towards blended learning ($\bar{X}$ =63.00 , SD=17.09);
- ii. there was a difference in the achievement of Biology students in the experimental and control groups in favor of those exposed to blended learning. ($t_{(114)} = 21.8, p < 0.05$);
- iii. there was no significant difference in the attitude of male and female students exposed to blended learning ;
- iv. there was a significant difference in the attitude of students exposed to blended learning, based on score level, in favor of medium score ($F_{(2, 44)} = 1.66; p < 0.05$) ;
- v. there was no significant difference in the achievement of male and female students exposed to blended learning;
- vi. there was a significant difference in the achievement of students based on score level, in favor of low score ($F_{(2,44)} = 36.39; p < 0.05$); and
- vii. there was no significant interaction effect of treatment, gender and score level on students' attitude, and achievement.

The study concluded that Colleges of Education Biology students exposed to blended learning had a better achievement. This implies that blended learning improved the performance of Biology students. The study recommended that blended learning should be integrated into the teaching and learning of Biology in Colleges of Education.

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CHAPTER ONE

INTRODUCTION

Background to the Problem

There has been a significant change in emphasis on science teaching and learning worldwide. The change with time has been to have a science classroom that is oriented and mainly student-centered, which will help focus on better understanding rather than rote-learning and simple recollection of knowledge (Owolabi, 2007). The government in most developing countries recognizes the importance of science and technology in terms of resources in encouraging teaching and learning of sciences in schools (Olorundare and Oni 2006). The outcome of teaching is supposed to give a better performance and not reduction in the performance of students in Nigeria tertiary institutions. The issue of poor performance of students in Nigeria tertiary institutions has been of great concern to the educator. Studies have found that overcrowding of classroom, large class size, inadequate equipments and some teaching methods are some factors that have contributed or affected Biology students 'achievement. (Awoderu, 2012, Omotere, 2013)

Nigeria educational system has consistently been experiencing an upward trend in school enrollment at all levels for over a score now. Onwu (1998) observed that there is high demand for formal education which gave rise to increase in school enrollment. This resulted in having a large impact on the class size at all levels and this has a very significant effect on teaching-learning process in schools. The National Policy of Education (FGN, 2004:13) stipulates that students should choose one subject from Physics, Chemistry, Biology or Health Science. It was however observed that almost all students preferred Biology as there is an assumption that it is the easiest of the four subjects. Awoderu (2012).

This variety of preference has placed a lot of stress on Biology teachers and has resulted to overcrowded classrooms in Biology with students in large class. These do not really encourage active learning between teachers and students. It however overstretches the inadequate instructional materials on ground and so much pressure on both the students and teachers involved. Ogunkola, Olatoye & Erinosh, (2004). Likewise, Hornic –Lockard (2015), viewed overcrowding as when an institution facility enrolls more students than it was designed to accommodate. Overcrowding of students in a class has also resulted to a large increase in mass failure and students tend to lose interest in what is being taught them in Biology by the teacher because of less attention from teachers to students (Omotere 2013). Students in Biology being a course in Natural sciences would necessarily require a smaller group for effective learning since both theory and practical classes are necessary for effective learning and better mastery of the subject.

To have a better learning skills (Cimer, 2007; Yip, 2001) observed that Biology students requires newly acquired concepts or skills to various contexts for effective learning. This provides a platform for teaching students to develop the ability to apply science concepts, principles and theories in solving everyday life problems with an exposition of knowledge all over the world via the internet; this tends to help expand the knowledge that will be acquired by the students in the process of learning (Nwosu, 2005). The teaching of some Biology concepts may seem difficult when they are not described to a certain point on students' comprehension.

According to Chew (2004), Biology concept sometimes can be difficult especially when describing things that are abstract in nature, which cannot be fully comprehended the first time. This gives rise to inadequate or less comprehension that may result in students' poor performance in Biology. Abimbola (1998) observed that

most of the content areas that are perceived as difficult belong to “Pure Biology” which includes cellular respiration, growth, and physiology. Students usually find physiological content areas such as photosynthesis, meiosis, cellular respiration and so on, difficult to deal with. According to the author, physiology content areas are mostly abstract and microscopic in nature; as they contain a lot of processes that require in-depth explanation to enable students to understand them. Cimer (2011) also viewed many concepts or topics in Biology including water transportation in plants, photosynthesis, respiration and protein synthesis, physiological processes and nervous system are perceived as difficult to learn by students. This made students’ experience difficulties in some topics and may have negative effects in terms of motivation and achievement (Ozcan, 2003). Since learning is done mainly by conventional method.

In most developing countries (Nigeria inclusive) of the world, the traditional or conventional method of instruction (chalk and talk) is more often employed to facilitate learning (Ngwu, 2015). However, such strategy makes learning ineffective and denies learners the opportunity to apply the skills needed in comprehending some Biological concept (Cimer, 2011). There are different strategies for teaching Biology that contributes to the learning process, this include memorization, teacher-centred activity and theoretical learning that tends to make learning of Biology difficult for students (Ozcan, 2003; Saka, 2006). Thus, this calls for the need to introduce innovative method of teaching, where traditional method of teaching and learning could be harmonized with the use of electronic resources to facilitate quick comprehension of some difficult concepts which could be technology based.

The use of Information Communication Technology (ICT) and internet facilities provide easy access and dissemination of information via myriads of electronic resources like desktop computers, smart phones, iPad, tablets, etc. Lecturers and

students can easily access the relevant materials needed for scholarship work through the internet. Such quality materials are used in equipping and upgrading students and lecturers' knowledge-bank in their field of study (Oviawe & Oshio, 2011).

ICT is also known to have a significant impact on the quality, quantity of teaching, learning, and research in the traditional/distance education institutions while using it (Kwacha, 2007). Ololube, Ubogu, and Ossai (2007) noted that the integration of ICT in education has initiated a new age in education methodologies, thus, it has drastically changed the traditional method of delivering information and usage patterns in the domains, as well as, offering up to date learning experiences for both teachers and students. Likewise, Nwosu and Ogbomo (2010) opined that the idea of sharing knowledge and using new ideas of learning can enhance the use ICTs, which can help improve the capability level of new information technology

Okeh and Opone (2007) opined that using new information technology can serve as main functions in the national educational growth namely: to help deliver all or some part of the learning experiences to learners involved and also help in supplementing and extending the learning content made available in different forms and make available a two-way guide of communication for exchange between teachers and students involved for a better feedback which might be of great importance to all. The relationship between students and teachers is more open and intimate through their interaction with ICT and internet facilities (Davids, 2005).

Electronic-learning, as an aspect of ICT, is becoming relevant in Nigeria education system. It is a different approach from the traditional way of seeing things to curriculum implementation. It is also an extended form of classroom teaching and learning, either online or offline, which is facilitated by the use of a computer, telecommunication devices, networks, and storage capacity. (Tunmibi, Aregbesola,

Adejobi & Ibrahim, 2015) ICT aids speedy production, retrieval, downloading of costly materials all over the world from internet use. According to Hamilton and Mbachu (2013), ICT and its use on the internet have been observed to stretch educational boundaries and created new ones in the twenty-first century, thereby inventing new terms like e-learning and mobile learning (m-learning).

Magbagbeola (2004) opined that students who had contact with the use of Internet are more likely to perform better than individuals that are not accessible to the internet. Sale (2010) defined e-learning as a way of using an electronic medium to deliver in terms of education, training applications, monitoring learners' performance and reporting learners' progress. E-learning is projected to ensure a valuable pedagogy and curriculum implementation and execution in this age and time (Nicholls and Nicholls, 1980; Mkpa, 1987; Offorma, 2002).

The roles and values of e-learning in education according to Ngwu (2015) vary and include promoting students' commitment to learning introduction of new learning concept; thereby bringing students and teachers together in order to make science learning more effective. E-learning also facilitates teamwork among students through interaction that could arouse students' interest and promote motivation to learning.

One of the major benefits of using e-learning when compared with the conventional method is that learners develop communication skills, such as dependence to learn, and analytical perception (Dargham, Saeed & Mcheik, 2013) this has given rise to learning on the move with the use of mobile devices to facilitate learning within and outside the school environment. Dickson (2012) defined mobile learning as an connection between mobile computing and communication devices. M-learning takes place through wireless devices, such as mobile phones, I pad, Mp3 player, e.t.c. Sharples, Arnedillo, Milrad and Vavoula (2007) opined that m-learning played a great

role in activity based and technology-based learning. The functionality of mobile devices is noted to be portable, versatile, easy to use, wireless and can also integrate and harmonize with quite a variety of other technology platforms (Traxler & Kukulska-Hulme, 2005). This Mobile technology are used anywhere and anytime, to access scholarship information and to harmonize traditional method with the use of modern technological tools in and out of various institutions.

In a traditional classroom setting, the primary method of interaction was a face-to-face dialogue between teachers and students (Anderson, 2003). But a modern and less stressful method is the medium for online delivery in teaching and learning of academic work that could be expanded with the evolution of the Internet, this could make the importance of interaction modes shift for easy access to learning. Hence, the delivery of learning has evolved into varieties with a face-to-face class at one end and asynchronous courses conducted totally online at the other end (Murray, Pérez, Geist, & Hedrick, 2013). Among the varieties of learning are combinations of traditional and online delivery methods that are commonly referred to as a blended mode of instruction.

There are various definition for blended learning. Graham (2005) defines blended learning as a mixture of face-to-face form of learning a self paced online learning. Blended learning employs a range of tools and education media in other to create an interactive learning environment, synchronously and asynchronously. The main goal of the use of blended learning is to harmonize face-to-face with online instruction in order to improve teaching and learning. This is helpful to both students and teachers because it enhances learning process electronically. It is also a forum to overcome the conventional problems of an environment, which can help increase students' achievement (Ibrahim, 2011). It enables student-teacher, student-content, and

student-student interactions through direct dialogue in order to surmount obstacles of learning via electronics and tradition and also to develop the skills and awareness of students effectively (Al-Madani, 2015).

Mayadas and Picciano (2007) defined blended learning as combining face to face with online learning. In simple terms, it is the combination of instructor-led traditional learning and computer-aided learning environment. Picciano (2006) described blended learning as being used to improve the traditional lecture with additional readings, electronic instructor note, images, charts, graphs and other handouts in one course. Aladejana (2008) posited blended learning to be a healthier way for alternative learning in Nigerian schools. Such learning provides various options for learners to acquire knowledge and also help increase what they have learned both in and out of their learning environment. Akinbobola and Asagha (2015) opined that blended learning can serve as a link by giving answers to the needs of educator for all in respect of the environmental, social or cultural circumstances. Also, Utami, (2018) and Abidoye (2015) indicated that a difference was found to exist in the academic achievement of students taught using blended learning approach as compared to those taught using the conventional approach. Aladejana (2008) and Korkmaz and Karakus (2014) are in support of the study, while Ibrahim and Mehmet (2014) study disagreed and therefore posited that the use of internet in learning makes the quality decline slightly. This gives idea into the attitudinal view of blended learning

Attitude can be described as settled behavior or manner of acting as are a presentation of feeling or opinion. It refers to certain tendency to act or react in either a positive or negative way towards certain situations and ideas. Attitude is based on three basic components, which are; cognitive, affective and psychomotor skills. Sani (2011) stated that the changes in the education sector have created pressure on conventional

teaching thereby causing changes in teaching and learning method, which has given rise to a greater emphasis on student-centered learning due to technological development. This gave rise to an increase in the availability of electronic information sources.

Similarly, Ayebi-Arthur (2010) posited a study on tertiary institution students' attitude and their achievement; it was observed that students had a positive attitude towards ICT. Though a positive attitude was noticed, it further implied that, there was higher score in achievement in ICT test. Therefore, suggested that student should neither be prevented nor should be encouraged on too much use of the computer. Mahmod and Azher (2017) carried out a study on students' attitude towards blended learning in English language. The study reveals that blended learning is seen as an effective learning style which pushes students to be more self knowledgeable. It further reveals that students have a favorable view towards the use, since they are actively involved in the learning. Also, Abidoeye (2015) opined that students showed the optimistic attitude towards the use of computer emphasizing that assisted their overall learning and also enables better plan for their learning.

Attitude is an emotional state of an individual towards an object or a particular situation. Adewole (2014), Duyilemi, Olagunju and Olumide (2014), Nassoura (2012), El- Gamal and El-Aziz (2011) pointed out that students have a positive attitude towards e-learning because the students involved found the system easy to use and useful for their coursework. Bertia (2009) reported that attitude can be positive if a new form of education fits the students' need and characteristics, or negative if the students cannot adapt to the new system because the students do not have the set characteristics. This shows the relevance of attitude towards students' academic achievement.

Achievement of students is a key determinant of the prospect of the youth and the nation, in general. According to Ewumi (2012), Studies on the achievement of

learners has attracted the attention of scholars, policymakers, and curriculum planners in order to identify various the level of learning in education. Adeyemo (2001) also opined that students' academic excellence is one of the major goals that schools desire to attain. This implied that school may have other peripheral objectives but the emphasis is normally placed more on the achievement of a sound scholarship.

Researchers have noted different and various reasons for students' poor performance in Biology. Some of which include the abstractness in understanding some aspects of Biology, and terminologies (Okeke and Ochuba, 1986; Nzelum, 2010). As a result of poor achievement by students, some begin to have reservations about academic ability in learning. Biology has been faced with quite a lot of challenges for decades now; studies have shown a high enrollment and low achievement in the internal and external examination (Olagunju, 2000; Kareem; Ezekannaya & Ikeagu, 2004). Ibe (2004) also noted that this decline in students' achievement in Biology could be contributed to the strategies of teaching Biology. Usman (2010) also emphasize that conventional mode of teaching (talk and chalk) of Biology in schools do not provide a complete cycle of learning experiences. Hence, there is a need to explore other teaching and learning approach, by this means such strategy/approach can facilitate a better perception of Biology through the use of technology and also give room to view what perception of male and female response to the use of blended learning will produce in the study.

Findings indicated that differences existed between the performance of male and female students when other learning method are introduced to students in science subject (Unodiaku, 2013), while other findings showed that gender had no impact on students' achievement (Abidoeye, 2015; Umoren, 2006; Baer & Baer, 2005). Mamman (2002) stated that male students had a high level of achievement in science and

technology than their female counterparts. However, Akanmu (2013), Nsofor and Momoh (2013), Awoniyi (2000) and Balogun (2000) posited that gender did not have any significant effect or variation on students' academic achievement in Biology. Thus, studies have revealed that the effect of students' gender on academic achievement have not produced conclusive results.

Previous achievements of learners in Biology have shown divergent views. Some of these work revealed that the score level is the recorded level of accomplishment an individual reaches and can be rated as either low, medium or high level (Bello & Abimbola, 1997). Adesoji (2008) studies revealed that there was no difference on the achievements of students at different score levels. However, Ehindero (1980) observed that there is a qualitative difference in the score levels of learners, and also score levels appear to play a significant role in achievement and also, high score-level students tend to perform better in biology. It has been observed that students with high intelligence have more capacity to reason deductively and inductively and also act purposefully than students with low level. Therefore, studies revealed inconsistent deductions on students' academic achievements in terms of score level.

Statement of the Problem

The teaching and learning of Biology in Nigerian Colleges of Education are characterized by the use of a traditional method which may not give an opportunity for active participation by both teachers and students and also, the continuous issue of large class with less equipment in laboratories and classroom. Teachers however, prefer the conventional method of teaching that encourages rote-learning without much understanding on the part of the students. This can lead to students shying away from innovative teaching methods that can help improve the achievement of the students in

question. The harmonization of conventional method with the use of electronic resources as a learning strategy for teaching and learning of Biology in Nigerian Colleges of Education need to be assessed in order to improve the performance of students in Biology.

One of the major problems that have been identified is the issue of large class size due to the overpopulation of students in Nigerian institutions of learning. Large class size and overcrowding of student in a learning environment could create an ineffective learning where students may not have direct access to the teachers involved and practical teaching would not be efficient for the students in question. Most of the indigenous institutions can be classified to belong to this category, where students might not visit the class for learning due to overcrowding and ill equipment in schools.

In Nigeria, a formidable obstacle to the use of information and communication is infrastructure deficiency, unreliable electricity supply, power outage that damages gadget. This can obstruct effective teaching and learning. Some studies have shown that the conventional method of teaching and learning is not satisfactory enough to facilitate better performance of Biology students (Aladejana 2008; Akinbobola & Asagha, 2015 and Abidoye (2015). Ibrahim and Mehmet (2014) compared students' performance in a blended learning environment with that of a traditional learning environment in Biology in Turkey. However, at the end of the study, there was no significant difference found at the end of the test that was applied to both groups.

Also, Abidoye (2015) viewed the effect of blended learning on instructional approach on students' achievement in geography using Achievement test and Blended learning package. The findings showed that blended learning instructional approach enhanced students achievement. However, this study was carried out using two instruments which are achievement test question in geography and a blended learning

package, while this present study used six instruments namely, a questionnaire on attitude, Achievement test and blended learning package in form of mobile device, a shuffled achievement test question, and an evaluation rubric assessment for application

A similar study was also conducted by Aladejana (2008) in which the use of ICT literacy skills on students and their educators was carried out to show if there was any significant difference in learner's outcome while using blended learning and those not exposed to it in a Biology class. Emphasis was placed more on their acquisition skill for the students and their educators. The outcome shows that there was a considerable difference in the performance of learners compared to the traditional approach.

However, Previous studies by Aladejana (2008), Ibrahim and Mehmet (2014); Abidoye (2015), Akinbobola and Asagha (2015) on blended learning examined the achievement of students in blended learning at the senior school level and not at tertiary level. Therefore, students' attitude to blended learning and their achievement in Biology in Nigerian Colleges of Education using a mobile device will be investigated along with the gender differences and score levels.

Findings by (Unodiaku, 2013; Mamman, 2002) indicated that significant differences existed between the male and female students performance. However, Abidoye (2015), Nsofor and Momoh (2013); observed that students' gender had no significant effect on their achievement when blended/ electronic medium was used. However, a study conducted by Ibrahim and Mehmet (2014) revealed that a significant difference existed between the academic achievement of male and female students taught when using a blended learning approach. These studies have shown that the effect on academic achievement of students based on gender had inconclusive findings.

Ayebi-Arthur (2010) observed that students had a positive attitude towards ICT. Also, Abidoye (2015) viewed students' positive attitude towards learning

of Geography using blended learning. This, however, gives room for further studies on students' attitude towards blended learning in the field of Biology. Adesoji (2008) established that there was no major difference in the performance of students in the three score levels after receiving the problem-solving strategy in chemistry. In spite of all the various studies conducted in the different field of study, there are few studies conducted on the effects of blended learning on students' attitude and Biology achievement in Nigeria tertiary institution using a mobile application. This study, therefore, would examine the effects of blended learning on students' attitude and Biology achievement using a mobile device to enhance learning. The dependent variables were their attitude towards blended learning and also achievement in Biology and moderating variables are gender and score levels.

Purpose of the Study

The main purpose of this study was to investigate the effects of blended learning on Biology students' attitude and achievement in Colleges of Education in Kwara State, Nigeria.

Specifically, the study determined the:

1. effect of blended learning on Biology students' attitude
2. effect of blended learning on Biology students' achievement;
3. effect of blended learning on Biology students' attitude based on gender;
4. difference in the attitude of high, medium and low score Biology students when exposed to blended learning;
5. difference in the achievement of male and female Biology students when exposed to blended learning ;

6. difference in the achievement of high, medium and low score Biology students when exposed to blended learning;
7. interaction effect of treatment and attitude of Biology students when exposed to blended learning.
8. interaction effect of treatment and score levels on the attitude of Biology students when exposed to blended learning
9. interaction effect of treatment and gender on Biology students' achievement when exposed to blended learning
10. interaction effect of treatment and score levels on Biology students achievement when exposed to blended learning
11. interaction effect of treatment, gender and score levels on the attitude of Biology students when exposed to blended learning
12. interaction effect of treatment, gender and score levels on the achievement of Biology students when exposed to blended learning.

Research Questions

The following research questions are raised to guide this study.

- i. What is the effect of blended learning on Biology students' attitude in Colleges of Education in Kwara State, Nigeria?
- ii. What is the effect of blended learning on Biology students' achievement in Colleges of Education in Kwara State, Nigeria?
- iii. What is the effect of blended learning on Biology students' attitude in Colleges of Education based on gender?
- iv. What is the difference in attitude of high, medium and low score Biology students in Colleges of Education when exposed to blended learning?

- v. What is the difference in the achievement of male and female Biology students in Colleges of Education when exposed to blended learning?
- vi. What is the difference in the achievement of high, medium and low score Biology students in Colleges of Education when exposed to blended learning?
- vii. What is the interaction effect of treatment and gender on the attitude of Biology students in Colleges of Education when exposed to blended learning?
- viii. What is the interaction effect of treatment and score levels on the attitude of Biology students in Colleges of Education when exposed to blended learning?
- ix. What is the interaction effect of treatment and gender on Biology students' achievement in Colleges of Education when exposed to blended learning?
- x. What is the interaction effect of treatment and score levels on Biology students' achievement in Colleges of Education when exposed to blended learning?
- xi. What is the interaction effect of treatment, gender and score levels on attitude of Biology students in Colleges of Education when exposed to blended learning?
- xii. What is the interaction effect of treatment, gender and score levels on the achievement of Biology students in Colleges of Education when exposed to blended learning?

Research Hypotheses

The following hypotheses were formulated and tested in this study:

H₀₁: There is no statistically significant difference in the attitude of Biology students in Colleges of Education in Kwara State, when exposed to blended learning.

H₀₂: There is no statistically significant difference in Biology students' achievement in Colleges of Education in Kwara State, when exposed to blended learning.

- H₀₃: There is no statistically significant difference in the attitude of Biology students in Colleges of Education when exposed to blended learning based on gender.
- H₀₄: There is no statistically significant difference in the attitude of high, medium and low score Biology students in Colleges of Education when exposed to blended learning.
- H₀₅: There is no statistically significant difference in the achievement of male and female Biology students in Colleges of Education when exposed to blended learning.
- H₀₆: There is no statistically significant difference in the achievement of high, medium and low score Biology students in Colleges of Education when exposed to blended learning.
- H₀₇: There is no statistically significant interaction effect of treatment and gender on the attitude of Biology students in Colleges of Education when exposed to blended learning.
- H₀₈: There is no statistically significant interaction effect of treatment and score levels on the attitude of Biology students in Colleges of Education when exposed to blended learning.
- H₀₉: There is no statistically significant interaction effect of treatment and gender on Biology student's achievement in Colleges of Education when exposed to blended learning.
- H₀₁₀: There is no statistically significant interaction effect of treatment and score levels on Biology students' achievement in Colleges of Education when exposed to blended learning.

H₀₁₁: There is no statistically significant interaction effect of treatment, gender and score levels on the attitude of Biology students in Colleges of Education when exposed to blended learning.

H₀₁₂: There is no statistically significant interaction effect of treatment, gender and score levels on the achievement of Biology students in Colleges of Education when exposed to blended learning.

Scope of the Study

This study involved Biology students in all Colleges of Education in Kwara State, Nigeria. The study involved NCE II Biology students. Face-to-face driver model of blended learning was adopted for the study based on time, pace, path and place using an adaptive digital content form of learning. The National Commission for Colleges of Education curriculum contents in Biology for students in Colleges of Education was used for the study. The content of instruction for the study were limited to the following topics; Photosynthesis, Mineral Nutrition in plants and Water relations in plant. These are based on concepts in Biology that are assumed to be difficult topics by students as viewed by researchers. Two state Colleges of Education served as the sample, one group was the experimental group while the other is the control group. Hence, this study put into consideration, gender and score levels of students as other variables. t-test and Analysis of Covariance were used to test the hypotheses formulated.

Significance of the Study

Using blended learning model in a Biology course, students' academic achievement levels and attitudes are expected to develop. Students trained in a blended

learning environment can achieve better than those trained in the traditional face-to-face teaching environment due to additional information acquired in the study.

It is assumed that the study would be of tremendous benefit to Nigeria's Educational system in the following ways;

This study would make a great contribution to the educational policy in Nigeria, in respect of the fact that information communication technology, especially, blended learning should be encouraged more into the system, it is hoped that this study will help to provide an insight for the decision-makers in education in order to place emphasis on the use of blended learning for teaching and learning.

This study would be of benefit to the education researchers in order to explore blended learning effectively, with useful empirical evidence for further research on other types of learning strategies and other variables that were not taking care of in this study, so as to enhance learning strategies at all levels.

Teacher education could benefit from blended learning approach in order to give or suggest new ideas and address some challenges to improve teaching and learning in schools. This will give teachers a better experience in using technology effectively in their professional development courses, hence preparing them to use blended models creatively and strategically, as it becomes more prevalent in the classroom to aid teaching and learning in schools.

This study could also be useful to the curriculum of Nigeria as it provides curriculum developers the flexibility to address the standard and maintain an effective curriculum while integrating digital content and learning experiences in the school curriculum for a better productive teaching and learning.

The study also could be useful in teaching and learning with ICT/blended. Students can learn through digital content hence helping in producing and sharing their

digital work with each other and this will enhance students to invest more in their sense of learning and be more motivated. Various mobile devices can now be transformed being a form of social media to a way of learning with few distractions. This can help to improve the achievement of learners in Biology and all subjects, at large since learning is done at a convenient pace and environment for every individual students.

Clarification of Major Terms and Variable

Blended Learning:- is a combination of teacher instructional and an adaptive digital content in mobile form that enables student-centred learning

Achievement:- students' scores in the test given to them in Biology.

Face-to-face:- this is a place where instructor and students devote their time to teaching and learning.

Score levels:- Student grouping based on their scores in past examinations in Biology.

Students which means

0% -44% ---- Low scorers

45% -59% ---- Medium scorers

60% -100% ---- High scorers

Attitude: This is a tendency to proceed or react in either a positive or negative way towards Biology by using blended learning.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter presents a review of related literature to this study. It has been presented under the following sub-headings:

- Theoretical Framework for the Study.
- Objectives and Contents of Colleges of Education Biology Curriculum.
- The Nature and Scope of Information Communication Technology in Education.
- Historical Background for Blended Learning Approach
- Models and Rationale for Blended learning.
- Empirical Studies on Blended Learning in Biology
- Studies on Attitude of Students towards Biology using Blended Learning.
- Studies on Blended Learning Approach in Biology Students' Achievement.
- Studies on Influence of Gender on Students' Attitude towards Biology using Blended learning
- Studies on Influence of Gender on Academic Achievement of Biology Students.
- Studies on Influence of Score Levels on Students' Attitudes towards Biology using Blended learning
- Studies on Influence of Score Levels on Students' Achievement in Biology using Blended learning
- Studies on Interaction Effect of Students Treatment on Attitude and Achievement in Biology
- Appraisal of the Reviewed Literature.

Theoretical Framework for the Study

Piaget theory of constructivism argues that people can produce knowledge and form meaning to the knowledge acquired based on their experience. This involves teaching method and education reform. Piaget (1970) developed the process of thinking and the intellectual development that could be regarded as an expansion of the biological process of evolution in various versions of species, which has given rise to two ongoing processes, namely, assimilation and accommodation. Assimilation can best be described as a way in which an individual can incorporate new experience into the old one such as new outlooks, rethink what was once misunderstood. While accommodation is reframing new experiences into mental capacity that already exist in an individual. This theory is a learning theory that explains how students acquire knowledge with the teacher acting as a facilitator and students doing the learning themselves and making an individual student to be a critical thinker, while the teacher becomes the consultant. It suggests how human being construct knowledge and meaning to the knowledge from experience gained during learning. Hence, this provides room for active learning than passive learning and therefore supports self knowledge (Nwankwoala, 2015). This theory gives idea about students use of information communication technology to aid learning being independent of their teachers.

The use of online learning is perceived as an alternative to lecture-based courses and these pedagogical approaches are adapted to fit the face to face teaching and learning process with the intention of making it easier for an individual (Bonk, 2004). Another way of use, according to Valiathain (2002), is that, blended learning can be used to explain a resolution that can combine different methods of delivery such as collaborative software's, web-based courses and knowledge management with learning

that can be mixed based on various activities, which include face-to-face classrooms, live e-learning, and self – paced learning.

Whitelock and Jelf (2003), proposed two definitions of blended learning and its relationship to pedagogy; Firstly, the integration of traditional learning with a web-based online approach (Harris, 2000).and secondly, the combination of media and the use of tools employed in an e-learning environment and pedagogic approaches, irrespective of the learning technology to be used (Driscoll, 2002).Likewise, Mayes, De Freitas (2004), describes a set of perspectives of learning as associative or constructivist approach; a constructivist approach seems to be pedagogical to blended learning. For the purpose of this study, constructivism would be viewed as the first theory to this study.

Similarly, Simina and Hamel (2005), have the assumption that a constructivist philosophy encourages the integration of online learning in Education. They also indicated that computer users interact with learning materials and with other people which gives room for a combination of social and individual aspect. Alebaikan (2010) posited in the study of blended learning that information has been observed to have exploded in recent years to a type of learning that cannot be controlled by learners but by the environment in which they evolved, this has reorganized how we live, learn and communicate with one another, hence, a new learning theory known as “Connectivism” (Downes, 2007, Siemens, 2005) was postulated to be a learning theory for digital age. This theory is one where learning occurs through connections within network This was further described as a form of social learning that is networked; knowledge is circulated across a network of connection when learning occurs, this later gives rise to ability to construct and navigate those networks, the principles of connectivism according to Seimen are that learning rests on diversity of opinion and that it is no longer an

individualistic activity. Knowledge is distributed across network. Ally (2008) further suggest the need for connectivism in the digital age and time; It observed that in addition to the existing learning theories (Constructivism), connectivism should be used to guide the development of online learning, since other learning theories were developed before we became a networked world.

Siemens (2005) however defined Connectivism, as the integration of principles explored by chaos, network complexity, and self-organization theories. According to this principle, learning and knowledge rest on diverse opinions of connecting some dedicated information and needs that may exist in non-human appliances and this can help build some critical things and help maintain a connection that is needed to facilitate a continuous learning within the environment. However, the ability to view the connection between ideas and concept as a skill with decisions made is a guideline used to aid learning. Hence, Constructivism and Connectivism are the theories considered for this study.

Based on this, the nature of blended learning however, involves an interactive learning environment that raises the need and a way for innovative development of new theory such as connectivism in line with the Piaget constructivism theory put in place to enhance the learning process for both the teachers, students in form of technology that is now evolving.

Objective and Content of Colleges of Education Biology Curriculum

Curriculum has been described by (Tanner & Tanner 2007), as a form of knowledge being reconstructed to enable learners grow in exercising intellectual control of knowledge and experiences needed. Indiana Department of Education (2010) also explains curriculum as a planned interaction of students with instructional content,

material resources, and processes for assessing the achievement of educational objectives. The curriculum could be viewed from the various aspect of learning within the educational system.

Adegoke (2005) viewed curriculum to be effective, and that it must have a definite and dynamic purpose based on the value of the society and the views of the students as a citizen and as a skilled individual for it to work. Curriculum can literally be described as what the teachers and students of a particular learning program described as course depends on what is expected of them and the extent of the requirement needed in relation to content, activities, teaching materials and evaluation involved in the teaching/learning process.

Curriculum for National Commission for Colleges of Education (NCCE, 2012) in Biology is designed to produce, a knowledgeable, highly motivated, professionals and effective teachers in Biology that would be able to develop in students, an appreciable and understanding of Biological process and principles. The program is also designed to develop confidence in the Biology Teacher, and also ability of students to adapt to the changing situation in science and technology with the society.

The philosophy supporting teacher education at the College of Education as noted by Isyaku (2007) include the desire of Nigerian Government to ensure uniformity of content and educational standard, it was observed that the general aim of producing teachers with highly personal with emphasis on specialized discipline and integrity. It was observed that teachers who are dedicated to suitable skills and intellectual depth can help to facilitate better achievement of the national goals. This would be relevant, considering the fact that, the position of the Government decision that the Nigeria

Certificate of Education (NCE) should ultimately be the minimum entry qualification into the teaching profession in Nigeria.

Consequently, based on the general aims highlighted, the Nigeria Education system under the NCCE have three types of Colleges of Education, conventional, technical and special, all of which have specific objectives based on achievement (NCCE, 2007). For the broad objectives of teaching a subject such as Biology, the following methods are recommended; Lecture, practical, project, field trips and excursion, games and simulation, team teaching, tutorials, concept mapping and computer-assisted. For the students' evaluation, grade points are assigned for scores based on the NCCE standard as follows; percentage scores for 100-70% are A, 69-60% is B; 59-50% -C, 49-45% -D, 44-40% -E, while 39% and below is F.

Biology curriculum requires some main objectives that would be expected at the end of the three-year program. The NCE Teacher would be expected to view Biology as a process of inquiry into the living world, critically analyzes the activities of living things in their environment and also demonstrate practical skills in handling scientific apparatus. this would include having positive scientific attitudes and values in the society and promoting positive disposition towards biological science and the scientific enterprise and applying concepts and methods acquired in the course in new areas of study and in everyday situation to make a successful career in Biology teaching and be able to undertake a program with a qualification of B.Ed / B.Sc (Ed) in Biology (NCCE, 2007).

Consequently, admission requirements in other to be qualified to partake in the program involves a requirement of Four (4) credit passes from recognized examination bodies such as Senior School Certificate Examination of WAEC or

NECO with a credit pass in English and Mathematics; A Grade II Teachers Certificate (TC II) with credit or merit in four subjects with relevance in the course of study, with English and Mathematics and also a pass in Unified Tertiary Matriculation Examination (UTME) is necessary for admission. Furthermore, in accordance with the objective and requirement for the award of NCE in Biology, an individual is expected to run a course of study on a prescribed curriculum over the duration of three years. The courses available in the curriculum are either compulsory or elective. For the purpose of this study, the accredited Biology curriculum content is as stated in Table 1:

Table 1

NCCE Curriculum

NCE 1 FIRST SEMESTER

Course Code	Course Title	Status
BIO 111	Basic Principles of Biology	C
BIO 112	Cell-Biology	C
BIO 113	Viruses, Bacteria & Lower Plant	C
BIO 114	Biology Practical	C
BIO 115	Ecology	C

NCE 1 SECOND SEMESTER

Course Code	Course Title	Status
BIO 121	Diversity of Invertebrates	C
BIO 122	Diversity, Anatomy, and Histology of Spermatophytes	C

BIO 123	Biology Methods	C
BIO 124	Biology Practical II	C

NCE II FIRST SEMESTER

Course Code	Course Title	Status
BIO 211	Diversity of Chordate	C
BIO 212	Research Methods and Biometry	C
BIO 213	Population Education	C
BIO 214	Plant Pathology	E
BIO 215	Animal Histology	E
BIO 216	Biology Practical	C

NCE II SECOND SEMESTER

Course Code	Course Title	Status
BIO 221	Plant Physiology	C
BIO 222	Vertebrate Anatomy & Physiology	C
BIO 223	Embryology	E
BIO 224	Biology Practical IV	C
BIO 225	Evolution	C

NCE III FIRST SEMESTER

Course Code	Course Title	Status
EDU 311	Teaching Practice	C

NCE III SECOND SEMESTER

Course Code	Course Title	Status
BIO 321	Laboratory Management	C
BIO 322	Applied Biology	C
BIO 323	Introductory Parasitology	C
BIO 324	Genetics	C
BIO 325	Biology Practical V	C

Source: NCCE Curriculum (2012): Pp 6 – 7

These are courses recommended by NCCE to be taken by all Biology students for an NCE program and the compulsory courses are expected to be passed before one can be certified.

Nature and Scope of Information Communication Technology in Education

The rapid development and growth of Information and Communication Technology (ICT) has added more value to teaching and learning experiences and as well provide a chance to involve learners in improving the quality of education particularly in developing countries. (Saleh, Bakry & Asfor 2010).

The influence of information and communication has penetrated all aspects of human life's (Olagunju, 2012). The learning and teaching process has been dramatically altered by the union of a variety of technological, instructional, and pedagogical developments (Marina, 2001; Smith, 2005). Badmus (2011) agreed that technology is challenging the boundaries of the educational structures that have traditionally fascinated and supported learning.

ICT has enabled the new ways of technology and learning rather simple by allowing teachers and students to do what had been done earlier in an improved way. These new ways of teaching and learning are underpinned by constructivist theories of learning and this constitutes a shift from a teacher-centered pedagogy or rote learning type to one that is student-centered. Thirs (2002) and Bransford (1999) outlined some benefits of an ICT-based instructional strategy against that of traditional method and came out with the following ideas; Firstly, Active learning, where ICT enhanced learning provides tools for examination, calculation, and analysis of information, which provides a stage for students inquiry and construction of new information for learners, they therefore learn with ease and whenever it is appropriate, and work on real-life problems in-depth, making learning less abstract in nature especially in Biology, and more relevant to learners life situation. This is in contrast to “rote-learning or memorization, ICT enhanced learning and promote learners involvement. It also enhances learning as “Just-in-time” learning where learners can make choices of what they need to learn.

Secondly, collaborative learning, is where ICT supported learning encourages interaction and corporation among students- teachers and experts not minding the location. This provides learners the opportunity to work with others from various cultures hence, enhancing team work and communicative skills globally and thirdly,

Creative learning where ICT supported learning helps to improve the changes in existing information and creating real-world products. There is also interactive learning and evaluative learning that promotes an integrative approach and it articulates knowledge respectively.

The evolution of ICT into tertiary institution clearly changes the way education is conducted (Nwosu & Ogbomo, 2012).The field of education has affected the penetration and influence of ICT worldwide, it has therefore made a lot of impact on the quality of teaching. According to UNESCO (2002) computers were introduced into the society suppressing time and space, but also claiming human intervention and participation, this is quite a new value: these machines humanize instruments and are better compared to previous media, such as television, this propitiates a more passive relationship;

Much of this precedent passivity do not exist again as new technologies such as the internet offer the possibilities to select, choose, transport information, visit libraries and museums, talk to other people or even see them in real time. All this are possible now that we have computers, hence they are main communication instruments rather than calculating machines as seen decades back.

In science education, literature model and modeling are connected to learning. By "model" we mean "a representation of an idea" object, event, process/ system". The purpose of any model in science especially in Biology is to simplify a phenomenon and make an explanation of it. Consequently, models have several tasks in science education: they help pupils to learn science education, to learn to do science (Gilbert & Boulter, 2000). One essential purpose of this is to help students gain an understanding of the basis of knowledge as is suitable to their needs, interest, and capacities. Rogers (2006) analyzed the use of simulations and modeling software in science. It was

observed that science teachers have embraced the method which supports valuable skills for scientific investigation.

There was a wide interest towards learning or what we call “inquiry in a web-based learning environment, the interest was not just how to share knowledge and learn to help students share knowledge. Bereiter, and Scardamalia, Cassell & Hewitt (1997) stressed that students should be able to participate in the scientific process. It was observed that a shared progressive discussion can advance students mutual understanding of science which could help students in Biology inquire more information in their field of study when using online method of learning.

The nature of the use of internet as a source of information of Inquiry or inquiry-based learning is similar. Some of the inquiry-based learning can be characterized as follows; Learning is an active process, rather than passive form of information. Students benefit from working on complex problems which can be approached from a different perspective. It is also a co-operative process and therefore students in Biology classes should be encouraged to interact with others working on the similar problem. Conceptual understanding should take precedence over procedural; teachers must be sensitive to student’s previous knowledge of the phenomena under study for effective learning to take place.

Similarly, learning activities can occur in interesting context with problems that are relevant to students experience outside the school setting, this would enable them to make connections between what they learn outside of school and in class. Lastly, the development of a better metacognitive skills enables students to take responsibility for managing and monitoring their own learning activities and prepare the students for a lifelong learning, hence, meeting the demands of a changing society.

According to Esoswo and Nwosu (2010), the introduction of ICT into tertiary institution has changed the way education is being conducted. Not only is it possible to work along with distance learning and achieve a chosen collaboration between tertiary institutions, but it also paved a way for a new pedagogical approach where a student is expected to play a more active role in learning. Using Information and Communication Technology (ICT) as a tool in education emphasized that, students should be able to communicate, create perspective in PowerPoint, interact with their colleagues and teachers using information technology, Esoswo and Nwosu (2010), further suggested that, for a country to benefit from this technological development a category of professionals should be educated with a sound ICT background and various computer platforms in a software environment.

Darkwa and Anao (2004) highlighted some impact that information communication technology has on the tertiary institution as it enhances the academic research by university and colleges of education lecturers and students. With the arrival of the internet, researchers and undergraduates now have the opportunity to access a lot of information for various assignments and diagrams related to Biology, which deals with nature in a more innovative way. By just a click on a button, researchers can have full access to different kinds of information and even know relevant areas of critical concern and interest. It will also offer them the chance to know the demands required for biological development in order to meet their expectations. In no doubt, the tertiary institutions are rich and innovative research can be conducted using ICT. This provides full access to the student on all kinds of information for their studies especially for Biology students that needs some diagrammatic representations of living things and writing of dissertations and thesis.

The use of the internet could reduce administrative cost because the same information on the internet can be disseminated to the individual department. With the current state of acute shortage of academic facility faced by tertiary institutions with focus on Biology, one could leverage ICT through video conferencing to other campuses where lectures are minimal. (Kwacha, 2007)

ICT reduces pressure on the university, polytechnics, and colleges of education academic admission process. It has made it easy for money to be accessed via inter-switch and other various e-banking hence increasing the population of computers literacy in our society. ICT also helps undergraduate share ideas, which can be shared online. This will give access to researchers and lecturers to have information and ideas.

ICT enables strong provision of support for all requirement and examples of world-class settings for competency and performance-based curricula that would make a sound and an affordance of technologies. This now plays a vital part in the lives of individual, organization and institutions and literacy information would be the key to the maximum use of information. There are several hindrance to the successful use of information and communication technology in Nigeria and Africa at large (Kwacha, 2007), as cited by Ololube, Ubogu, and Ossai, (2007), Aduwa-Ogiegbean & Iyamu (2005).

Nigeria partially lacks skills in terms of information through low human skills when compared to other developed countries. There is shortage of trained personnel in the operating systems, application of software, network administration and local technicians to service and repairs of facilities. Anao (2013). All these may change for Nigeria now, as foreign investors are already in the market, but may take some time to have a full impact on Nigeria education system. There is some prospect of information communication technology that could be reviewed as follow.

Kwacha (2007) suggested some way forward in this integration to help develop Nigeria educational system, by the adoption of ICT international standard and its inclusion in the Nigeria curriculum with the training of teachers and ICT skill acquisition. This could help in the development and training of ICT experts, especially for instruction design within the educational system. Hence, improve funds specifically to the need for teachers/students in computer education. There is need for the Nigeria Government to address the problem of erratic power supply. This has given rise to other substitutes in the educational system within the learning environment.

According to Valk, Rashid and Elder (2010) ICT has been in place to empower teachers and student by facilitating communication and aiding interaction, thereby offering better ways of delivery and also transforming teaching and learning process in Biology. It was noted that of the many types of ICTs, mobile devices are known to be particularly a suitable tool for advancing education in developing regions. UNESCO (2012) in a report also acknowledge that mobile learning project in Africa has been used to improve teaching system. Some of these features in mobile learning include educational practices such as downloading of materials for use in learning, Short Message Services (SMS), Bluetooth and the use of Wi-Fi (Kizito, 2012). Mobile learning, therefore, could be made possible by different and various forms that include mobile technology (mobile devices, and application).

Oyibo (2013) opined that internet connectivity is one of the basic requirements for a successful mobile learning environment. Its availability and accessibility still tend to pose a big challenge to our community especially at the higher level of learning, let alone the cost of maintenance. However, this gave rise to the need for mobile learning application that can help boost or serve as an alternative to a web-based learning within our locality.

With the total number of internet users in Nigeria presently as at February 2016, Ericson Consumer Lab TV and media reports have it that Nigeria has been ranked in 17th position in a global ranking of countries with Smart phones. This gives a range of Android users with a population of about 23.1 million Smart phones in Nigeria. However, a Mobile Application is software packages that can run on a feature or Smart phones with associated operating systems such as androids. ECIS Report (2015).It is also a computer program designed to run on a mobile device such as a phone or a watch. According to Viswanathan, (2017), a mobile app offers a lot of interactivity and also present a lot of specific information in a particular format that makes learning easy and intuitive to use.

App can be used as a standalone application to support or complement services on a mobile device. According to a report by Infodev 2014, the services offered through a mobile phone can be differentiated as mobile services, mobile web, and mobile application which of all the services can be independent and interact with other services as at when due. As a result of this, a large number of learning content developers started taking advantages of it as a medium of delivering interactive multimedia content to a wide range of learners with different views to learning across different areas and time zone.

Sharples, Taylor, and Vavoula (2007) accessed mobile phones theoretically as a way of making learner-centered learning possible by enabling students to customize, transfer and access information in order to help build their skills and knowledge to meet their educational goals which happens to be one of the reasons that would help reduce poor performance within our tertiary institution.

Historical Background for Blended Learning Approach

Nigeria started implementing its ICT policy in April 2001 with the establishment of National Information Technology Development Agency (NITDA) with a vision of making the country IT capable in Africa and with the launch of the Global System for Mobile Communication (G.S.M) in August 2001. Its objective includes the integrating of ICT into the mainstream of education and training.

Pelgrum and Law (2003) stated that almost at the end of the 1980's, the term; Computers' was replaced by 'IT' (Information Technology) hence, signifying a shift of focus from computing technology to what is referred to as a 'capacity to store and retrieve information'. The introduction of the term "ICT (Information Communication Technology) then came up around 1992 when e-mail was then made available to the general public.

With the advancement of computer communication, a new media, known as the 'internet' with a webpage referred to as World Wide Web occurred. The 1990's were the decade of this information accessibility. Harris (2000) conducted a case study that involved three primary and secondary schools. The study focused on the innovative pedagogical practices that involved the use ICT. The study concludes that the benefits of ICT will be "gained" when confident teachers shows interest in exploring new opportunities for altering their classroom practices by using ICT, the use of ICT will then , not only enhance learning environment but also prepare upcoming generation for future live (Wheeler, 2001). This view has given rise to the progressive use of ICT in teaching and learning in educational system. According to Guzer and Caner(2013).The first attempt on blended learning started in the 2000,where Cooney ,Gupton and Laughlin (2000) carried out the first study on the term blended learning in a prekindergarten school where combine elements of play and work to acquire blended

activity. Over time, other studies were carried out by other researchers such as Voci and Young, (2001) on integration of e-learning into an instructor to help improve better teamwork; Bonk, Olson, Wisher and Orvis, 2002 on understanding blended approach; Osguthorpe and Graham's, (2003) on blended learning models in three forms; Singh (2003) on online ,offline delivery mode programs; Garrison and Kanuka, (2004) on blended learning in higher education.; Graham, (2006).viewed the trends ,definition, categories of blended learning and challenges. However between 2007 and 2009,blended learning became known and was classified into popularity period where other various researchers viewed it in diverse ways.

Blended learning all began as an online learning when the less privileged rural school district in the State had to rely on online learning for students who were taking a higher level class but could not afford a teacher to come in and teach (Horn; Heather, 2011). It is however, a progressive concept with respect to Nigerian educational system even though it had been in existence for over a decade in the worldwide educational system. The concept of blended learning has been around from the onset of instructional method of learning. The term was not coined until the late nineties with the earliest reference being on March 5, 1999 (Okwoli, 2013). Though it is a relatively a innovative term for today's instructor, Moore (2006) noted that it can be traced as far back as the 1920's in what is referred to as "supervised correspondence study".

Okwoli (2013) identifies blended course as an instructional course delivered in both asynchronous and synchronous format, and this is becoming increasingly common in today's society. It has been in existence for many years, but the name has changed as the users and recognition increases. Many educators may be using a form of blended learning in lessons and teaching, but may not realize it or be able to identify it with an

actual name. It is not a new concept but maybe a new term for many users especially in Nigeria educational system. A comprehensive study in 2011, profiled 40 different blended learning models at various stages of their life cycle (Okwoli, 2013) hence the term blended learning has increased in frequency in academic circle. In 2003, the American society of training and development recognized it as one of the top-ten methods of teaching and learning to become known in the knowledge of the delivery industry (Graham, 2006).

The blending of face-to-face instruction with different types of non-classroom technology-based delivery has been practiced within the academy for over four decades (Dziuban et al, 2004). Blended learning in its early stage means the mix of the classroom (brick) and e-learning (click) but has now been moved to mean a mix of various learning methods and media. The majority of definitions follow the concept that it a blend solution between e-learning (online or click) and classroom learning (face-to-face or brick). This then refers to a mixing of different learning environment that would give learners and teachers a promising and potentials environment to learn and teach effectively.

The existence of so many names and definitions for what is essentially a single concept suggests that no dominants model has yet been accepted as a standard practice. Many authorities have been known to recognize a continuum of instructional models ranging from full face to face to full online but for now, there is no definite consensus on a solitary agreed definition of blended learning, as several journals articles provide several definitions.

Rationale and Models for Blended Learning Approach

In the evolution of learning, the process in education has relied on incorporating new instructional strategies to improve the pedagogy and also increase flexibility. Studies have been conducted to explore learning strategies that exploit the potential of online instruction, while still retaining the advantages of face-to-face (traditional) instruction from which the concept “Blended learning” emerged.

Blended approach combines the elements of online and face-to-face learning, Graham (2013). Most educators, individual and policymakers believe that "online learning" is a division of distance learning, where the students and teacher are geographically separated. In this case, content and communication are achieved with the use of computers connected to the internet. However, online form of learning or blended learning can be supported by introducing a new approach of instruction that takes advantage of the best element. Blended learning has various meanings to many scholars and people at large. The North American Council for Online Learning identified it both to mean blended or hybrid learning.

In general terms, blended learning combines the online delivery mode of educational content with the classroom interaction at its best feature and live instruction to make learning personal, by allowing thoughtful reflection, and differentiating instruction across various groups of learners. The presence of web-based instructor over the years has led to the emergence of “Blended learning” which is also known as “hybrid learning” or mixed-mode learning. Sharpe et al (2006) stated that there is no existing definition of blended learning universally accepted. Obviously, the most common definition refers to an integration of online learning and traditional (face-to-face) learning.

Graham (2006) stated that online (web-based) learning and traditional (face-to-face) learning have largely remained separated due to the various differences in their methods in the past. It was noted that 100% online learning requires more self-paced learning and materials interaction when compared with traditional. (Face- to- face) learning that places much priority on a human to human interaction and more didactic in nature.

In a blended learning environment Horton (2000) recommended several methodologies for combining the face-to-face and the online components of a course, these components include using classroom sessions as an orientation or as time for questions, online components that prepare learners for face-to-face sessions, online materials made in form of presentation where the instrument is use as web-based materials for classroom presentation and lastly, online lesson that are completed by individuals in the classroom and facilitated by the instructor/teacher while in class. Global practices of blended learning were classified by Graham (2006) into four levels learning; Activity level, course level, program level and the institutional level. These was categorized into various levels as seen in table

Table 2

Four categories of blending levels

	Activity level	Course level	Program level	Instructional level
How blend occurs	Learning activity both F2F and online element	Distinct F2F and online activities are used	A mix of F2F courses is required with is an online course	Blended models created by instruction
Examples	Using technological tools in class (Oliver 2005)	Owston, Garrison, and Cook (2006) provides eight different cases of course level blending	A program in which certain F2F courses are required and the rest are online courses. (Jung & Suzuki, 2006)	University of Central Florida made courses where F2F time is reduced when online are integrated (Dziuban, Hartman, Juge, Muskal&Sorg, 2006)

Source: Graham (2006)

In line with program level blending, Ross, and Gage (2006) agreed that this type of blending level is mostly used in higher education. However, in the case of the institutional level; a case study of the University of Central Florida in blending, analyzed their course with letters indicated as follow: (i) E-course used for technology-enhanced courses which are fully Face- to- face with supplementary online materials. (ii) M- courses for blended courses with reduced seating time and (iii) W- courses for web-based courses that are fully online (Dziuban et al 2006).Graham (2006) also made suggestion by offering learners the prospect to benefit from the two (face to face and online environment), the researcher explained that “It is not sufficient for the institution to have a distance learning division that is largely separate from the on-campus operation”

Along with the various definitions of blended learning, Graham, Allen, and Ure (2003) identified three other common definitions which are: combining instructional modalities/delivery media, combining instructional methods, and combining online and face-to-face instruction. However, Graham (2006) in Alebaikan (2010) argues that the first two definitions are wide because they include most learning systems in which courses involve at least two instructional methods. (i.e. face-to-face lecture and textbook reading).. These three categories as named by Graham (2006) identifies blended as; Enabling blend which provides similar opportunity or learning experience through more than one mode; face-to-face and online, enhancing blend, which provides online alternative resources for courses that are mainly conducted face-to-face or vice-versa and lastly, transforming blend, which utilizes online learning approaches in teaching as a main instructional method combined with traditional learning.

The enabling blend can be offered within the said program level as discussed earlier, here online programs or blended programs are offered as an added choice for on-campus students (Lindquist, 2006). In the case of enhancing blend, it is more likely to be at the course level. Graham observed that the enhancing blend has been given enormous focus in the traditional tertiary setting. Supporting his view Sharpe, Benfield, Roberts, and Francis (2006) observed that the regular type of blended learning is the provision of alternative resources that are conducted along with traditional lines through an institution that supports the virtual learning environment. Lastly, transforming blend can be within course level in which activities are determined by the designer or lecturers. This is also at the institutional level.

Bleimann (2004) identifies many advantages in traditional learning or face-to-face learning including the direct communication amongst students themselves and

among student and teachers and that teacher can give direct and immediate feedback for a student in the classroom. On the contrary, online learning provides students with a right to use different learning resources like websites, animation, and electronic activity.

Blended learning is a learning approach referred to as “Hybrid learning” in which face-to-face teaching could be integrated along with online approach to learning (Thompson 2003). Answer.com (2008) also describes blended learning as the mixture of multiple approaches in learning. These approaches are mostly combined traditionally as a learning element with e-learning as an online component of the blending strategy.

Many studies have shown the success and the advantages of blended learning over online and face- to- face learning alone. In blended learning approach, students can learn from an online course that matches his/her different learning styles and at the same time, he/she can learn from lectures delivered in class (Osguthorpe & Graham, 2003). In a blended learning, a student can likewise gain knowlegde from social interaction whether face to face or online and have an immediate feedback (Osguthorpe & Graham, 2003). Through the use of blended learning, students' achievement tends to be higher because the retention level with the learning materials in use can be improved through the use of Virtual Learning Environment (VLE) tools in a media. (Thompson, 2003). Likewise, in blended learning, students are involved in the learning process actively (Thompson 2003) and have access to different online resources (Osguthorpe & Graham, 2003; Lim, Morris & Kupritz; 2006).

From various studies and focus on the learning outcomes of blended learning, Echavez-Solano (2003) discovered that students in the technology-enhanced class had better understanding of course content, immediate feedback, self-learning, and control of learning. Lim, Morris, and Kupritz (2006) compared online and blended learning groups according to their learning outcomes. They observed that higher students'

satisfaction in the blended course gives a significant increase in the perceived and actual learning of both groups, as compared to online course students who experienced significantly higher workload for the study in the blended format. Likewise, Echavez-Solano (2003) observed that there were no differences between students' performances in traditional classes as compared to technology-enhanced classes (blended) in the assignment, examinations, and their final grades.

Johnson, Aragon, Shaik, and Palma-Rivas (2000) carried out a study on the comparison between online with face-to-face instruction. The purpose was to compare graduate course with another equivalent course taught in a face-to-face approach. Their intent was to determine difference and similarities in students rating and course quality which amounts to performance, assessment of course structure support and their achievement in terms of their grades. The study compared the outcomes enrolled in one of two versions of institutional design in a graduate course. Instructors delivered same course within same department with same content activities.

The sample used was thirty-eight graduate students; nineteen registered in the online course while nineteen were in the face-to-face group. Three different types of data collection were used to answer the research question. First, course interaction, secondly, to determine the level of performance and thirdly, to create a package for training.

The result further showed that students' satisfaction and their learning experience showed a positive effect in the traditional format than students in online format. Students of both groups reported positive rating for the quality of the instruction and the course even though the face-to-face group presented a slightly higher-level instruction for quality. This may have been because the instruction were more effective in teaching in a more traditional class setting. The findings were in favor the traditional

group. From the aspect of course structure, the findings indicated that there was no difference between the online format and the traditional face-to-face format in the students' ability to work at their own pace, the quality of a course syllabus, the structure of class activities and also students' assessment.

Another study conducted by Schutte (1997) analyzed the effect of face-to-face vs. virtual professor-student interaction and the impact the environment has on performance of students. It was argued that face-to-face interaction with a professor was basic form of learning process without which the student would be disadvantaged due to lack of interaction. It was also argued that the loss of face-to-face interaction with the professor would lead to greater interaction between the students, which in turn, will result in higher students test results.

The subjects in the study were thirty-three students enrolled in the fall, 1996 social statistics class at the California State University Northridge. The subjects were randomly divided into two groups, one taught in a traditional classroom, and the other taught using World Wide Web(WWW).Data for the study were collected and analyzed based on the implementation of a pre-test questionnaire, a post-test questionnaire and the students' scores reported on a midterm and final examination.

The result of the study above indicates that the virtual class had an average score of 20% higher on both examinations than that of the traditional class examinations. These results hence suggest that more interaction occurred and therefore this increase their level of achievement.

Though, Jones (1999) criticized this study and attempted to carry out the same study, but used a large sample size. Based on this, the study was able to make a recommendation that "it is unlikely that a simple translation of a course from a

traditional classroom format to an all Web-based class will improve or degrade students' performance.

One area that is often insignificant when creating online Education is the option of taking and creating an online experience, where it incorporates both traditional face-to-face strategies with online by doing so, we have blended learning strategies instruction. Blended learning strategies are educational events, which have been created and delivered using a combination of a traditional face-to-face approach and online approach (Ganzel, 2001; Horton, 2000, Zenger & Uehlein 2001). Also, it was claimed that those Web-based training and traditional training offer complementary strengths, thus providing a better learning opportunity for an individual Horton (2000).

In a study that was conducted by Edward and Fritz (1997), students' perception of education learning outcome between three different learning environments were studied. Participants used for the study were thirty-four undergraduate students, splits up into three classes each of the classes were being presented with a different educational online delivery approach the first approach was visual communication, half of the class materials were online, a traditional textbook, and traditional lectures based on the textbook materials. The second approach was a computer graphic design, online supplemental material, traditional, textbook, no traditional lectures, and a coaching/hands-on style of face-to-face teaching. The third approach was a World Wide Web publishing; using all online class materials and textbook.

The result indicates that students perceived strong learning outcomes from online materials and from mediated modes of education. It further shows that the effect of online learning seems to influence students' access to materials. Based on the findings of the study the result here would suggest that a blended approach that uses

modes and forms of education and face-to-face, may be appropriate for delivering educational materials based on various/different 'modes'

Blended learning benefits students and institutions because it helps improve learning outcomes, flexible accessibility, and better use of resources, students are satisfied with the learning and there is a sense of belonging to its community.

Several studies have shown that blended learning in a course is a form of the delivery method that has contributed to the improvement of learning outcome or performance; (Dziuban, Hartman, Juge, Moskal, and Sorg (2006); Lim & Morris, 2009, Garnham & Kaleta, 2002; Lopez-perez, Perez-lopez, Rodriquez-Ariza (2011). Their study showed that the effective use of blended learning had a positive effect. One of the benefits of blended learning is that it increases the flexibility of access to learning which reinforces students' reflection and autonomy. (Chambers 1999; Sharp et al (2006); Tam, (2000); also it facilitates control of learning (Osguthorpe & Graham, 2003) notably, Owston, Wideman, Murphy, and Lupshenyuk (2008) examined the professional development of blended learning in schools of education.

Cost and resource efficacy is also an advantage (Graham 2006; Vaughan, 2007). The cost for institutions are saved as the developed materials placed online can be reused for an extensive period of time. The use of blended learning can help reduce the staff and student classroom interaction time and also help save a lot of cost on staffing.

Blended learning also help to promote students' satisfaction, it enables the students to become more motivated and more involved in the learning process, thereby enhancing their commitment and steadfastness (Donnelly, 2010; Sharpe et al; 2006; Wang, Shen, Novak, and Pan 2009); Woltering, Herrler & Spreckelsen, 2009). Students' satisfaction has also been reported to be higher in

blended learning course compared with full face-to-face courses (Dziuban et al, 2006; Owston et al, 2008; Twigg, 2003). The use of blended learning has also been known to pose some challenges for students in tertiary institutions. Vaughan (2007) in a study, suggests that students that were registered in the blended learning course can sometimes have impractical expectations. The students may presume that few classes' means less work and may experience insufficient time management skills. The use of blended learning has strongly influenced teaching and learning in the digital age. Tertiary institutions need to recognize the awareness for a change in the education system. Young (2002) opined that not all students learn in the same way, therefore traditional approach may need some adjustment for such students. Littlejohn and Pegler (2007) noted that e-learning is the way to tackle the global challenges of meeting the demand for Higher Education. With the expansion of the use of the internet, courses at a tertiary level were developed to be taught online to provide access to Higher Education. However, online courses have been criticized to lack socialization and benefits traditional instruction (Bersin & Associates, 2003). So and Brush (2008) noted that students on full online courses are likely not to be satisfied and frustration can set in due to a number of factors such as infrastructure and lack of synchronous communication.

Viewing it from a different perspective, Linardo Polous (2010) noted that a full online version of a public speaking course is equivalent to a face-to-face version in terms of skill, knowledge acquisition, workload, and academic performance.

As technology is greatly improving, a growing number of e-learning concepts are finding their way into the educational system. Compared to the traditional method of teaching, e-learning now offers many advantages which include flexibility during the learning process, self-organized learning using different formats. But in spite of its benefits, e-learning has some disadvantages as well. These include the fact that content

cannot be directly imparted; social aspect is lacking and learners need cannot be catered for individually. Given that this problem can be avoided during a traditional class session, a new learning concept called Blended learning was developed (Allen & Seaman, 2008).

Osguthorpe and Graham (2003) placed emphasis on the fact that, each stage would depend on the learning goals, content, learning group, available online resources and didactical design. Also, Collins (2005) noted that blended learning combines and organizes the electronic content, which can help reduce the use of heavy textbooks from the classroom, as well as removing the medical fears from carrying heavy books. This study would help to improve the use of blended learning.

A study by the University of Central Florida (2001) revealed that students who studied using the blended learning method got better and higher achievement than the students who studied using the traditional teaching method or pure online learning method. The researcher is meant to view and clarify this study.

Having complexity with sophisticated technologies is another challenge in blended learning (Joanna, 2013). This is peculiar in a case where a student has to rely on slow internet connection (Smyth et al, 2012), poor internet connectivity (King, 2002) and this can create considerable frustration to users. (Hara, 2000; Welker & Bernardino, 2006). Johnson (2002) estimated that planning and developing a large enrollment blended learning course will usually take two to three times the amount of time required to develop a similar course in a traditional format. For the purpose of this research, blended learning is broadly viewed as an instruction practice that combines teaching methods from both face-to - face instruction and online learning.

Blended Learning models are of six types, as discussed by Thompson,(2016) ; Nelson,(2013),Horn and Staker,(2011) as; Face-to-face driver Model, Rotation Model, Flex Model, Online laboratory Model, Self-blend Model and Online driver Model.

Face-to-face driver Model: This is a model in which teachers convey most of the curriculum content into teaching. Technology is used alongside traditional teaching to increase success in educational outcomes. Teachers guide the class in a lecture with an established protocol taking priority and technology being a secondary thought. However, they also produce online resources to supplement or revise course material which students can study at home based on flexibility, at any time and place. Students may access this extra help through classroom computer, computer laboratory on campus or through their individual androids phones. It allows for a traditional classroom experience with individualization in teaching and learning.

Flex Model: This is a model where contents and instruction are delivered mainly by an online platform with the face-to-face teachers available for on-site support.

Online Laboratory Model: in this model, instructions are delivered by online teachers through a digital learning platform but within a classroom setting.

Self-blend Model: students take one or multiple online courses to complement their traditional classroom learning. The online courses are taken outside of the school facility, and students' core instruction is still conducted in the traditional classroom setting.

Online Driver Model: In this model, students receive all of their instruction online, through an online platform and from an online teacher, with occasional face-to-face check-ins.

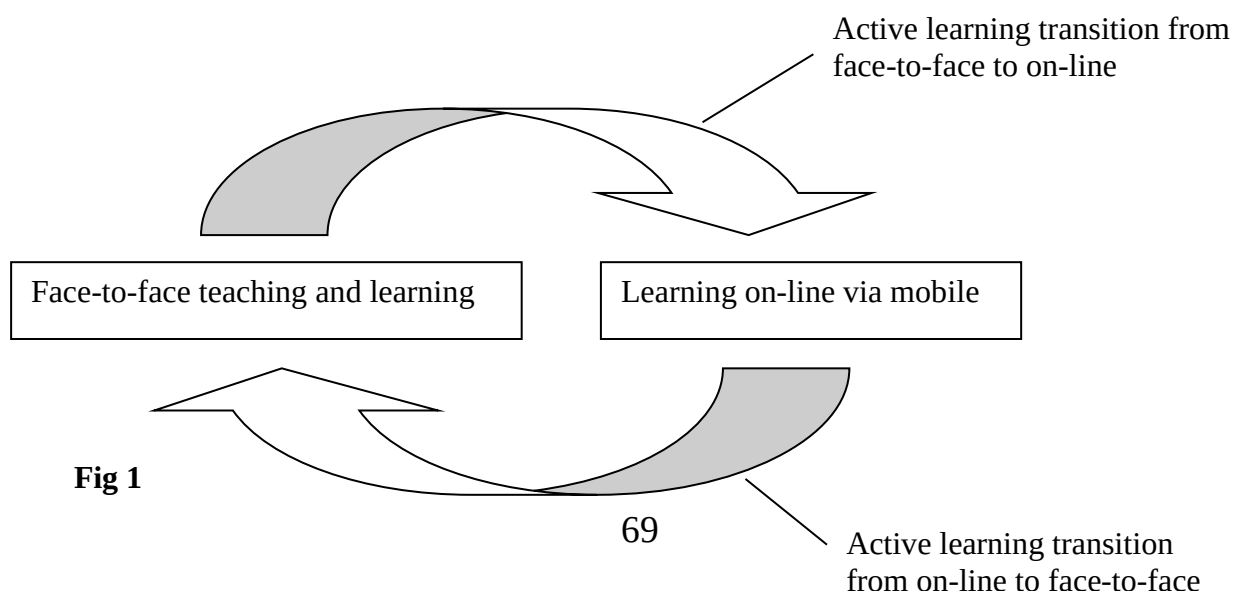
The models above are the various blended learning models that exist as of the time this research was carried out. They are flexible and adaptable for teachers to create

instructional activities and assignments that can give students opportunity to collaborate in learning. Students in blended environment can then have control over time, place, path and pace in learning. Of the six blended learning model only the self blend model is a program level model, while the other five models are course level models.

However, according to Graham,(2006), it was noted that six different rationales that can be used for adopting blended learning were; pedagogical richness, having access to knowledge, social interaction, cost effectiveness and ease of revision. Of these, pedagogical richness, access to knowledge and cost effectiveness have been noticed to be the most popular and this has helped in considering some rationale for the adoption of face-to-face driver model

For the purpose of this study, the researcher adopted the face-to-face driver model because of its suitability to the environment for the study. Biology students in this research, were taught in class using the conventional method for all topics required for the research, after which Biology content based is introduced online that students can use at any place, pace and time. The conceptual framework that best suits the face to face drive model for this study is described below .In this case, the cycle of learning is repeated several times for an effective build up in learning. This framework was adopted from Kolb’s model of learning cycle.

Conceptual Framework for Blended learning



Empirical Studies on Blended Learning in Biology

Numerous studies have been carried out on the use of blended learning by various researchers; Utami (2018) carried out a study on the effect of blended learning model on senior high school students' achievement. The study was an experimental research with a pretest-posttest design. It was carried out on 63 information communication students. In the experimental group, teachers used blended learning instructional model while the control group were subject to the conventional method of teaching. The results indicated that the use of blended learning model was higher as compared to the control group that was not exposed to blended learning. It was concluded that blended learning contributed more to students' achievement. Dziuban, Graham, Moskal, Norbeg and Silica (2018) also carried out a study on the new, normal and emerging technologies. The study considered the theoretical concept and the empirical findings of blended learning in tertiary institution of learning. The result indicate that blended learning maintains or increase the accessibility of students' collective learning and it also helps students success rate for all score levels.

Abidoye (2015) also examined the effect of blended learning as an instructional approach on students' achievement in geography; two hypotheses were generated for the study. A pretest-posttest control group using a quasi-experimental research design was adopted. A total of 110 senior secondary students were used. Two instruments were also used in the study which was geography students' achievement test and a blended learning package. The findings indicated that blended learning was more effective than a conventional teaching method. The result also revealed that no significant difference exist between the achievement of male and female Biology students.

Ibrahim and Mehmet (2014) analyzed students' academic performance in Biology by comparing blended learning and traditional learning. The study was conducted with 54 participants, with 19 males, and 8 females for the experimental group and 18 males and 9 females for the control group. The experimental group used blended learning while traditional learning environment was used for the control. The focus was on genetics, a topic in Biology course that lasted 6 weeks of pretest and final test was used for achievement analysis. The result indicated that, there was no significant difference between the experimental and control group at the pre-test stage, in line with the average score of the final test grade. It was discovered that the experimental group were more successful than the control group, also observing both learning environments, female students were more successful than the male student.

Yapici and Akbayin (2012) carried out a study on blended learning model on Biology students' achievement. The pre-test-post-test control group model was used in the study. The study was conducted on 107 biology students (47 in the experimental group, 60 control group). The experimental group was exposed to blended learning model using a website, while the control group was exposed to traditional teaching methods. Achievement test of 40 questions ($KR-20=0.88$) were used for data collection. Analysis of the data was done using mean scores, independent t-test, and paired samples t-test. The result of the study revealed that blended learning model assist students' in their achievement in Biology than traditional teaching methods.

Robertson, Grant, and Jackson (2005) examined students' perceived quality of learning experience in an online course compared to classroom-based learning in a graduate program. It was observed that students perceived that the quality of their online learning was superior to the campus course. Guiller, Durndell and Ross (2008) also carried out a study that involves students' critical thinking in the use of both online

and face- to- face methods. It was observed that critical thinking had a better effect on the online condition and that students preferred this mode of discussion to be than the face-to-face method.

In another study designed with the pretest and posttest control group model with a total of 312 randomly selected student teachers candidate from 3 different universities in Nigeria by Aladejana (2008), the study applied the use of blended learning model in teaching evolution as a topic in Biology. It was deduced that there was no difference in the pretest scores; however, the result also revealed that the posttest scores also showed no difference. The result is therefore in favor of the experimental group.

In another study by El-Deghaidy and Nouby (2008), a blended e-learning cooperative based method of learning was used. The study involved 26 teachers, there were both experimental and control group. The findings obtained showed that the post-test scores of the teachers showed a higher mean score than those in the control group in favor of the experimental group. Also, Pereira et al (2007) carried out a study on blended learning model for Human Anatomy course. The study was done with 1st-grade Biology students from PompeiiFabra University (Barcelona). There were 69 and 65 students in the experimental and control group respectively. In the experimental group, blended learning was used as a model for learning, while the control group were subject to the traditional method, it was however observed that there was a difference (6.3-5.0; $p<0.0001$) between the mean scores of the two groups involve. The rate of passing the course was higher in the experimental group (87.9-71.4%; $p<0.02$). This study was in favor of the experimental group

Studies on Attitude of Students towards Biology using Blended Learning.

Attitude is an important concept in social judgments' and behavior and thus, it is one of the most important concepts in decision-making. Van Kakesh and Morris (2000). A lot of research based on the attitude of the student towards ICT in teaching and learning had been done with outcomes being either positive or negative.

Becta (2004) reported that negative attitude was a barrier towards the integration of ICT in teaching and learning, while Rhoda and Gerald (2000) discovered that positive attitude towards the use of ICT was widely accepted as one of the necessary conditions for effective teaching and learning. Rapid development in Education technology has provided teachers and students with other new options in a continuously changing competitive environment where teaching and learning exist.

Students' attitudes towards traditional and online methods of teaching are of great importance, this would help to determine if, the increased use of technology in the curriculum has been of benefit to learning or not. According to Ong and Lai (2006) gaining insight into the learners' motivation and attitude by using technology, may influence the level of online learning utilization, hence, with the increasing pressure to provide a more e-learning options to students. It is of great concern, to consider students attitude towards this move from face- to- face to online method of delivery.

In a study conducted by Ginns and Ellis (2007) it was observed that the increasing pressure for greater integration of new technology into the students' learning experience are well acknowledged. Wells, de-Lange, Fieger (2008) also found out that the use of technology in educational setting assists in the achievement of learning outcomes. Dowling, Godfrey, and Gyles (2003) analyzed whether blended and flexible teaching method, is compare able to traditional face to face lecture and improved learning outcome. Their results suggested that there was variation in a positive attitude

of students when the traditional approach was used in combination with the extensive use of multi-media resources.

One of the early authors in blended learning was Garrison and Kanuka (2004). In which research papers offers a framework which explores how integrating online learning into traditional college classroom could be transformative for tertiary institutions. In this case, blended learning typifies an opportunity to support better learning. King and Hildreth (2001) investigated the effectiveness of freshman-level internet-based Biology course. The study compared students' performance and their attitude towards the use of internet-based Biology course to that of a traditional Biology course. It was observed that there were no difference between the students' test scores on the internet-based and traditional courses when used, it was observed however, that the internet-based course was worth the study, while, one-on-one contact between the instruction and students' was higher in the internet-based course, and that the internet-based course provided multiple sources of information for students.

Also, Graff (2003) investigated the cognitive style differences (as measured by Cognitive Style Index) and gender differences in the logics of a classroom community in a blended learning environment. The result shows that students' with intuitive cognitive style showed a lower sense of community than students with an intermediate or analytic style. However, differences were found in the study, with respect to gender and sense of community in a blended learning environment. Also, Mohammed (2013) examined the effects of the traditional learning, blended learning and virtual classes learning on University Students' achievement and their attitude; here 34 male students studying an English language program were involved. They were categorized into three groups (blended, traditional and virtual classes). The results showed that there was a significant difference between the three instructional approaches in the achievement test

scores in favor of blended learning. In addition, the results showed a significant difference in students' attitude as well.

In another study, Grandzol (2004) studied the students' attitudes towards blended learning and traditional learning. The result indicated that there were no differences between blended learning and conventional method of learning. This was also complemented by findings from Gomez, Mercedes and Emilio (2007) who examined the effects of instructional methods for specific purposes. It was observed that even though students benefited more in the use of blended learning, there was no difference between blended learning and conventional learning achievements in their final test marks.

Similarly, Adas and Abu (2011) also conducted a study on Palestinian University students to find out their perception towards blended learning environment. The result here indicated that majority of the learner expressed a positive attitude towards blended learning but no significant difference mentioned. Furthermore, Al-saai, Al-kaabi, and Al-muftah (2011) conducted a study on 43 female University students' test and attitudes towards blended learning and traditional learning, their results showed no difference in the students' achievement scores, although there was a difference in their attitudes towards the teaching approach in favor of blended learning.

Studies on Blended Learning Approach in Biology Students' Achievement

There has been a continuous development of Information and Communication Technology (ICT) within the educational system, where blended instruction emerges as one of the most prominent instructional methods of teaching at higher level of education. Clark and James (2005) noted that the pedagogy of a blended learning environment is based on the assumption that there are internet benefits in face-

to-face interaction as well as the understanding of the online method of learning. Blended learning as seen is a combination of traditional face-to-face and online learning within a classroom and it is essential to note that online components become a normal extension of traditional classroom teaching (Falconer & Littlejohn, 2007).

It has been observed that conventional teaching has been revolving around the use of textbooks and improvised instructional materials. Amin (2005) noted that teachers have taught through lectures and presentation interspersed with tutorial and learning activities, all of which are designed to consolidate and rehearse the content. The author observed that curricula are now starting to emphasize that capabilities and information should be inducted into the learning process. ICTs are able to provide a strong support for all requirements needed for classroom settings (Oliver, 2000). There is considerable evidence to attest to the fact that blended learning can have a positive impact on students' performance. Some research has shown that blended learning can foster a decrease in students' attrition which can also facilitate an increase in the rate of performance in students' examination. (Lopez Perez, Perez Lopez-Rodriguez Ariza 2011)

Ginns and Ellis (2007) explored the relationships between students and their perceptions on e-learning environment, their approaches to studying, and their academic performance. It was observed that students differed widely in their perception, resulting in variation in study approaches and their grades, while e-learning environment tends to obtain better grades. O'Toole and Absalom (2003) observed whether providing courses materials on a university intranet had a positive effect on students' attainment of the intended outcomes. Their investigation showed that the provision of these materials in electronic format is of limited benefits. It can otherwise have an unfavorable effect on

students' performance due to misplaced confidence in the media where the material used for the purpose is delivered.

Blended learning according to Poon (2013) can be considered a good practice, its use as a delivery method viewed about seven major principles of practice to be; Encouraging students to engage in active learning and elicit good practice, providing opportunities for students to work in cooperation, encouraging students to use active learning strategies, providing timely feedback on students' academic, it also requires students spending quality time on academic tasks and establishing high standards for acceptable academic work for learners. This would address different learner needs in the teaching process. The principles, in this case, helps to improve students' achievement and learning in schools. Blended learning benefits students and institutions. It helps to facilitate and improve learning outcomes, flexible accessibility, effective use of resources and also students' satisfaction.

Studies have demonstrated that blended learning contributes to improving learning outcomes for students. (Dziuban et. al, 2006; Garnham & Kaleta,2002; Lim & Morris,2009; Twigg,2003). Twenty out of the thirty institutions that participated in a research funded by Pew Foundation in the United States reported that there was an improvement in learning outcomes. 18 (eighteen) of the participating institutions showed a decrease in student drop-failure-withdrawal rates. Twigg (2003) also reported that course redesigned resulted in students achieving a higher grade, better knowledge, and greater understanding, of the course and the concepts. It was observed that the study showed blended learning had a positive effect in reducing the rates of dropouts and also helped improve their examination marks at the end of each session.

Blended learning also increases the flexibility of access to learning. Poon (2013) stated that students' autonomy and reflection are reinforced. This autonomy

according to the research, allows learner to work whenever and wherever they prefer, as they can access the internet anywhere. This enhances students' ability to control the pace of learning. (Garnham & Kaleta (2002); Smyth, Houghton, Cooney & Casey, 2012).

Garrison and Kanuka (2004) also examined some of the benefits of using blended learning in higher education. Poon (2013) in a study, stated that they described how blended learning had a form of potential, giving various institutions the opportunity to embrace technology, encourage a community of inquiry and also support active and meaningful learning.

Blended learning can promote students to have more interest and be more involved in the learning process thereby enhancing their commitment (Donnelly, 2010; Sharpe et al; 2006). Some setbacks can be experienced by the students in tertiary institutions. For example, unrealistic expectation and feelings of isolation for students, on the other hand, the institution can also face challenges of time and support. Vaughan (2007) cited studies suggesting that students enrolled in blended courses could sometimes have not viable expectations. The students used in the study assumed that fewer classes meant less work. They experienced inadequate time management and had problems in accepting personal learning responsibility. Students in such courses also reported some sense of isolation due to minimal opportunities for social interaction in a face-to-face classroom environment (Smyth et al, 2012).

The problem of having sophisticated technology is another challenge in blended learning. There was particularly a case where students had to rely on slow internet connection (Smyth et al; 2012), Poor connectivity of internet has been reported to inhibit students' ability to engage in online discussion (King, 2002). This can create

considerable frustration; Hara, 2000; Welker & Berardino, 2006. These challenges are viewed and could have a negative impact on learning due to the constraints.

In as much as time poses a challenge for the student, the first challenge for implementation of blended learning for the tertiary institution is time commitment. Johnson (2002) estimates that in planning and developing a large-enrollment blended learning course, it will usually take two to three times the amount of time required to develop a similar course using traditional format.

The achievement of blended learning as described by Stacey and Gerbic (2008) is a practice that promotes high-quality learning outcomes with positive students learning experiences and high teacher satisfaction that allows for research and scholarship. Some factors affecting the success of blended learning include; Students factor, this consider learners need and management of their expectations and their level of understanding is quite significant in the growth and success of carrying out blended learning modules (Bliuc et al 2007; Mitchell & Honore 2007). These researchers viewed the attitude and motivation of learners as being significant, when e-learning is inculcated, as these factors tend to affect acceptance and participation of learners. It is important to manage students' expectation; especially the idea that fewer face-to-face classes means less work in an actual sense, students must be encouraged to take more responsibility for autonomy over their learning (Vaughan, 2007; Tabor, 2007).

The institutional factor is one of the first factors required for a successful blended learning. This is a form of allocation of dedicated services to assist and support learners and facilitators in the development and use of the modules and electronic learning (Poon 2013). The attitudes, readiness, and skills of the facilitators are likewise important as these factors affect the successful use, development and update of the technology-based tools and resources to be used are operational (Beadle & Santy,

2008). Although technology is evidently important for blended learning implementation, Sloman (2007) recommended that emphasis should be changed from a purely technological focus towards teaching and learning methods and styles rather, technology should be considered as merely a means to facilitate students learning.

A study by Lowes (2005) at Columbia University describes the usefulness of blended learning. It was discovered that teachers' instructional methods can be transformed by learning how to teach online, this can help develop new skills and build pedagogical strategies using technology. The study reported that online teaching improves practices in both virtual and face-to-face setting. It was discovered that 75% of the teachers indicated that teaching online had a positive effect on their face-to-face teaching; the study also noted that, teachers who gained experience delivering instruction online can serve as alternative agents in schools where they also teach face-to-face courses.

According to a 2009 report from the United States Department of Education in an quasi-experimental studies, contrasting blends of online and face- to- face method of learning, with conventional face-to-face classes, tends to be more effective, hence, providing a rationale for the effort necessary to design and implement the blended approach. The study's main findings are that students who took part in class online performed better than those taking the same course through traditional face-to-face instruction. Instructions with online and face-to-face fundamentals had an advantage over purely face-to-face instruction than did purely online instruction. Also, the efficacy of online learning approaches appears to be broad across different content and learners types; hence, online learning can be enhanced by giving learners control over their interaction level with media and hence, promoting learning reflection. Singh and Reed

(2001) defined blended teaching as an training program that uses more than one presentation method to recover the cost of program presentation and educational output.

Korkmaz and Karakuz (2009) carried out a study to determine the effect of blended learning model on students' attitudes towards geography course and also their critical thinking dispositions and skill. A pretest-posttest control group was used in the study and the result showed that blended learning models had an impact on students' attitude towards geography course when compared to the conventional learning model. Also, blended learning had a positive impact on students' critical dispositions and levels when compared to the conventional learning model, and there was a positive correlation between students' attitude towards geography course and also their critical thinking dispositions and levels.

Alonso et al (2005) reported that the conventional educational system has focused on transmitting teachers knowledge to students (what the teacher knows, is not necessarily what the student should know) face-to-face instruction is usually provided through various teaching methods which include, discussions, lectures, and guest speaker. Notably, lectures are mainly used in tertiary classes to teach large groups; here materials are presented in a direct, logical manner with content and examples with a summary.

The lecturing method requires the lecturer having proficient oral skills with very little interaction with students which is more of didactic style. Alebaikan (2010) stated that lecturing enables the lecturers to present large amounts of information to a large audience with maximum control of learning experience. It further explained that during lectures limited feedback can be received about the effectiveness of students learning.

In this case, communication would be a one-way process where students are passive with little or no indication on whether they are engaged intellectually or not with the materials made available. It was noted that information, in this case, tends to be forgotten quickly when students are passive and that lectures are not suitable for teaching higher orders of thinking such as application, analysis, synthesis or evaluation. Although lecturing could be appealing to those who prefer to learn by listening, it is however essential to offer students different methods/ activities to meet their various learning needs. The idea of it being a student-centered instruction where lecturing, assignment, test and grading as a traditional instruction will do well, but will also enable students to become independent learners and can learn from one another (Felder & Brent, 1996). O'Toole & Absalom (2003) studies were based on students' achievement where provision of course materials on the internet had a positive effect on students' achievement of course outcomes. It was observed that those who attended the lecture and read Web materials performed better on the quiz than those students who only attended lectures or only used the web.

Studies on Influence of Gender on Students' Attitude towards Blended Learning

Gender plays an important role in influencing the attitude of students in the different learning environment. Yau and Cheng (2012) observed that male students have been shown more a more confident in using technology for learning than female students. However, in another study, Huang, Hood & Yoo (2013) discovered that female students were found to be more comfortable using social media tools for learning than using web 2.0. Vale and Leder (2004) found that male students are more willing to embrace learning technology compared to female students. This was attributed to lack of gender alongside curriculum in online learning technology. These

researchers emphasize the importance of a technology training course for female students in preparing them for using this mode of learning.

Also, Wong and Hanafi (2007) found that female participants possessed a higher level of confidence and improved attitude after going through a technology training course. Arbaugh (2000) on the other hand, noticed that male students encountered difficulty in using learning technology for class participation compared to their female counterpart. However, in Shaw and Marlow (1999) studies, it did not reveal any gender imbalance in attitude towards using technology for learning. Al-Fadhli (2008) also reported a strong significance in students' attitude toward e-learning in line with gender, here; female students mean scores outscored their male counterpart in all areas (items). Female students were obviously positive in evaluating the e-element of the course.

Askar, Altun, and Ilgaz (2008) reported no statistically significant differences between female and male in line with the satisfaction on blended learning; however female scores here were statistically higher than the male scores for the face to face environment. Despite these differences, male and female students have shown a similarity in self-motivation in the online learning environment as observed by Yukselturk and Bulut (2009).

Studies on Influence of Gender on Academic Achievement of Biology Students

Gender is a broad socio-psychological concept. The term is used in referring to boys and girls, men and women as social groups. Gender is a cultural construct that distinguishes the roles, behavior, mental and emotional characteristics between females and males developed by a society (Uduosoro, 2011).

Gender has the sound psychological background and is used to refer to specific cultural patterns of behavior attributed to human sexes. Taylor (2003) referred to a set of assumptions about the nature and character differences between males and female as that which manifest in a number of ideas and practices that have a determinant influence on identification, social opportunities and life experiences of human factors. However, the role of a particular sex of student on the effect of students' gender on achievement has not really produced a conclusive result.

Some findings however, showed a significant difference between the performance of male and female students while other findings showed that sex factor had no impact on students' performance. While some researchers observed that male students had a higher level of achievement in science, technology and mathematics than their female counterparts (Okeke and Ochuba 1986), Yet, some studies found that gender had no effect on students' performance (Adebayo, 2002).

A study was carried out on the use of ICTs and the perception of E-learning among University students using 730 students with the average age of 22 years. 72.8% (531) were females, 29.2% (199) were males, 54.9% (436) were in the first year and 40.2% (294) were in their second year studying for various university qualifications with a greater presence of social sciences and Human Science. A quantitative methodology was used to measure the students; selection was done using a stratified and proportional sample of the students' body registered within the university in which the degree courses were stratified. A structured questionnaire with 15 questionnaires involving simple and compound item was used. The instrument was validated by experts in ICT and pilot test was conducted on the group of students to boost the instrument validity and reliability. The results, in this case, were analyzed using t-test. (Adebayo, 2008).

The result showed there was no difference between male and females in the use of technology but differences were established between males and females. The male students made more use of technology than the female students. Also, a significant difference was observed with regard to their use of internet and computer based on time usage. There were more males that made use of computer and internet both at home and campus than females.

In the awareness of various types of software according to the gender variable, the use of PowerPoint, internet and educational software, it was observed that male students have greater knowledge than female (Adebayo, 2008). However, there are no differences in students' year group. Females showed a higher level of significance than male in the use of the computer in study activity and the reverse is the case in the female. Male use the internet mostly for playing games while female for e-mail chatting. On the usefulness of e-learning, there are no significant differences between males and females.

In another study conducted Ibrahim and Mehmet (2014), the study analyzed students' performance by comparing the blended learning and traditional learning environment respectively. It was observed that there was no difference that exists between the achievement grade dispersion and male-female student grade. Cluster analysis was conducted with experimental and control group. The study involved 54 participants. 19 males and 8 females were used in the experimental group while 18 males and 9 females were in the control group. The focus was on the genetics topics in Biology. The result indicated that female students turned out more successful than the male students. Spencer (2004) also observed that there was no influence on male and female students in mathematics' achievement in college students, when exposed to courseware in an online and traditional learning environment in Mathematics as a

subject. However, female online learners were less likely to conclude the course as compared to their traditional female counterpart or male online counterpart.

In another study, Yusuf and Afolabi (2010) examined the effects of Computer Assisted Instruction (CAI) on Secondary School Students' Performance in Biology and also the influence of gender on the performance of students when exposed to CAI in individualized or cooperative learning settings package. The research was a quasi-experimental involving a 3 X 2 factorial design. The study involved about 120 senior secondary school students (SSS I) that were sampled from various private secondary schools in Oyo state Nigeria, precisely three. The findings showed that the performance of students that were exposed to CAI either individually or cooperatively, performed better than their counterparts that were not exposed to the instruction (traditional). However, the result also shows that there was no difference in the performance of male and female students exposed to CAI in either individual or cooperative settings.

Nsofor and Momoh (2013) also examined the effects of an electronic instructional medium (video DVD instructional package) on students' achievement in Biology. Two research questions and two hypotheses, using a quasi-experimental, pretest-posttest control group design were used as a guide. The sample were 180 senior secondary year two students from six different schools located in three education zones in Niger State. The subjects were divided into two groups; experimental group (electronic medium instruction) and a control group (traditional lecture instruction).

A Structured Biology Achievement Test (SBAT) with a reliability coefficient of 0.83 was used to measure the students' achievement before and after the treatment. The data were analyzed using, Analysis of Covariance, ANOVA and Scheffe test. The result shows that the achievement of students in Biology improved with the use of electronic instructional medium, however, students' gender had no effect on the achievement

when the electronic medium is used. This result, however, has implications for the innovative use of instructional media and creates sound strategies for disseminating science in the classroom.

Ewumi (2012) investigated the correlation between gender and socio-economic status of students' academic achievement in senior secondary schools in Ogun State, Nigeria. Two hypotheses were tested at a significance level of 0.05. 108 students from three different secondary schools in Nigeria with their age ranged between 14 and 21 were involved in this study. Results showed that there was a negative significant relationship between gender and academic achievement ($r = .260$ $p < .05$) and no significant relationship between socio-economic status academic achievement ($r = .083$; $p < .05$). The influence of gender on their achievement has been a concern to researcher yet not consistent result had emerged.

Awoniyi (2000) noted that gender had no influence on the achievement of students, while Mohammed (2000) and Mohammed (2004) reported that gender difference has influenced the academic achievement. Thus the issue is still far from being conclusive.

Studies on Influence of Score Levels on Students Attitudes towards Blended learning

Students' attitude towards ICT education has been found to perform better either positively or negatively attitude. Nayashi, Chen, Ryan and Wu (2004). Also, Gao (2005) found out that the students perceived the use of a computer to had a positive correlation towards students' attitude. Unodiaku (2013) observed that the three ability level (high, medium, low) are factors that influence the readiness of a student in a learning environment.

Simpson and Anderson (2009) carried out a study on the effect of blended learning methods in science students. The results showed that the teaching method and blended learning helped to improve the outcome of students and also gave a high cognitive level. The study also discovered that blended learning can increase the level of interest in students. It was further observed that there was a strong relationship between the level of interest, students' motivation level and their cognitive knowledge.

Turki (2014) carried out a study on the use of blended learning to measure achievement and attitude, it was observed that using blended learning to teach science had a positive impact on their skills and attitude. Also, the importance of blended learning comes from the students' feelings towards this method, it was observed that they play a major role during learning and thus create an option to choose which method of learning suits them.

Studies on Influence of Score Levels on Students' Achievement in Biology.

Achievement is a means of measuring the behavior in a standardized series of test. It is a measure of how much an individual has accomplished after an instruction or training. Academic performance is defined or regarded as participants' examination grades (Grade Point Average) at the end of a particular semester or program. Okoh (2010) noted that the level of performance could be seen based on a particular field of study. Higher scores indicate a better academic performance (Egbule, 2004). Adeoye and Abimbola (2016) findings revealed that students' that used demonstration kit had a greater effect on all the score levels, but the high scorers benefitted most followed by the medium and lastly low scorers. This finding was credited to the high cognitive requirements placed on the students to carefully pick and assign significance on the odds and ends.

In a school setting, student's performance is often determined by individual scores in relation to a given standards or sometimes in relation to the performance of another student in class tests or examination. Webb (2000) viewed a study on students' interaction and learning in small groups, randomly assigned high school students to work on mathematics problems either alone or in a small group in a laboratory setting. Some of the groups were uniform inability. High ability students were found to perform equally well in mixed ability group. Whereas, low ability students performed better in mixed ability groups than in uniform ability group. It was concluded that the roles of the student in group processes produced the result. Those high ability students actively taught other students in the mixed ability groups which reinforced learning. Also, the low ability students who received an activated explanation in mixed ability groups had a better understanding of the concept.

Adeniyi (2012) also examined the effects of the personalized system of instruction on students' performance in mathematics in Kwara South, Nigeria. The researcher used the students' pre-test scores to categorize them into High, medium and low ability groups. The study revealed that all the three categories of scoring level benefited from the study with the low scorers benefitted most (with 25.36 mean gain score), followed by the average scores (with 1.44 mean gain score) and high scorer (with 6.4 mean gain score) respectively. The researcher concluded that personalized system of instruction can be used to teach all the three categories of score levels of student effectively. Also, Adesoji (2008) carried out a study on students' score levels and their effectiveness on problem-solving instructional strategy. The various differences in the performances of students in high, medium and low score in a problem task were compared to the teachers' directed problem-solving instruction. The data collected were analyzed and the findings revealed that there was no significant

difference in the performance of the different score levels after the treatment. The treatment was found to have an influence on the academic achievement of low achievers.

Studies on Interaction Effect of Students' Treatment on Attitude and Achievement in Biology

Interaction has been recognized as an essential and a critical component involved in an educational process (Anderson, 2003). It occurs when objects such as actions or series of events mutually influence each other Sutton (2001). This interaction may exist between students, teachers, and content that are involved in various forms of learning. Moore (1989) classified interaction into three modes namely; student/teacher, student/student, and student/content, while recently another mode which is student/computer were discovered. It is otherwise known as student interface interaction (Mattheos 2004). This interaction may significantly influence learning impact of academic achievement at tertiary level. The students interface interaction involves human-computer interaction.

Alabi (2016) carried out a study on the interaction effect of treatment on gender and performer levels on Biology student, it was discovered that there was no significant interaction between treatment and gender; treatment, performer levels and also treatment, performer levels and gender. However, there was a significant interaction that existed between gender and performer level; this implies that gender is felt at all the various levels of performance. Likewise, Adeoye and Abimbola (2016) carried out a study on the use of demonstration kit on biology student achievement based on the groups (experimental and control) and score levels, it was discovered that there was interaction effect because it had a non- parallel condition, this is due to the

three score levels not been the same, hence there was significant interaction effect. Akanmu (2013) and Abdulkadri (2011) in the studies noted an interaction effect between groups and scoring levels on students' achievements. While Alabi (2016) on the other hand noted that there was no interaction effect between treatment and score level.

Bernard, Abrami, Borokhovski, Wade, Tamin, Sukes and Bethel (2009) carried out research on each mode of interaction; student/teacher, student/student, student/content interaction and each mode had a positive effect on students' achievement. However, Syarif and Sofyan (n.d) carried out a study on blended learning model implementation, there was no interaction effect on teaching and learning model, motivation to students learning achievement hence, it was concluded that student learning achievement is purely influenced significantly by teaching and learning implementation.

Appraisal of the Reviewed Literature

Government in most developing countries recognizes the importance of science and technology in terms of resources in encouraging teaching and learning of sciences in schools (Olorundare and Oni 2006). The outcome of teaching is supposed to give a better performance and not a decline in performance of students in Nigeria institutions. The issue of poor performance of students in Nigeria tertiary institutions has been of great concern to the educators. Studies have found that overcrowding of classroom, large class size, inadequate equipments and some teaching methods are some factors that has contributed or affected Biology students' achievement in one way or the other. Awoderu, (2014); Ogunkola, et.al, 2004. This study however looked into

ways of reducing large class by introducing the use of online learning to Biology students in Tertiary institution.

Utami (2018) carried out a study on the effect of blended learning model on senior high school students' achievement. The study was an experimental research with a pretest-posttest design. It was carried out on 63 information communication students. In the experimental group, teachers used blended learning instructional model while the control group were subject to the conventional method of teaching. The results indicated that the use of blended learning model was higher as compared to the control group that was not exposed to blended learning. It was concluded that blended learning contributed more to students' achievement. This study however would compare the students' attitude and achievement when exposed to blended learning. Several studies have demonstrated that blended learning forms a delivery method to improve learning outcome and performance

Ibrahim and Mehmet (2014) analyzed the students' academic performance in Biology using blended learning and traditional face-to-face learning, the study was experimental with no significant difference, Yapici, and Akbayin (2012), Robertson, Grant and Jackson (2005); Pereira et al (2007) also carried out studies on online and traditional face-to-face with little or no significant differences in the use of blended learning to traditional face-to-face learning, while Abidoye (2015) noticed a significant difference in the students achievement

Korkmaz and Karakuz (2009), Alonzo et al (2005) presented studies to determine the impact of blended on students' attitude. These studies indicate that learners had a positive attitude towards learning which also increases their critical thinking and disposition towards learning. However an instructional tool was not used to enhance learning at students pace, time and place. Studies to indicate the attitude of

Biology students to blended learning with the use of a mobile application for better achievement was viewed.

Studies on the effect of students' gender on academic achievement have not really produced a conclusive result. Some findings indicate a significant difference in performance with gender while some are otherwise Adebayo (2012), Ibrahim and Mehmet (2014), Yusuf and Afolabi (2010) investigated the influence of gender on student performance in Biology and observe no significant difference while Mohammed (2000, 2004) reported that gender has an influence on the academic achievement. Thus the issue is inconclusive

Simpson and Anderson (2009) carried out a study on the effect of teaching and blended learning on knowledge and motivation among science students. The result indicated that the teaching strategy and blended learning help to improved educational outcomes and in particular, cognitive processes were high. The study further observed that blended learning increases the interest and inclination of students and that there was a strong relationship between interest, motivation and cognitive learning outcome.

Most of the researchers in the literature reviewed did not analyze students' attitude and achievement with the use of a mobile application in biology courses that were conceived to be difficult topics, with score level and gender as variables for the study considering attitude and achievement as a dependent variable. This creates a gap which this study intends to fill.

CHAPTER THREE

RESEARCH METHOD

This chapter describes the methodology adopted to carry out this study. This chapter was discussed under the following sub-headings: Research Design, Sample and Sampling Techniques, Research Instrument, Instruments Validation, Procedure for Data Collection and Data Analysis Techniques.

Research Design

This research employed a quasi-experimental research design involving a 2 X 2 X 3 pretest, posttest, non-equivalent and non-randomized control group. The first 2 represents experimental and control group, the other 2 represents male and female while 3 represents high, medium and low scoring levels.

This design was considered appropriate for the study because the study sought for the effects of blended learning on students' attitude and achievement of Biology students in Colleges of Education in Kwara state, Nigeria

In a schematic form, the quasi-experimental design took this format:

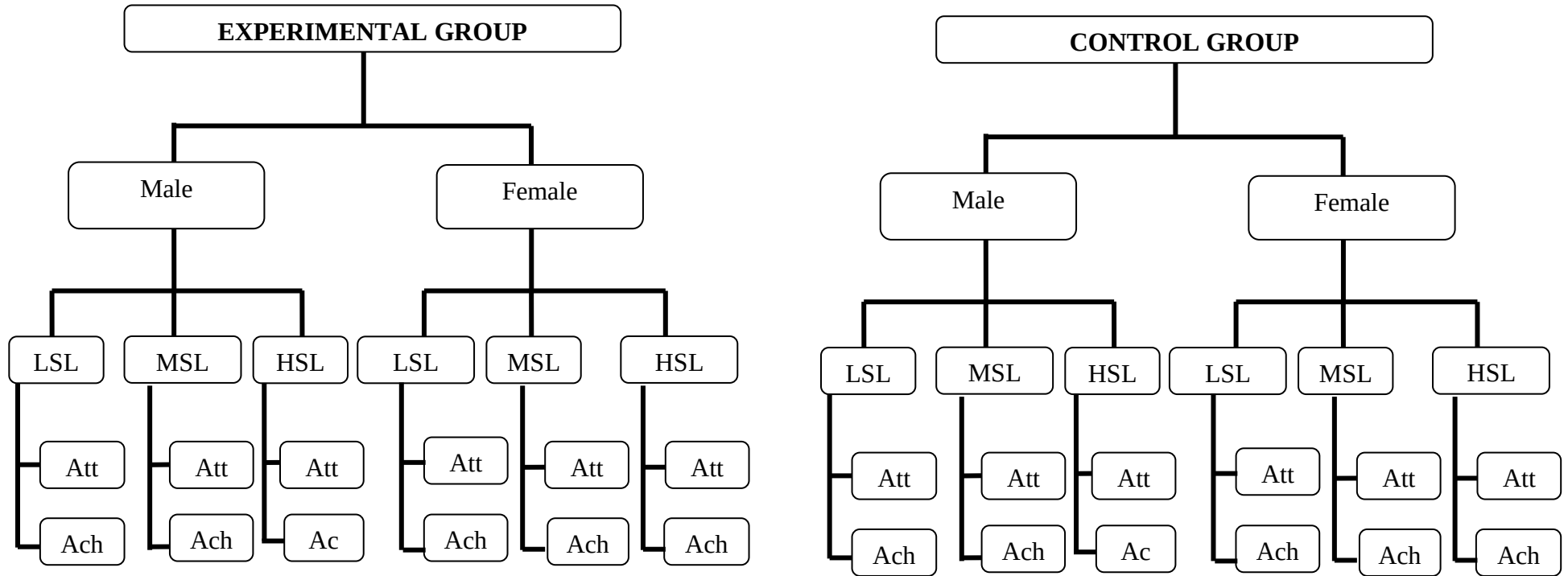
Table 3

Experimental Design Layout

Group	Pretest	Treatment	Post-test	Learning Outcome
Experimental	Attitude	X	Attitude	Attitude
	Achievement		Achievement	Achievement
Control	Attitude		Attitude	Attitude
	Achievement		Achievement	Achievement

Where: X= Experimental treatment (Blended learning).

Diagrammatic Representation of Research Design



KEY: LSL – Low Score Level, MSL – Medium Score Level, HSL – High Score Level, Att – Attitude, Ach – Achievement

Figure 2

Population, Sample and Sampling Technique

The population for this study was made up of all the Biology Education students in Kwara State Colleges of Education. The target population was NCE II Biology Education students in all Colleges of Education in Kwara State, Nigeria. This was based on terms of entry qualification, geographical location and years of establishment. Purposive sampling technique was used to select two Colleges of Education; this was based on the availability and accessibility of internet services within the College campus environment. The sample for the experimental group consisted of 48 students that were purposively selected based on device ownership and willingness to participate, the control group consist of 67 Biology students that were purposively selected from another College of Education. All the 48 Biology students had a mobile phone and all volunteered to participate in the study. To ensure that the schools selected were equivalent, a standard course content based on the National Commission for Colleges of Education minimum standards was used for the teaching, the institutions were located within Kwara State and NCE II students were considered for the study.

Research Instrument

Six research instruments were developed in this study; these are,

- 1) Achievement test instrument-- containing Multiple-choice Test of 64 questions with four options, each based on the NCCE course content in Biology specifically plant physiology, entitled Biology Blended Learning Achievement Test (BBLAT).It is a response instrument that was aimed at measuring the acquisition achievement level of students on the Biology content.

- 2) Attitude questionnaire-- A 45 set of questions adapted to measure the attitude of Biology students towards Blended learning entitled Blended Learning Attitude Questionnaire (BLAQ).
- 3) Internet software application (BBLP App)--This is a Biology contents linked website that is internet-based using a mobile device. The content of the app include, diagrams, notes and other visual aids in some selected topics in Biology. Objectives and Constructive feedback in form of assignments are available in the App for further guidelines.
- 4) Trainer Manual—A manual/ guideline to be used by lecturer in teaching plant physiology in Biology.
- 5) Shuffled Biology Blended Learning Achievement Test (SBBLAT)--This are plant physiology questions that was used for the post test achievement test
- 6) Rubric Rating Scale for Mobile Application.—this is a scale rating manual used for evaluating the mobile app. It is a checklist. The criterion on the checklist is to help evaluate the educational app to promote students understanding and impart learning.

Each of these instruments has its own design procedures. The test for achievement was based on Bloom's taxonomy in other to measure the students' knowledge, comprehension, application, analysis, synthesis, and evaluation.

Selected topics in plant physiology were used for the study:

- i. Photosynthesis.
- ii. Mineral Nutrition in Plant.
- iii. Water Relations.

A Test blueprint was used to represent the number of questions in the test within each topic and the number indicated in Table 4 represents the number of items

on each of the topics. This identified the objectives and skills that were tested and the relative weight of the tests items given to each question. This helps to ensure the desired coverage of topics to be achieved.

Table 4

Table of Specification of Achievement Test on Plant Physiology

Content Area	Number of Items in each Cognitive Domain						Total No. Items	Percentage (%)
	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation		
Photosynthesis	10	8	11	6	4	1	40	53.33
Mineral Nutrition	8	6	1	1	0	0	16	21.33
Water Relations	12	1	5	0	1	0	19	25.33
Total	30	15	27	7	0.5	1	75	100
Percentage %	40	20	22.77	9.3	6.77	1.33	100	

Researcher-Designed Blueprint

Validation of Research Instrument

The Achievement test instrument was validated by making use of three experienced Biology lecturers in a College of Education, two Biology education lecturers from Science Education Department, University of Ilorin, also helped to establish the content and face validity of the instruments. Corrections and comments were adhered to before it was given to Researcher's Supervisor for further amendment and suggestions.

Item analysis was done to determine difficulty index and discrimination index of the items (achievement test). Thereafter, the test was administered to the students of another College not participating in the study. Values from items shown in Appendix II indicates some Zero (0) values within the items that did not fulfill either of the two conditions (Difficulty and Discrimination index), while values below 0.5 in difficulty index were restructured. Items within the range of 0.25-0.3 in discrimination index too were restructured.

To estimate the reliability of the 64 multiple-choice items in the achievement test (BBLAT), a test was conducted on 40 Biology students in College of Education, Lafiagi, that were not part of the main study in this research. The collected data were statistically analyzed using a split-half technique. The result indicated that the 64 items achievement test was reliable to a degree of 0.82 at a correlation ratio between the two separate halves (odd and even) of the achievement test items.

Based on the review of the literature on Biology students' attitude towards blended learning, the researcher adapted a 45-item attitude scale questionnaire entitled Blended Learning Attitude Questionnaire (BLAQ). The attitude scale questionnaire was given to the Researcher's Supervisor and a reviewer to evaluate for internal validity. The reviewers suggested that some of the items be revisited or eliminated in order for the scale to be reduced in terms of items.

A Cronbach alpha statistical analysis was employed to analyze the sample study of 22 Biology students who responded to the 50 item attitude scale. The findings hence, showed a reliability of 0.833, this value was assumed to be appropriate for this study.

The BBLP app was validated by five experts in Educational Technology and an expert in Computer science Department in University of Ilorin. Experts in

Educational Technology along with the Researchers' Supervisor went through the package for face validation while a checklist mobile application assessment for mobile ranking scale was used for face and content validation of the instrument. Based on their views and comments, the package was reviewed and all necessary adjustments were made for proper use of the application on a mobile device.

Procedure for Data Collection

A letter of introduction of the researcher seeking permission to administer the test was presented to the Provosts of the Colleges of Education for approval. Students' consent was sought prior to the commencement of the treatments to meet the ethics requirements in research. One experimental and one control group were used for the study in order to measure the attitude and achievement. Students in the experimental group were exposed to face-to-face driver model type of blended learning with an Internet-based software application titled Biology Blended Learning Package (BBLP), while the control group was subjected to a didactic method of learning. The dependent variables of the study were the students' attitude towards blended learning and achievement of students in Biology. The independent variables were gender and score level of the Biology students.

The cooperation of the Biology lecturers that served as the Research Assistants for both the control group and experimental group was also sought. The researcher did the introduction in the first lecture for both groups after which copies of Blended Learning attitude questionnaire (BLAQ) was first administered to the two groups to determine their views on their attitude towards blended learning and a pretest on the achievement of Biology students (BBLAT) was administered. The usual lecture commenced for both groups. In the case of the experimental group, after few lectures, the app was introduced to the students. Technologists were employed to assist and

supervise the students in installing the application on their various android phones and given further instructions on the usage of the App by the researcher. Assignments based on plant physiology were made available to the students on the App. The students were expected to use the app at their own convenience after lectures during their leisure time out, especially, off the school environment.

For internet access, a 1 GB internet bundle was given to each student in the experimental group. The students were expected to give details of their profiles after which they had access to the content on the app. The BBLP is an online based application that allows users to browse for topics taught in class and links on the App that the students can have access to.

Concurrently, the control groups were taught Biology topics in photosynthesis, mineral nutrition and water relations with the use of lecture method only. The two procedures lasted for four weeks, where each topic were taught within the four weeks. At the end of the treatments for the two groups involved, a test of multiple-choice questions that had been shuffled (SBBLAT) was administered to the students in question in order to get a feedback. While the attitude scale questionnaire for the post-test was administered to both the experimental and the control groups. Data collection involving administration of pre-test and post-test in all sampled Colleges was done by the assistants and the researcher.

The prerequisite grades of the respondents were used to categorize them into their different score levels, i.e., high scorers, medium scorers and low scorers, respectively using the NCCE standard grading levels. The attitude was measured by administration of a questionnaire using a Likert-type scale.

The period of instruction for the study was the regular second-semester session based on the requirement of NCCE. Pre-test and Post-test were administered to both experimental and control groups before and after the treatment.

Data Analysis Techniques

Data collected from pretest and post-test scores for experimental and control groups were analyzed using, *t*-test for hypotheses 1, 2 and 3, while Analysis of Covariance (ANCOVA) was used for hypotheses 4-12. Statistical Package for Social Sciences (SPSS) Version 23.0 was used to analyze the data.

CHAPTER FOUR

DATA ANALYSIS AND RESULTS

This chapter presents the results obtained from the Data collected on the study on the effects of blended learning on students' attitude and Biology achievement. It further presents the description of the research subjects, statistical analysis, and results based on research questions and research hypotheses stated earlier.

A total of 115 respondents participated in this study, each group consisting of 67 and 48 students in the control and the experimental groups, respectively; the respondents were pre-tested and post-tested in this study. The sample sizes for this research were sufficient and well represented.

Figure 3 shows the demographic characteristics of students that participated in the study. The chart here shows the two groups involved in the study.

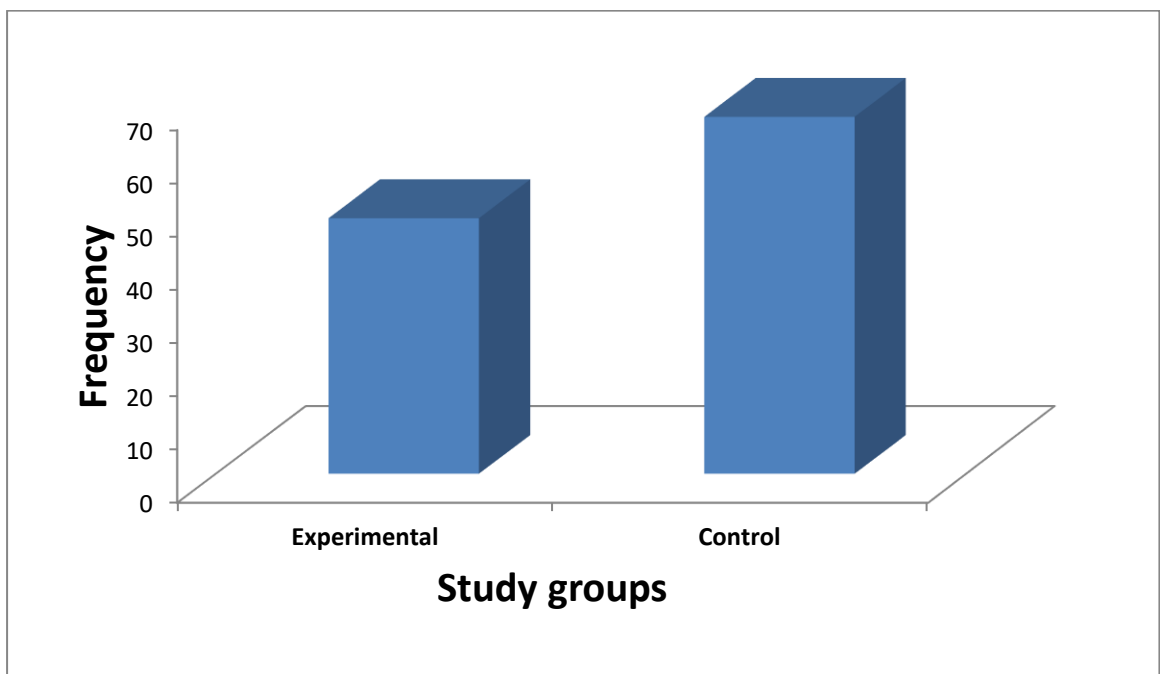


Figure 3: Distribution of participants based on study groups.

Figure 4 illustrates the number of male and female students involved in each of the study groups. The experimental group comprised of 35 female students and 13 male students, while the control group consist of 47 female and 20 male students respectively.

Figure 5 also, presents the demographic representation of the numbers of high, medium and low-scoring students in each of the groups. In the experimental group, there were 17 high scorers, 30 medium scorers and 1 low scorer, while the control group comprises of 27 high scorers, 36 medium scorers and 4 low scorers, respectively.

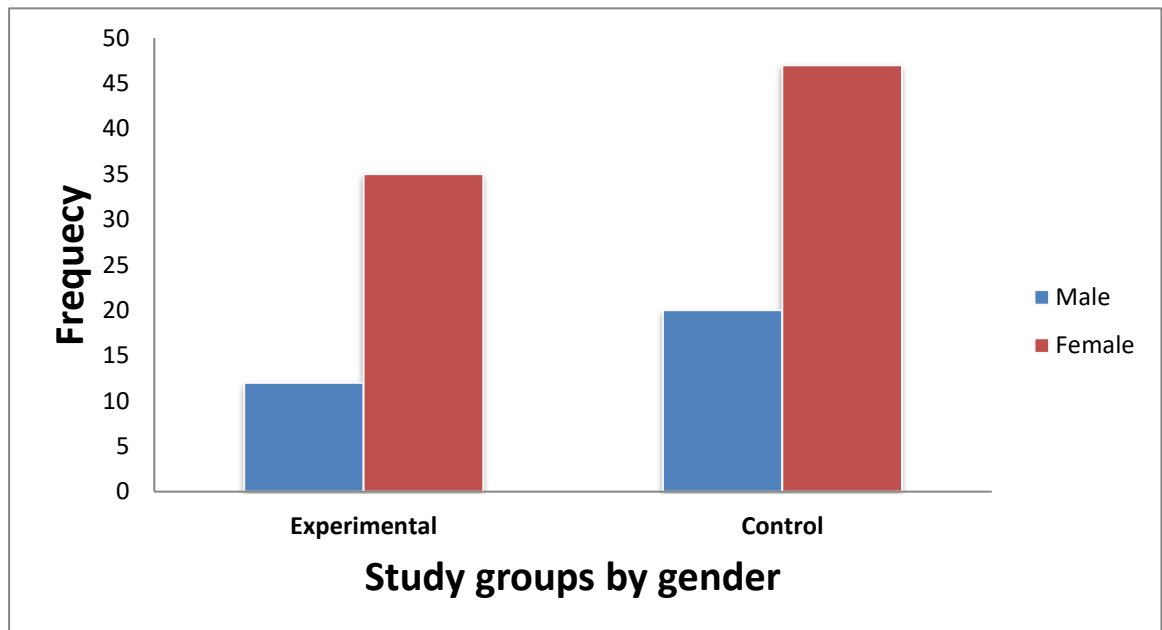


Figure 4: Distribution of participants based on gender.

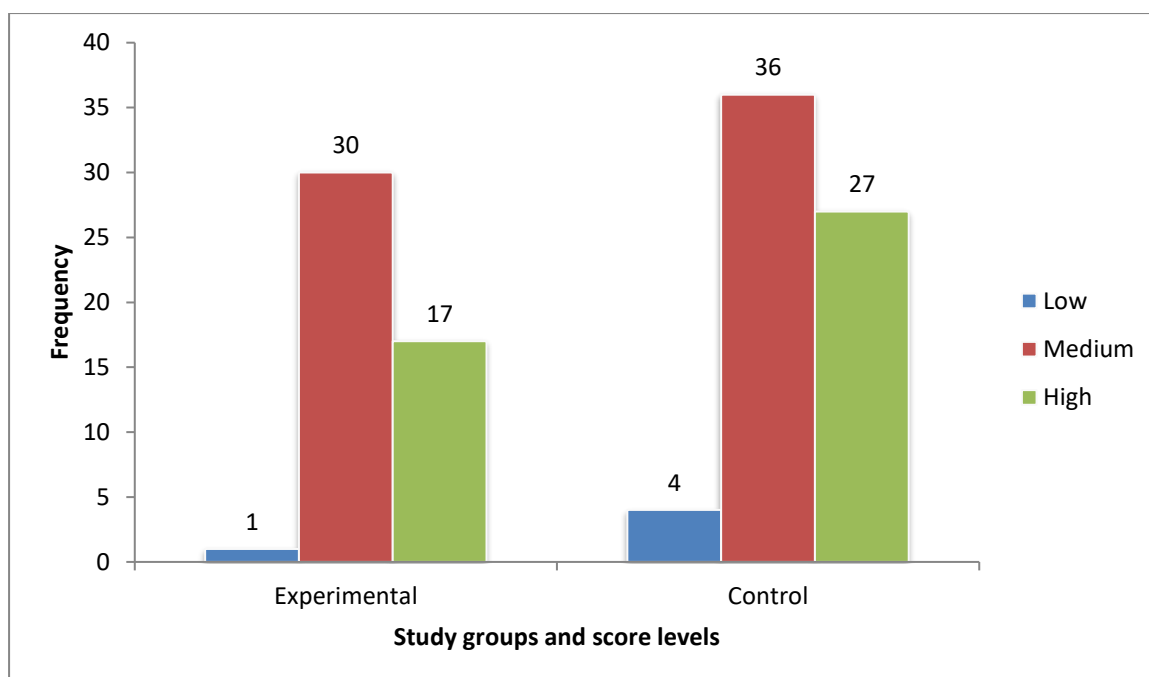


Figure 5: Distribution of participants based on score levels

Research Question 1: What is the effect of blended learning on Biology students' attitude in Colleges of Education in Kwara State, Nigeria?

Blended learning had an effect on students' attitude towards learning of Biology. Table 5 shows that the posttest had a mean score and standard deviation of 63.00 and 17.09 respectively, as against the pretest which had a mean score of 52.67 and a standard deviation of 19.62. This however, implies that student exposed to blended learning had a higher positive attitude towards learning of Biology than those not exposed to blended learning as seen in the pretest mean score. Hence, attitude had a positive effect on blended learning.

Hypothesis 1: There is no statistically significant difference in the attitude of Biology students in Colleges of Education in Kwara State, when exposed to blended learning.

The t -test of the data for blended learning on the pretest, posttest groups as shown in Table 5 reveals that there was a significant difference in the attitude of Biology students in Colleges of Education when exposed to blended learning at $t_{(113)} = 6.91, p < 0.05$. This implies that Biology students in Colleges of Education had a positive attitude towards blended learning. The hypothesis that states that there is no statistically significant difference in the attitude of Biology students in Colleges of Education is therefore rejected.

Table 5

t-test analysis on the Difference in the Attitude of Biology Students in Colleges of Education

Attitude	N	Mean($\bar{x}$)	Std.Dev	t	df	Sig
Pretest	115	52.67	19.62	6.91	113	0.00
Posttest	115	63.00	17.09			

Research Question 2: What is the effect of blended learning on Biology students' achievement in Colleges of Education in Kwara State, Nigeria?

Students exposed to blended learning have a post test mean score of 38.83 with a standard deviation of 10.30. While the pretest mean score is 824.37 with a standard deviation of 8.56. This implies that students exposed to blended learning had a higher achievement towards the learning of Biology than those not exposed to blended learning. Hence, blended learning had an effect on Biology students' achievement.

Hypothesis 2: There is no statistically significant difference in Biology students' achievement in Colleges of Education in Kwara State, when exposed to blended learning

The t-test analysis on effect of blended learning on Biology students' achievement in the pretest, posttest group as shown in Table 6 shows that there was a significant difference in Biology students' achievement when exposed to blended learning. $t_{(113)} = 21.88$, $p < 0.05$. Since the p value is than 0.05, it indicate that there was a significant difference in the achievement of Biology students to blended learning. Therefore, hypothesis that states that there is no statistically significant difference in Biology students' achievement in Colleges of Education when exposed to blended learning formulated is rejected.

Table 6

t-test Analysis on the Difference in the Achievement of Biology Students in Colleges of Education to Blended Learning

Achievement	N	Mean($\bar{x}$)	Std. Dev	<i>t</i>	<i>df</i>	sig
Pretest	115	24.37	8.56			
				21.88	113	0.00
Post test	115	38.83	10.30			

Research Question 3: What is the effect of blended learning on Biology students' attitude in Colleges of Education based on gender?

Table 7 reveals that male Biology students' in the experimental group had a mean score and a standard deviation of 70.84 and 15.59 respectively, while female in same experimental group had a mean score and a standard deviation of 68.00 and 17.00. This implies that male Biology students had a positive attitude to blended learning as compared to their female counterpart

Hypothesis 3: There is no statistically significant difference in the attitude of Biology students in Colleges of Education when exposed to blended learning based on gender.

Table 7 shows that there was no significant difference in the attitude of Biology students in Colleges of Education when exposed to blended learning based on gender. $t_{(46)} = .53, p > 0.05$. Since the p value is greater than 0.05, it means that there was no significant difference in the attitude of Biology students when exposed to blended learning based on gender. Therefore, hypothesis that states that there is no statistically significant difference in the attitude of Biology students in Colleges of Education when exposed to blended learning based on gender is therefore not rejected. .

Table 7

t-test Analysis on the Difference in the Attitude of Biology Students towards Blended Learning

Attitude	Gender	N	Mean($\bar{x}$)	Std.dev	<i>t</i>	<i>df</i>	Sig
Experimental group	Male	13	70.84	15.59	.53	46	.60
	Female	35	68.00	17.00			

Research Question 4: What is the difference in the attitude of high, medium and low score Biology students in Colleges of Education when exposed to blended learning?

Table 8 shows the difference in the attitude of Biology students to blended learning on low, medium and high scorers when exposed to it. It is apparent from the table that the medium scorers benefitted the most with a mean score of 72.10 and a standard deviation of 11.59, as compared to high scorer with 63.17 with standard

deviation of 17.09 and low scorers with 64.00 mean scores with zero standard deviation . It was deduced that there is a difference in the score levels.

Table 8

Description of the Differences in the Attitude of High, Medium and Low Scorers to Blended Learning

Attitude	N	Mean($\bar{x}$)	Std Dev
High scorer	17	63.17	17.09
Medium scorer	30	72.10	15.82
Low scorer	1	64.00	-
Total	48		

Hypothesis 4: There is no statistically significant difference in the attitude of high, medium and low score Biology students when exposed to blended learning.

The result of the test of statistically significant difference in high, medium and low scoring students is presented in Table 9. The Analysis of Covariance (ANCOVA) reveals that there is a significant difference in the attitude of Biology students when exposed to blended learning based on score level, this is in favor of the medium scorer with $F_{(2,44)} = 1.66$; $p < 0.05$, since p value is greater than 0.05. This implies that there is a significant difference in the attitude of score level to blended learning among Colleges of Education Biology students in favor of medium scorer students. Hence, the null hypothesis that states that there is no statistically significant difference in the attitude of high, medium and low score Biology student when exposed to blended learning is therefore rejected.

Table 9

Analysis of Covariance on the Difference in the Attitude of Biology Students to Blended Learning, Based on Score Levels

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	972.65 ^a	3	324.22	1.20	.32
Intercept	144559.99	1	144559.99	54.06	.00
Pre-test	85.34	1	85.34	.317	.058
Score Level	895.86	2	447.93	1.66	.20
Error	11849.83	44	269.31		
Total	239835.00	48			
Corrected Total	12822.48	47			

^a. R Squared = 0.76(Adjusted R Squared = .013)

Research Question 5: What is the difference in the achievement of male and female Biology students in Colleges of Education when exposed to blended learning?

Male Biology students in Colleges of Education exposed to blended learning has a post test mean score of 39.76 and standard deviation of 10.50, while the female Biology students had a post test mean score of 39.17 and standard deviation of 10.32 as shown in Table 10. This implies that there is no difference in the achievement of male and female Biology students when exposed to blended learning

Table 10

t-test Analysis on Achievement on Male and Female Biology Students when exposed and when not exposed to blended learning

	Gender	N	Mean($\bar{x}$)	Std.dev	t	df	Sig
Post test	Male	13	39.76	10.50	.177	46	.86
	Female	35	39.17	10.32			

Hypothesis 5: There is no statistically significant difference in the achievement of male and female Biology students in Colleges of Education when exposed to blended learning.

The t-test analysis on male and female Biology students when exposed to blended learning reveals that there is no significant difference between male and female Biology students with $t_{(46)} = .18$, $p > 0.05$, since p value is greater than 0.05. Hence, the null hypothesis which states that there is no significant difference in the achievement of male and female Biology students when exposed to blended learning is therefore not rejected.

Research Question 6: What is the difference in the achievement of high, medium and low score Biology students in Colleges of Education when exposed to blended learning?

Table 11 illustrates the difference in the achievement of Biology of High, Medium and Low score students when exposed to blended learning. From the table below, the mean score and standard deviation for low score Biology students is at 49.82 and 4.94 respectively while the medium score Biology students had a mean score and standard deviation of 34.03 and 7.13. the mean for high scores is 20.00. this shows that low score Biology students had a higher mean score over the medium and high scorer which indicate that low score Biology students improved in their achievement in Biology using blended learning in Colleges of Education

Table 11

Description of the Difference in the Achievement of High, Medium and Low Score Students

Score level	N	Mean($\bar{x}$)	Std Dev
High scorer	1	20.00	-
Medium Scorer	30	34.03	7.13
Low Scorer	17	49.82	4.94

Hypothesis 6: There is no statistically significant difference in the achievement of high, medium and low score Biology students in Colleges of Education when exposed to blended learning.

The result of the test of statistical difference in the achievement of high, medium and low scorer students is presented in Table 12. The analysis of Covariance in the table reveals that $F_{(2,44)} = 36.39$, $p < 0.05$ for those exposed to blended learning, since the p value for high, medium and low scorer is less than 0.05. The null hypothesis that states that there is no statistical significant difference in the achievement of high, medium and low score Biology students when exposed to blended learning is therefore rejected.

Table 12

Analysis of Covariance of Posttest on the Achievement of Biology on Score Levels when exposed to Blended Learning

Source	Type III Sum of Square	df	Mean Square	<i>F</i>	Sig
Corrected Model	3089.27 ^a	3	1029.76	24.29	0.00
Intercept	4560.22	1	4560.23	107.56	0.00
Pre-test	2.04	1	2.05	.048	.83
Score Level	3085.88	2	1542.94	36.39	0.00
Error	1865.39	44	42.39		
Total	79216.00	48			
Corrected Total	124954.67	47			

a. R. Squared = .624 (Adjusted R Squared = .598)

Research Question 7: What is the interaction effect of treatment and gender on the attitude of Biology students in Colleges of Education when exposed to blended learning?

Table 13 presents the description of the interaction effect of treatment and gender on the attitude of Biology students to blended learning. It was observed from

the table that the mean score for male in the experimental group is 39.17 with a standard deviation of 10.51, while female had 39.77 with a standard deviation of 10.33 based on the students' attitude, the control group had a mean score and standard deviation for male Biology students (40.23 and 10.25) respectively, and female had 37.62 with standard deviation of 10.47. The Table therefore suggests that female and male had a little difference in their attitude when exposed or not exposed to blended learning.

Table 13

Description of the Interaction Effect of Treatment and Gender on Attitude of Biology Students When Exposed to Blended Learning

Treatment	Gender	N	Mean ($\bar{x}$)	Std Dev
Experimental	Male	13	39.17	10.51
	Female	35	39.77	10.33
Control	Male	22	40.23	10.25
	Female	45	37.62	10.47
Total	Male	35	40.06	10.19
	Female	80	38.30	10.37

Hypothesis 7: There is no statistically significant interaction effect of treatment and gender on attitude of Biology students in Colleges of Education, when exposed to blended learning.

The Analysis of Covariance (ANCOVA) in Table 14 shows that the treatment had no interaction effect on gender, at $F_{(1,87)}=1.78$; $p > 0.05$. Hence, the null hypothesis, which states that there is no statistically significant interaction effect of treatment and gender on the attitude of Biology students when exposed and when not exposed to blended learning, is not rejected. The graphical representation of the interaction is presented in Figure 5

Table 14

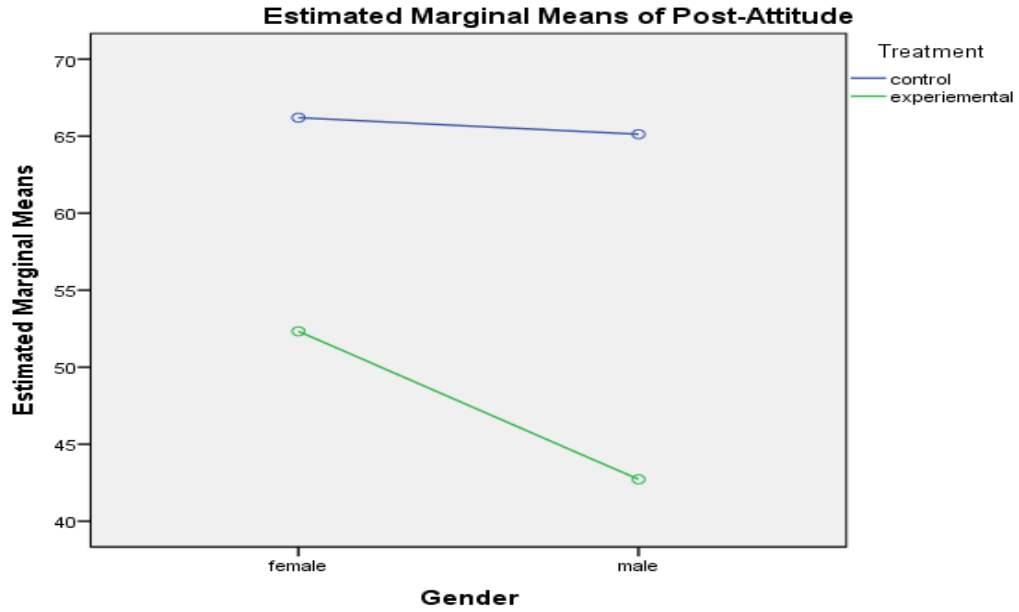
Analysis of Covariance on Interaction Effect of Treatment and Gender on Attitude of Biology Students towards Blended Learning

Source	Type III Sum of Squares	df	Mean Square	<i>F</i>	Sig.
Corrected Model	17848.832 ^a	4	4462.208	34.324	.000
Intercept	744.659	1	744.659	5.728	.019
Pre- test	16232.249	1	16232.249	124.859	.000
Treatment	2831.053	1	2831.053	21.777	.000
Gender	352.551	1	352.551	2.712	.103
Treatment* Gender	224.639	1	224.639	1.728	.192
Error	11310.385	87	130.004		
Total	380826.000	92			
Corrected Total	29159.217	91			

a. R squared = .612 (Adjusted R Squared =.594)

Research Question 8: What is the interaction effect of treatment and score levels on attitude of Biology students in Colleges of Education when exposed to blended learning?

Table 15 shows the description of the interaction effect of treatment and score levels. The mean score for the medium scorers in the control group was higher than that of the low scorers and no interaction for the high scorer, only three higher score were involved in the study and they fall into the experimental group, hence, the control group does not have representation for high score.



Covariates appearing in the model are evaluated at the following values: Pre-Attitude = 48.8696

Figure 6: Graphical Illustration of the Interaction Effect of Treatment and Gender on Biology students' attitude

Table 15

Description of the Interaction Effect of Treatment and Score Levels on the Attitude of Biology Students towards Blended Learning

Treatment	Scoring Levels	N	Mean	Std.Dev
Experimental	High Scorer	3	64.33	11.59
	Medium Scorer	19	67.79	12.57
	Low Scorer	2	68.50	20.51
Control	High Scorer	0	00.00	00.00
	Medium Scorer	33	75.55	10.69
	Low scorer	35	45.06	12.29
Total	High Scorer	03	64.33	11.59
	Medium Scorer	52	72.71	11.90
	Low Scorer	37	46.32	13.53

Hypothesis 8: There is no statistically significant interaction effect of treatment and score levels on the attitude of Biology students in Colleges of Education when exposed to blended learning.

Table 16 shows the Analysis of Covariance on treatment and score level. Treatment which is blended learning and the score levels did interact, the degree of freedom being 27.7 with a significant level of 0.001 It can be deduced that there is a statistically significant interaction effect of treatment and score levels on the attitude of Biology students; $F_{(1, 86)} = 27.7$; $p < 0.05$. The formulated hypothesis is therefore rejected. This is shown graphically in Figure 6.

Table 16

Analysis of Covariance on Interaction Effect of Treatment and Score Level on the Attitude of Biology Students

Source	Type III Sum of Squares	df	Mean Square	<i>F</i>	Sig.
Corrected Model	24009.494 ^a	5	4801.899	80.191	.000
Intercept	.925	1	.925	.015	.901
Pre-test	7172.669	1	7172.669	119.783	.000
Treatment	75.204	1	75.204	1.256	.266
Score Levels	4030.549	2	2015.275	33.655	.000
Treatment * Score Levels	1658.683	1	1658.683	27.700	.001
Error	5149.723	86	59.881		
Total	380826.000	92			
Corrected Total	29159.217	91			

RSquared=.823(Adjusted R Squared=.813)

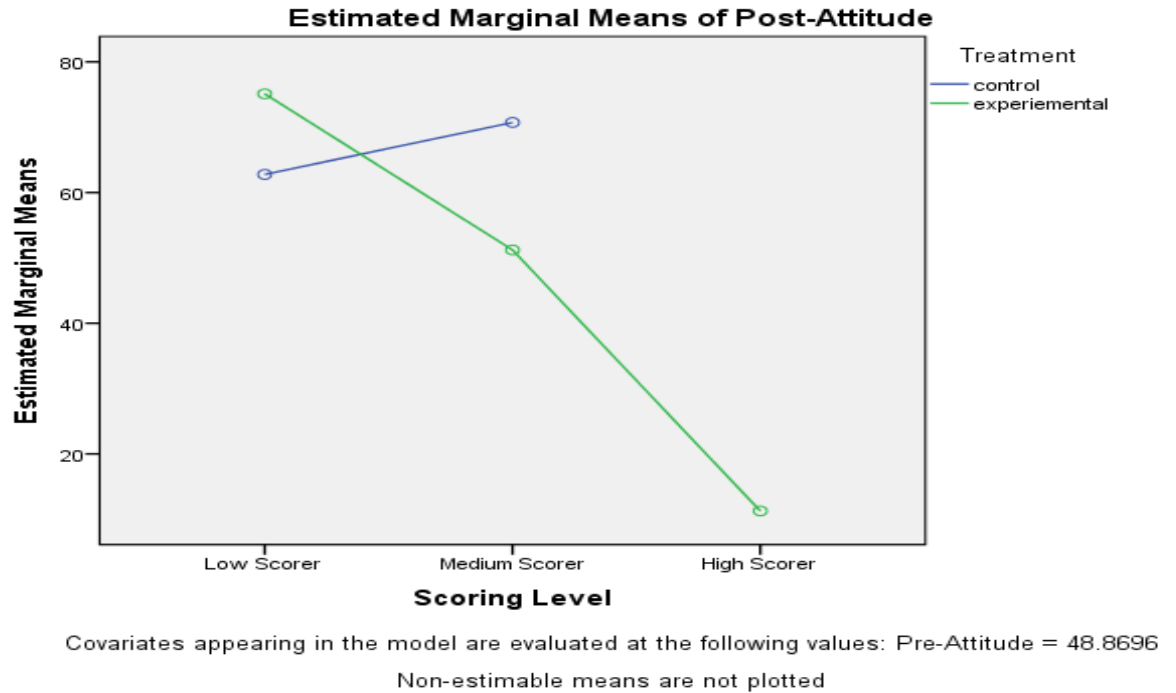


Figure 7: Graphical Illustration of the Interaction Effect of Treatment and Score levels on Biology Students' Attitude when Exposed to Blended Learning.

Research Question 9: What is the interaction effect of treatment and gender on Biology students' achievement in Colleges of Education when exposed to blended learning?

Table 17 illustrates the description of the interaction effect of treatment and gender. It could be detected from the Table 18, that the male and female students in the control group had a mean score of (40.23, 37.62), while for the experimental group the mean score was (39.77, 39.17). This indicates that the mean scores of both male and female in both the control and the experimental groups had very little difference (38.48, 39.33).

Table 17

Description of Interaction Effect of Treatment and Gender on Achievement of Biology Students

Treatment	Gender	N	Mean($\bar{x}$)	Std. Dev
Experimental	Female	35	39.17	10.33
	Male	13	39.77	10.51
Control	Female	45	37.62	10.47
	Male	22	40.23	10.25
Total	Female	80	38.30	10.37
	Male	35	40.06	10.19
	Total	115	38.83	10.31

Hypothesis 9: There is no statistically significant interaction effect of treatment and gender on Biology Students' achievement in Colleges of Education when exposed to blended learning.

The results of the test on interaction of treatment and gender on the achievement of Biology students when exposed to blended and when not exposed to it is presented in Table 18. The Analysis of Covariance in Table 18 shows that at $F_{(1, 110)} = 1.06$; $p > 0.05$. The result shows that the degree of freedom is at 110 at a significant level of 0.31. This proves that there no statistically significant interaction effect on treatment and gender on Biology students achievement. Hence the Hypothesis is not rejected.

Table 18

Analysis of Covariance on Interaction Effect of Treatment and Gender on Achievement of Biology Students to Blended Learning

Source	Type III Sum of Square	df	Mean Square	F	Sig.
Corrected Model	8494.58 ^a	4	2123.65	64.69	0.001
Intercept	1489.07	1	1489.07	45.36	0.001
Pretest	8370.44	1	8370.44	254.97	0.001
Treatment	1845.79	1	1845.79	56.22	0.001
Gender	.057	1	.057	.002	0.97
Treatment*gender	34.69	1	34.69	1.06	0.31
Error	3611.28	110	32.83		
Total	185542.00	115			
Corrected Total	12105.86	114			

R Squared =.702(Adjusted R Squared=.691)

Research Question 10: What is the interaction effect of treatment and score levels on Biology students' Achievement in Colleges of Education when exposed to blended learning?

Table 19 describes the interaction effect of treatment and score levels on the achievement of Biology Students. It could be deduced from the table that the high scoring students in both the control and the experimental groups had a mean score of 27.50 with a standard deviation of 10.61 as compared to the medium scorers and low scorers (9.45, 10.30), respectively.

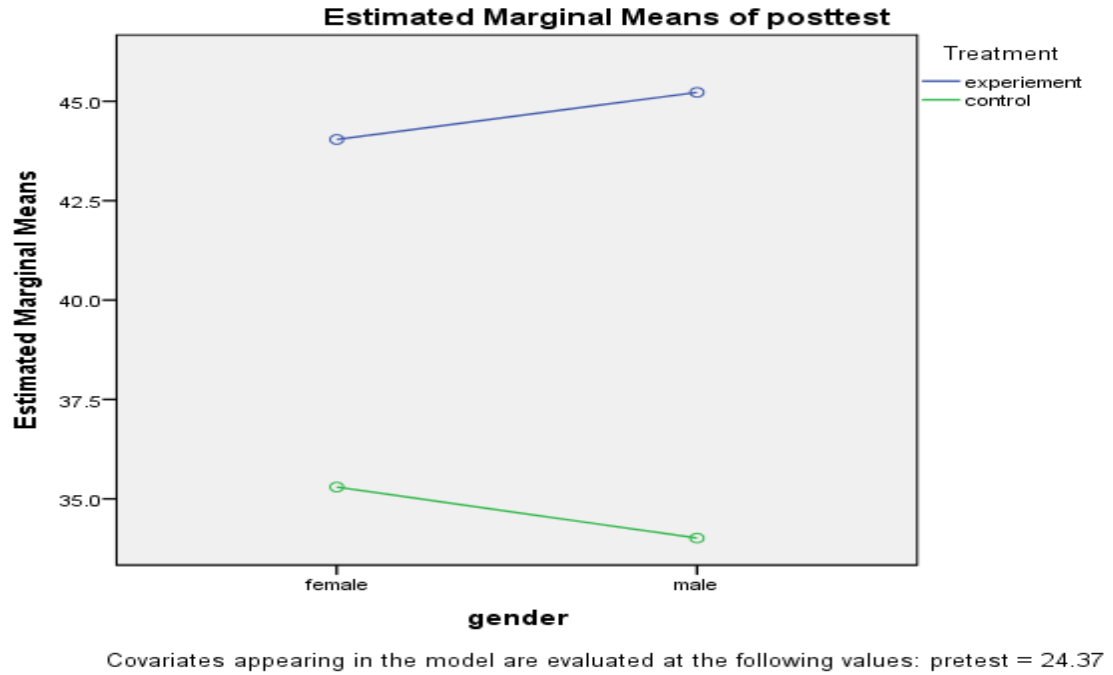


Figure 8: Graphical illustration of the Interaction Effect of Treatment and Gender on the Achievement of Biology Students.

Table 19

Description of Interaction Effect of Treatment and Score Levels on the Achievement of Biology Students To Blended Learning

Treatment	Score Level	N	Mean ($\bar{x}$)	Std. Dev
Experimental	High Score	1	20.00	0.00
	Medium Score	30	34.03	10.59
	Low Score	17	49.82	10.48
	Total	48	39.33	10.39
Control	High Score	1	35.00	0.00
	Medium Score	39	38.49	10.59
	Low Score	27	38.59	10.48
	Total	67	38.48	10.39
Total	High Score	2	27.50	10.61
	Medium Score	69	36.55	9.45
	Low Score	44	42.93	10.30
	Total	115	38.83	10.31

Hypothesis 10: There is no statistically significant interaction effect of Treatment and Score levels on Biology Students' Achievement in Colleges of Education when exposed to blended learning.

Table 20 shows the ANCOVA of the effect of treatment and score levels on the achievement of Biology students. The degree of freedom in this result is at 108 with a significant level of 0.001. It could be deduced there is a statistically significant effect in the interaction effect of treatment and score levels on the achievement of Biology students; $F_{(2,108)} = 11.04$; $p < 0.05$. The formulated hypothesis that there is no statistically significant effect in the interaction of treatment and score levels on Biology students' achievement is therefore rejected.

Table 20

Analysis of Covariance on the Interaction Effect of Treatment and Score levels on Biology Students' Achievement to Blended Learning.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9474.143 ^a	6	1579.024	64.800	.000
Intercept	1282.230	1	1282.230	52.620	.000
Pretest	6353.981	1	6353.981	260.754	.000
Treatment	117.435	1	117.435	4.819	.030
Score Levels	682.367	2	341.183	14.001	.000
Treatment* Score Levels	538.158	2	269.079	11.042	.001
Error	2631.718	108	24.368		
Total	185542.000	115			
Corrected Total	12105.861	114			

R Squared = .783 (Adjusted R Squared = .771)

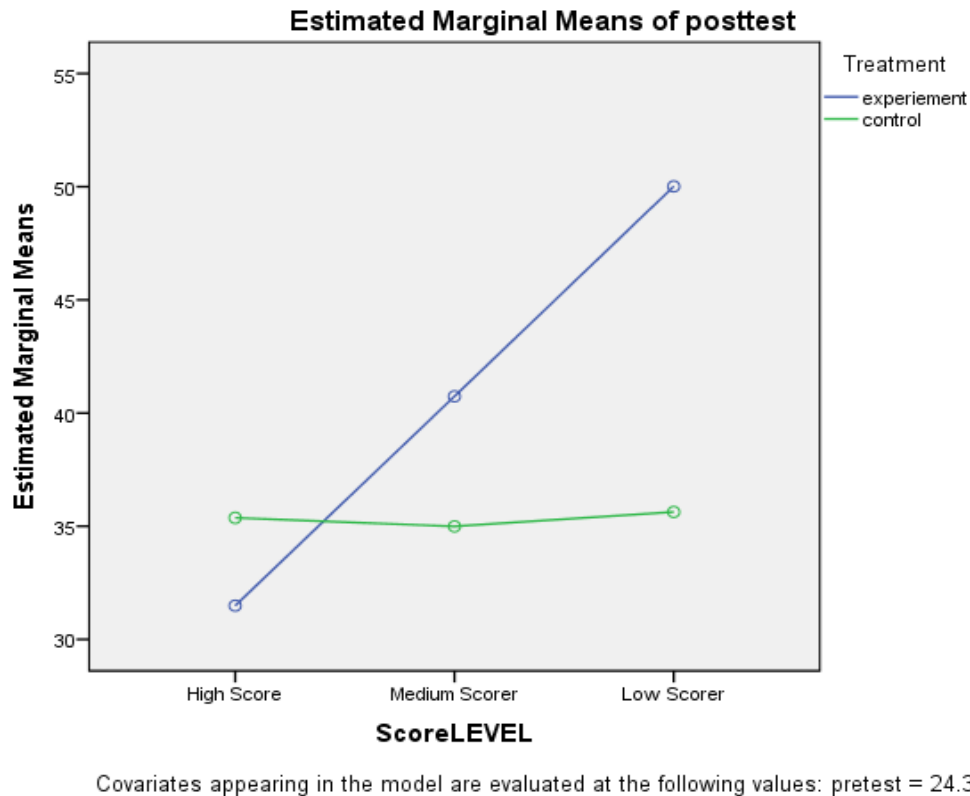


Figure 9: Graphical Illustration of the Interaction Effect of Treatment and Score Levels on Achievement of Biology Students.

Research Question 11: What is the interaction effect of treatment, gender and score levels on attitude of Biology students in Colleges of Education when exposed to blended learning?

Table 21 describes the interaction effect among treatment, gender and score levels. The Table further shows that attitude of students towards blended learning depends on the levels of other independent variables considered in the study. It is therefore evident from the table that students attitude varies based on gender and their score levels. Medium scoring students in the control group supersedes the High scorers and hence made the high scores less significant in the study as compared to the experimental group that had a difference in the male scoring level to the female

scoring level. Hence, the interaction effect of treatment, gender, and score levels varies based on whether the students are either male or female, or the score levels are high, medium and low in the study.

Hypothesis 11: There is no statistically significant interaction effect of treatment, gender, and score levels on the attitude of Biology students in Colleges of Education when exposed to blended learning.

Table 22 illustrates that there is no statistically significant interaction effect among treatment, gender, and score levels on the attitude of Biology students. The result shows $F_{(1, 81)} = 3.78$; $p > 0.05$, which indicates a degree of freedom of 81 with a significant level of 0.55. Hence, the hypothesis that states that there is no statistically significant interaction effect among treatment, gender and score levels on the attitude of Biology students is therefore not rejected.

Table 21

Description of the Interaction Effect of Treatment, Gender and Score levels on Attitude of Biology Students

Treatment	Gender	Score Level	N	Mean($\bar{x}$)	Std. Dev.
Control	Female	Medium Scorer	25	73.92	9.68
		Low Scorer	23	47.26	11.47
		Total	48	61.15	17.05
	Male	Medium Scorer	8	80.63	12.74
		Low Scorer	12	40.83	13.18
		Total	20	56.75	23.67
	Total	Medium Scorer	33	75.55	10.69
		Low Scorer	35	45.06	12.29
		Total	68	59.85	19.15
Experimental	Female	High Scorer	2	71.00	1.41
		Medium Scorer	16	68.25	13.36
		Low Scorer	1	83.00	-
		Total	19	69.32	12.67
	Male	High Scorer	1	51.00	-
		Medium Scorer	3	65.33	8.51
		Low Scorer	1	83.00	-
		Total	5	60.20	9.31
	Total	High Scorer	3	64.33	11.59
		Medium Scorer	19	67.79	12.57
		Low Scorer	2	68.50	20.51
		Total	24	67.42	12.45
Total	Female	High Scorer	2	71.00	1.41
		Medium Scorer	41	71.71	11.44
		Low Scorer	24	48.75	13.38
		Total	67	63.46	16.26
	Male	High Scorer	1	51.00	-
		Medium Scorer	11	76.45	13.38
		Low Scorer	13	41.85	13.14
		Total	25	57.44	21.45
	Total	High Scorer	3	64.33	11.59
		Medium Scorer	52	72.71	11.90
		Low Scorer	37	46.32	13.53
		Total	92	61.83	17.90

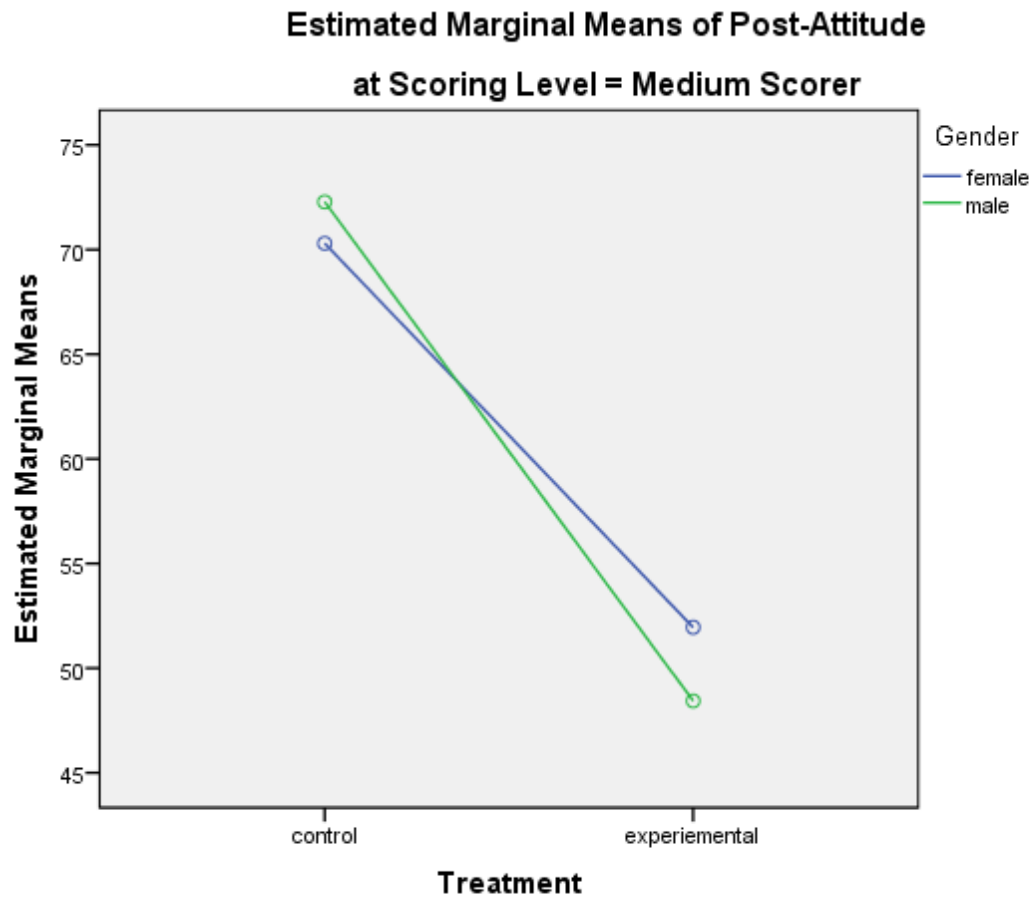
Table 22

ANCOVA of Interaction Effect of Treatment, Gender and Score levels on Attitude of Colleges of Education Biology Students to Blended Learning

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	24789.235 ^a	10	2478.923	45.948	.000
Intercept	.387	1	.387	.007	.933
Pre-test	6645.501	1	6645.501	123.178	.000
Treatment	96.010	1	96.010	1.780	.186
Gender	577.597	1	577.597	10.706	.002
Score Level	3859.871	2	1929.935	35.772	.000
Treatment*Gender	443.038	1	443.038	8.212	.005
Treatment*ScoreLevel	1691.205	1	1691.205	31.347	.000
Gender*Score Level	399.338	2	199.669	3.701	.029
Treatment*Gender * Score Level	204.429	1	204.429	3.789	.055
Error	4369.983	81	53.950		
Total	380826.000	92			
Corrected Total	29159.217	91			

a. R Squared = .850 (Adjusted R Squared = .832)

Figure 10 illustrates the graphical interaction effect of treatment, gender and score levels on the attitude of Biology students when exposed and when not exposed to blended learning. It can be observed that medium score Biology students had an interaction effect on treatment, while high and low scorers do not have interact effect on attitude of Biology students. It is evident that attitude had an effect on medium scorer and not on the high or low scorers, as seen in this study.



Covariates appearing in the model are evaluated at the following values: Pre-Attitude = 48.8696

Figure 10: Graphical Illustration of the Interaction Effect of Treatment, Gender, and Score levels on Biology students Attitude towards blended learning

Research Question 12: What is the interaction effect of treatment, gender, and score levels on the achievement of Biology students in Colleges of Education when exposed to blended learning?

Table 23

Description of the Interaction Effect of Treatment, Gender, and Score Levels on the Achievement of Colleges of Education Biology Students

Group	Gender	Score Level	N	Mean($\bar{x}$)	Std. Dev
Experiment	Female	High Scorer	1	20.00	
		Medium Scorer	22	34.27	7.19
		Low Scorer	12	49.75	5.26
		Total	35	39.17	10.33
	Male	Medium Scorer	8	33.38	7.44
		Low Scorer	5	50.00	4.64
		Total	13	39.77	10.50
	Total	High Scorer	1	20.00	0.00
		Medium Scorer	30	34.03	7.14
		Low Scorer	17	49.82	4.94
Control	Female	Total	48	39.33	10.27
		High Scorer	1	35.00	0.00
		Medium Scorer	27	36.74	10.97
		Low Scorer	17	39.18	10.08
	Male	Total	45	37.62	10.47
		Medium Scorer	12	42.42	8.87
		Low Scorer	10	37.60	11.61
	Total	Total	22	40.23	10.25
		High Scorer	1	35.00	0.00
		Medium Scorer	39	38.49	10.59
Total	Female	Low Scorer	27	38.59	10.48
		Total	67	38.48	10.39
		High Scorer	2	27.50	10.60
		Medium Scorer	49	35.63	9.45
	Male	Low Scorer	29	43.55	9.85
		Total	80	38.30	10.37
		Medium Scorer	20	38.80	9.30
	Total	Low Scorer	15	41.73	11.38
		Total	35	40.06	10.19
		High Scorer	2	27.50	10.60
Medium Scorer		69	36.55	9.45	
Total	Low Scorer	44	42.93	10.30	
	Total	115	38.83	10.30	

Hypothesis 12: There is no statistically significant interaction effect of treatment, gender, and score levels on the achievement of Biology students in Colleges of Education when exposed to blended learning.

Table 23 illustrates the interaction effect of treatment, gender and score levels with a degree of freedom of 104 and a significant level of 0.28. This therefore indicates that there is no statistically significant interaction effect among treatment, gender and score levels in the achievement of Biology students. Since $F_{(1, 104)} = 24.67$; $p > 0.05$. The null hypothesis, which states that there is no statistically significant interaction effect amongst treatment, gender and score levels, is therefore not rejected.

Figure 11 illustrates the graphical representation of the interaction effect of treatment, gender, and score levels on the achievement of Biology students when exposed to blended learning and when not exposed to it. The graph shows that there is interaction among the scorers, the treatment, and gender in the study

Table 24

ANCOVA of Interaction Effect of Treatment, Gender, and Score levels on the Achievement of Biology Students

Source	Type III Sum of Squares	df	Mean Square	<i>F</i>	Sig.
Corrected Model	9539.721 ^a	10	953.97	38.66	.001
Intercept	1492.674	1	1492.67	60.49	.001
Pre-test	6131.321	1	6131.32	248.48	.001
Treatment	264.986	1	264.98	10.73	.001
Gender	1.871	1	1.87	.076	.784
Score Level	568.844	2	284.42	11.52	.001
Treatment * gender	16.974	1	16.974	.68	.409
Treatment * Score Level	524.816	2	262.40	10.63	.001
Gender * Score Level	10.147	1	10.14	.41	.523
Treatment * Gender * Score Level	29.473	1	29.47	1.19	.277
Error	2566.140	104	24.67		
Total	185542.000	115			
Corrected Total	12105.861	114			

a R Squared = .788 (Adjusted R Squared = .768)

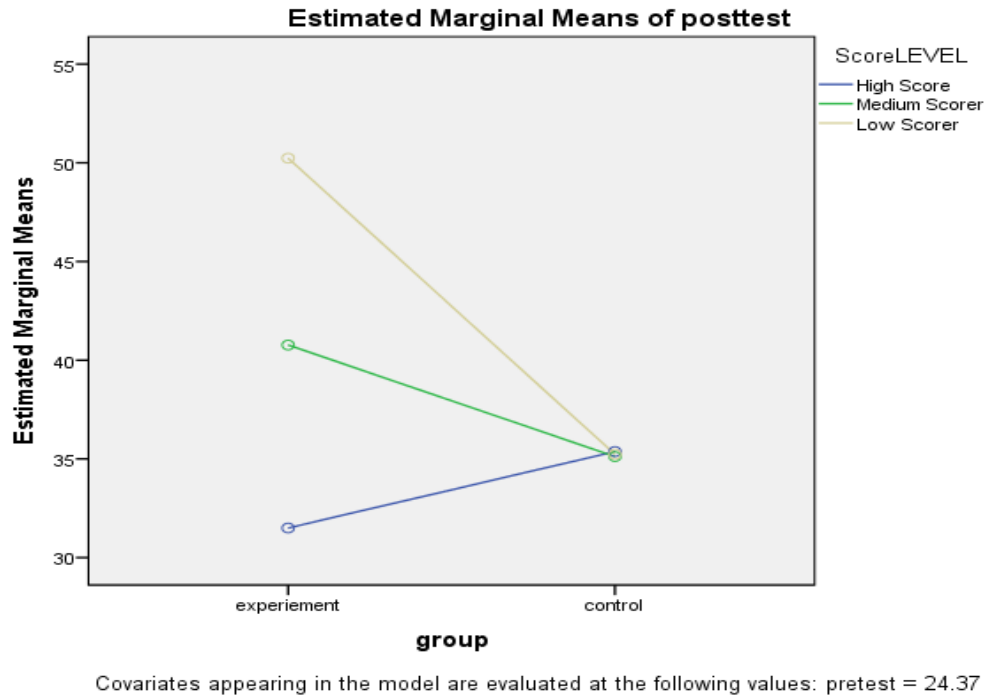


Figure 11: Graphical Representation of Interaction Effect of Treatment, Gender, and Score levels on the Achievement of Biology students.

Summary of Major Findings

The major findings of this study based on the data analyzed and hypotheses tested are summarized as follows:

1. Biology students in Colleges of Education had a positive attitude to blended learning. ($\bar{x}$ = 63.00, SD = 17.09)
2. There was a statistically significant difference in the achievement of Biology students in the experimental and control group in favor of those exposed to blended learning $t_{(114)} = 21.8$, $p < 0.05$

3. There was no statistically significant difference in the attitude of male and female Biology students in Colleges of Education when exposed to blended learning.
4. There was a statistically significant difference in the attitude of high, medium and low score Biology students in Colleges of Education when exposed to blended learning in favor of medium scorer, $F_{(2, 44)} = 1.66$; $p < 0.05$
5. There was no statistically significant difference in the achievement of male and female Biology students in Colleges of Education when exposed to blended learning.
6. There was a statistically significant difference in the achievement of high, medium and low scoring Biology students in Colleges of Education when exposed to blended learning in favor of low scorer. $F_{(2, 44)} = 36.39$; $p < 0.05$
7. There was no statistically significant interaction effect of treatment and gender on Biology students' attitude in Colleges of Education.
8. There is a statistically significant interaction effect of treatment and score levels on Biology students' attitude in Colleges of Education. $F_{(1, 86)} = 27.7$; $p < 0.05$
9. There was no statistically significant interaction effect of treatment and gender on Biology students' achievement in Colleges of Education.
10. There was a statistically significant interaction effect of treatment and score levels on Biology students' achievement in Colleges of Education. $F_{(2, 108)} = 11.04$; $p < 0.05$
11. There was no statistically significant interaction effect of treatment, gender and score levels of Biology students' attitude in Colleges of Education.

12. There was no statistically significant interaction effect of treatment, gender and score levels on Biology students' achievement in Colleges of Education.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This chapter focuses on a well detailed discussion of findings, conclusion drawn from the results and recommendations based on the major findings from the study carried out. The discussion is based on the considered variables, such as the attitude, achievement, gender and score levels of the students.

Discussion

The findings have been discussed under the following headings:

1. Findings on Biology students' attitude in Colleges of Education to blended learning.
2. Findings on the difference in Biology students' achievement in Colleges of Education to blended learning.
3. Findings on the influence of gender on students' attitude.
4. Findings on the influence of gender on students' achievement.
5. Findings on the influence of score levels on students' attitude.
6. Findings on the influence of score levels on students' achievement.
7. Findings on interaction effect on Biology students in Colleges of Education attitude towards blended learning based on gender and score level.
8. Findings on interaction effect on Biology students in Colleges of Education achievement using blended learning based on gender and score level

1. Findings on Biology Students' Attitude towards Blended in Colleges of Education.

Hypothesis 1 was used to investigate the difference in the Biology students' attitude in Colleges of Education to blended learning. The result analysis showed that students had a positive attitude towards blended learning. This implies that exposing students to blended learning made a difference in their attitude towards learning of Biology.

This agrees with Abidoye (2015); Mohammed (2013); Ayebi-Arthur (2010); Dowling, Godfrey and Gyles (2003); Ong and Lai (2006) who observed a positive effect on students' attitude to blended learning. These results suggested a positive change in students' scores when blended learning method is used. However, this result disagrees with that of King and Hildreth (2001); Grandzol (2004) who compared the performance of students with attitude from an internet-based Biology course and observed no significant difference between students test scores on the internet-based and traditional course. The implication of this is that exposing students to blended learning approach using Biology as a course is of benefit to teaching and learning. The use of blended learning had an effect on the attitude of students and helped enhance their achievement. It helps strengthen learning by way of increasing learning skills, critical thinking and development of interest towards Biology as a subjects. Students in this instance can study at their leisure and overcrowding in lecture rooms can be minimal with the use of blended learning.

2. Findings on the Difference in the Achievement of Biology Students in Colleges of Education to Blended learning

Blended learning made a difference on the achievement of Biology students in College of Education. The result indicates that there was a significant effect on the achievement of students. This implies that using blended learning in teaching Biology made the students have a better achievement in their study. The results in Hypothesis Two illustrates that students taught using blended learning performed better than the control group that used only the conventional method of learning. This study examined the students' achievement between blended learning and conventional learning and the findings emanated from the study indicated that students taught using blended learning had higher achievement scores than those who were taught in the conventional approach. Jones and Pickard (2003); Dziuban et.al (2006); Graham and Kaleta (2002); Lim and Morris(2009); Twigg (2003) agreed that blended learning contributed to improved learning outcome for students. Their study showed that the used of blended learning had a positive effect in reducing overcrowdings and large class enrollment.

One the contrary, Sloman (2007) and O' Toole & Absalom (2003) suggested that a purely technological focus with its various methods and styles of teaching and learning could be changed to other means that can facilitate effective learning in students. Here, Smyth et. al (2012) ; King (2002) findings also viewed the challenges of students relying on slow internet connection that could create frustration in learning and reduce morals in students. As Vaughan (2007) finding also assumed that few classes with less work can create problems of time management and responsibility for personal learning. Hence, students should be encouraged to always be hands on for a better and effective learning to yield a positive effect.

3. Findings on the Influence of Gender on Students' Attitude to Blended Learning

Gender influence on blended learning was considered in this study as well. Hypothesis 3 examined the difference in the attitude of male and female Biology students when exposed to blended learning and when not exposed to it. The exposure to blended learning had a significant difference on the male as compared to female. It depicts from the results that male Biology students had a higher positive attitude to blended learning than female Biology students.

It can be deduced that male students had a better attitude to blended learning than female students in the experimental group while the female had a better attitude than their male counterpart in the conventional method.

The interpretation of this is that male Biology students preferred the use of blended learning or were more comfortable with it than their female counterpart, while the female Biology students may have preferred the conventional method. The difference in their attitude might be as a result of the fact that most male are better off at operating devices than female student. This agrees with the findings of Yau and Chenge(2012);Vale and Leder (2004) whose findings indicates that male students showed more confidence in using technology for learning than female students.

On the contrary, Wong and Hanafi (2007) found out that female students posed a higher level of confidence and also improved attitude after they might have gone through a technology training course. However, Yaksetruk and Bulut (2009) have shown that male and female students have similarity in self motivation in the online learning environment.

4. Findings on the Influence of Students' Achievement using Blended Learning Based on Gender

The difference in the achievement of male and female Biology students to blended learning is minimal. This was examined with Hypothesis 5; the interpretation of this is that there is no significant difference in the scores obtained by male and female Biology students when taught using blended learning or when the conventional learning method was used. Students in this case did not show difference in their performance either male or female, when exposed or not exposed to any form of learning. This implies that blended learning did not make a difference in the achievement of Biology students in Colleges of Education.

This study agrees with Abidoye (2015); Adebayo (2002); Ibrahim and Mehmet (2014); Spencer (2004), where students' academic performance was viewed, by comparing blended learning environment and traditional learning environment. The result agrees with this study that there was no significant difference between the achievement and gender of student grade. Also Yusuf and Afolabi (2010) investigated the effect of Computer Assisted Instruction (CAI) on secondary school students Biology performance, it was deduced that there was no difference that existed in the performance of male and female students when CAI was used, which is also in line with this study.

The findings in this research is contrary to studies by Mohammed (2000) and Mohammed (2004); Banjoko (1998); Okeke and Achuba (1996) where gender differences had influence on the academic achievement of students in teaching of science and other instructional strategy.

5. Findings on the influence of Score Levels on Students' Attitude to Blended Learning

From this study, there is a significant difference in low, medium and high scoring student based on their attitude to blended learning. Hypothesis Four was tested in this case; it is obvious that the various differences in their score levels can be related to their attitude. It could be interpreted that the various score levels associated with blended learning had impact on their attitude and achievement.

This study is in agreement with Gao (2005) that indicates a positive correlation with students' attitude. While Unodiaku (2013) findings revealed that score level are factors that influence the readiness and willingness of students in a learning environment.

6. Findings on the Influence of Score level on Students' Achievement to Blended Learning

Score level had a significant influence on the achievement of Biology students in this study. This was examined with Hypothesis Six where there was a difference in the achievement of Biology students' score level to blended learning. It was observed from the results that low score Biology students achieved better with the use of blended learning as well as the medium score Biology students. The high scorers in this case still maintained their high scores, hence, blended learning is assumed to have a great effect on the achievement of both the low and medium scorers.

This study agrees with the studies carried out by Webb (2000); Adeniyi (2012) where all the three categories of score levels benefited from the study and their

achievements improved. The outcome of this study, however, disagrees with the submissions of Adeoye and Abimbola (2016); Adesoji (2008) that observed that high scorers benefited more when introduced to other instructional methods, though it was attributed to the effectiveness demonstrated towards the use of the instructional method but various score level responded differently to the study in this case.

7. Findings on the Interaction Effect of Treatment, Gender and Score Level on Attitude of Biology students

These research findings focus on the interaction effect of treatment, gender and score levels on Biology students' attitude to blended learning.

The Hypotheses involved in these studies are 7, 8, and 11. Findings from this study indicate that there was an interaction effect of treatment on gender and score levels of Biology students' attitude towards blended learning. This implies that gender and score levels of Biology students had impact on attitude when blended learning is used. However, to the best of the knowledge of the researcher, evidence to back up this finding in previously documented literature were not available.

8. Findings on the Interaction Effect of Treatment, Gender and Score Levels on Biology Students' Achievement

These research findings focus on the interaction effect of treatment, gender and score levels on students' achievement in Biology.

The Hypotheses involved in these studies are 9, 10, and 12. Findings from this study indicate that there is interaction effect of treatment on gender and score levels of Biology students' achievement. This implies that blended learning had a

joint effect on gender and score levels in Biology students' achievement which means there is a relationship among the variables in this study.

These research findings supports those earlier studies from Adeoye and Abimbola (2016); Akanmu (2013); Abdulkadri (2011) that agreed that there is interaction effect of treatment, gender and score levels on students' achievement to instructional methods, while there was variance with Alabi (2016) who observed that there was no significant interaction between treatment and score levels on students' achievement to instructional methods.

Conclusion

Due to continuous increase on the population of students in higher institution of learning, that gave rise to large class and large enrollment of students in tertiary institution with limited facilities especially lecture rooms and poor performance. Also, students bored with same method of teaching and learning. There arise a need for other innovative methods of teaching and learning. In an attempt to solve and reduce poor performance, this study was carried out to view the attitude of students towards blended learning and their achievement in Biology using blended learning method. This gave the researcher an insight into using Biology students in Colleges of Education within Kwara State, Nigeria as samples / population for the purpose of this study.

The result of the study shows the significant difference between the two mean scores in the group (pretest and posttest) performance on attitude of Biology students towards blended learning. This was in favor of the experimental group that was taught using blended learning; this implies that Biology students showed a positive attitude when exposed to blended learning. It was observed that the use of blended learning through mobile device enhanced their attitude.

The result of the study also showed that there was a significant difference between the mean score of the results in the pretest, posttest achievement of Biology students when exposed to blended learning based on the pretest, posttest achievement result. The difference was in favor of the experimental group that was taught using blended learning. Students exposed to blended learning achieved significantly higher than those not exposed to it. This implies that blended learning method enhanced the achievement of Biology students in Colleges of Education.

The result from this study further shows that there was no statistically significant difference in the attitude of male and female Biology students when exposed to blended learning. This implies that male and female students do not show difference in their attitude when blended learning is used. Hence blended learning can be used for teaching and learning without being biased about gender.

The result likewise shows the difference in the attitude of all scorers (high, medium, and low scorer) towards the use of blended learning which was in favor of Medium scorer. This implies that each individual (high, medium, low) showed interest in blended learning, though the medium scorer showed more interest than the high and low scorer. It then implies that medium score students showed more interest in the teaching and learning of Biology using blended learning.

Similarly, this study shows that male or female Biology students did not show any significant difference in their achievement when exposed to blended learning. This implies that gender do not really affect the performance of Biology students

In this case, there is difference in the achievement of score level of Biology students when blended learning was used. It was observed that low scorers improved

in their performance more than medium and low scorers when exposed to blended learning. Blended learning favored low scorer and this suggests that enhancing learning with technology would improve students' ability to learning and perform better, especially for students that are low scorer academically.

In conclusion, blended learning had an interaction effect on score levels of Biology students with attitude and their achievement having a joint effect. It is assumed that since blended learning, gender, score levels, attitude and achievement interacts, it could be considered suitable for effective learning at tertiary level and if possible at all educational level without any doubt.

Recommendations

The following recommendations were made based on the findings of this study:

1. The use of blended learning has been found to have a positive effect on the attitude of Biology Students in Colleges of Education. Unlike the conventional learning, blended learning as a method of teaching would help motivate the students and help increase their interest in the use of technology for learning; since the future of the country is relying increasingly on technology it is therefore recommended that decision makers could lay emphasis on technology environment and make decisions for an internet-based teaching and learning environment.
2. The use of blended learning made a significant difference in the achievement of Biology students. This shows that if blended is introduced into teaching and learning, students' achievement would improve in their various course of study

It is therefore suggested that blended learning should be adopted and implemented into existing curriculum at various level of education.

3. The study has shown that Low and medium scoring students improved in their attitude and achievement respectively, when exposed to blended learning. it is therefore recommended that Biology teachers need to be equipped with technological knowledge and skills for their day to day teaching and learning and also update themselves through seminars, workshops and conferences that will enhance the use of blended learning
4. The use of mobile phones as educational tool should be encouraged; students can download educational materials online and read using their individual cell phones at a convenient place, space, pace and time. This will promote individual learning and participation and also improve their attitude and achievement.
5. Difficult topics in Biology should be taught using blended learning. It has been observed that difficult topics in Biology that were taught using this method had a positive attitude towards it and they achieved better. Hence, blended learning should be integrated into teaching and learning of Biology in Colleges of Education.
6. Blended learning in form of educative Application should be designed and installed on cell phones and made available for teachers and students use in tertiary institutions.

Suggestion for Further Studies

For further researches in this area, the following are suggested:

1. efforts to replicate this study in other tertiary institutions in Kwara State, Nigeria and in other African countries should be encouraged. Comparison of their findings would authenticate these findings;
2. investigate the effects of blended learning on Biology students' attitude and achievement in private Colleges of Education in Kwara State and Nigeria at large.
3. future studies can also focus on the lecturers' attitude towards the utilization of blended teaching and learning of Biology in Nigerian tertiary institutions.
4. some other attitudinal constructs such as cognitive, emotional behavioral attitude, intention to use blended approach, e.t.c in facilitating learning of Biology could be looked into, and
5. the influence of other variables like: facilitating conditions(funding and institutional support), students' and lecturers' performance expectancy among others, could be investigated.

Limitations of the Study

In the course of this study, the researcher encountered some issues. These include having to buy data for students in the experimental group with various network services, this developed from the type of model used for the experiment, because students had to use their cell phones at their leisure and at various places and times for learning. Different network data had to be purchased and given for an effective study.

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APPENDIX I

UNIVERSITY OF ILORIN, ILORIN, NIGERIA
FACULTY OF EDUCATION
DEPARTMENT OF SCIENCE EDUCATION
INFORMED CONSENT FORM

Dear Respondent,

Please be informed that you are selected to participate in a research study. Your consent is hereby required to take part in the study. Detail information about the research is provided below. Kindly endorse this consent form if you volunteer to participate in the study.

Purpose of the study: The purpose of the research is to determine the effects of Blended Learning on students' attitude and Achievement in Biology as an effort to promote a better learning strategy/Approach in biology.

Procedure: Student participant will be required to have attended lectures in plant physiology based on the National Commission for Colleges of Education curriculum and a normal period of time allocated on the lecture time-table for the semester. The lesson would be expected to last for about weeks only.

Confidentiality: All information provided by you will be treated with utmost confidentiality and used for the purpose of the research only.

Risk: Lectures on plant physiology will be taught in your regular classroom. Hence no risk is envisaged to your person during the research

Benefit: Likely benefits include meaningful learning of plant physiology and better incite to other methods learning of biology from another perspective at tertiary level. To aid a better performance level at Nigeria Certificate of Education (NCE)

Rights of Volunteers (student participants): Your participation in this research is voluntary; hence, if you decide not to take part or stop your participation in the research at any time, you may contact the department of Science Education, University of Ilorin, Ilorin, Nigeria or call the researcher on 07063094805

Student Respondent Agreement: I hereby voluntarily consent to participate in the research. I know that I may refuse to participate or stop my participation in the research at any time. Also, I understand that I have any question about the research or my right as a student participant. I may contact the department of Science Education, University of Ilorin, Nigeria or call the researcher on 07063094805

.....
Student Participant

.....
Signature and Date

.....
Student Guardian

.....
Signature and Date

.....
Researcher

.....
Signature and Date

APPENDIX II

BIOLOGY BLENDED LEARNING ACHIEVEMENT TEST (BBLAT)

Level:

Sex:

Instruction: Answer all Questions

Duration: 1hr 30 mins

- 1) The water readily available to plants for absorption by root is
 - (A) Gravitational water
 - (B) Capillary water
 - (C) Rain water
 - (D) Hygroscopic water.
- 2) The water potential of pure water at atmospheric pressure is
 - (A) -2.3 bar
 - (B) +2.3 bar
 - (C) Zero bar
 - (D) One bar.
- 3) Loss of water from the stomata of leaves is known as
 - (A) Guttation
 - (B) Exudation
 - (C) Transpiration
 - (D) Evaporation.
- 4) During rainy season, wooden doors are difficult to open or close because of
 - (A) Plasmolysis
 - (B) Imbibition
 - (C) Osmosis
 - (D) Diffusion
- 5) Plasmolysis occurs due to
 - (A) Absorption
 - (B) Osmosis
 - (C) Endosmosis
 - (D) Exosmosis
- 6) The cooling of plant is caused by
 - (A) Guttation
 - (B) Photorespiration
 - (C) Transpiration
 - (D) Assimilation

- 7) Active uptake of minerals by roots mainly depends on the
(A) Availability of oxygen
(B) Temperature
(C) Light
(D) Availability of CO_2
- 8) The hormones which indicate the closure of stomata is
(A) Auxins
(B) Cytokinin
(C) Gibberelline
(D) Absciscic acid
- 9) Water Absorption takes place through
(A) Lateral roots
(B) Roots cap
(C) Root hairs
(D) Tap root
- 10) What is the action spectrum of transpiration?
(A) Orange and red
(B) Green and ultraviolet
(C) Blue and red
(D) Blue, red, orange
- 11) Which one of the following is used for measuring the rate of transpiration?
(A) Porometer
(B) Osmometer
(C) Moll's experiment
(D) Potometer
- 12) Transpiration is least in
(A) High atmospheric humidity
(B) Good soil moisture
(C) High wind velocity
(D) Dry environment
- 13) Stomata opens at night and closes during the day time in
(A) Xerophytes
(B) Mesophytes
(C) Succulents
(D) Hydrophytes

- 14) Which of the following is necessary for biological Nitrogen fixation
- (A) Copper
 - (B) Zinc
 - (C) Manganese
 - (D) Molybdenum
- 15) The essential element for the synthesis of Auxin is
- (A) Zinc
 - (B) Sulphur
 - (C) Potassium
 - (D) Phosphate
- 16) The disease “die back of shoots” is caused due to the deficiency of the following micro elements
- (A) Copper
 - (B) Chlorine
 - (C) Manganese
 - (D) Molybdenum
- 17) Hydroponic is
- (A) growing of aquatic plants
 - (B) growing of floating aquatic plants
 - (C) soilless cultivation of plants
 - (D) growing of plants inside water
- 18) Molybdenum is involved in plant metabolism in
- (A) translocation of solute
 - (B) tryptophan synthesis
 - (C) ABA synthesis
 - (D) nitrate reduction
- 19) Plant requires Fe and Mg for
- (A) synthesis of chlorophyll
 - (B) opening and closing of stomata
 - (C) translocation of carbohydrates
 - (D) transpiration
- 20) Plant absorbs the element Nitrogen in the form of
- (A) Nitrogen gas
 - (B) Nitrites
 - (C) Nitrates
 - (D) Nitric acid

- 21) Of all the environmental factors, which is the most influential in determining the rate of transpiration
- (A) Light
 - (B) Relative Humidity of Atmosphere
 - (C) Temperature
 - (D) Water
- 22) Transpiration helps in
- (A) ascent of Sap
 - (B) mass flow of mineral along with water
 - (C) active Absorption of water
 - (D) temperature
- 23) Wilting occurs due to excessive
- (A) guttation
 - (B) absorption
 - (C) transpiration
 - (D) imbibitions
- 24) In what direction does the phloem transport materials
- (A) Up the plant at night and down the plant during the day
 - (B) Up and down the plant all the time
 - (C) Up the plant only
 - (D) Down the plant only
- 25) What treatment is most likely to lead to germination
- (A) Increasing light intensity
 - (B) Dehydrating the seeds
 - (C) Increasing CO₂ Concentration
 - (D) Soaking the seeds in a solution of gibberellins
- 26) When a farmer sprays a chemical on crop plants, how does the chemical travel to the roots of the plants
- (A) In the xylem, by transpiration pull
 - (B) In the phloem, by transpiration pull
 - (C) In the xylem, by active translocation
 - (D) In the phloem, by active translocation
- 27) What causes movement of water through xylem
- (A) Evaporation
 - (B) Active transport in the root tissue
 - (C) Active translocation
 - (D) Gravity

- 30) Micronutrients are
- (A) Available in the soil only in small amount
 - (B) Required by plants in small amount
 - (C) Small Molecules required by plants
 - (D) Useful but not required by plants
- 31) Which of the following is a correct list of contents of the organic material in soil?
- (A) Humus, roots and decomposed material
 - (B) Roots and small animals
 - (C) Minerals, small animals and root
 - (D) Small animals, humus and roots
- 32) Turgor pressure is also referred to as
- (A) Solute potential
 - (B) Water potential
 - (C) Pressure potential
 - (D) Osmotic potential
- 33) The opening of the stomata is effected by all of the following except
- (A) Oxygen concentration
 - (B) Temperature
 - (C) Light
 - (D) Carbon dioxide concentration
- 34) The process of respiration in green plant occurs
- (A) only when stomata are open
 - (B) only when photosynthesis ceases
 - (C) only when photosynthesis is in progress
 - (D) at all times.
- 35) The annual plant exchange of gases takes place mainly through
- (A) Leaf scars
 - (B) Lenticels
 - (C) Stomata
 - (D) Stem
- 36) The rate of photorespiration in most plants increases at higher temperature. Some plants have evolved a somewhat round-about system to deal with this problem. This series of reactions is called
- (A) ETS (electron transfer system in light reaction)
 - (B) C4 pathway
 - (C) Photosystem ii
 - (D) Calvin cycle.

- 37) NADP^+ is reduced to NADPH during
- (A) Light dependent reactions
 - (B) Photorespiration
 - (C) Calvin cycle
 - (D) None of the above
- 38) The light reactions of photosynthesis supply the Calvin cycle with
- (A) Light energy
 - (B) CO_2 and ATP
 - (C) ATP and NADPH
 - (D) H_2O and NADPH
- 39) The splitting of carbon dioxide to form oxygen and Carbon Compounds occurs during
- (A) photosynthesis
 - (B) respiration
 - (C) both photosynthesis and respiration
 - (D) neither photosynthesis nor respiration
- 40) Reduction of NADP^+ occurs during
- (A) photosynthesis
 - (B) respiration
 - (C) both photosynthesis and respiration
 - (D) neither photosynthesis nor respiration
- 41) Krebs cycle takes place in
- (A) Vesicles of Endoplasmic Reticulum
 - (B) Mitochondrial Matrix
 - (C) Lysosomes
 - (D) Dictyosomes
- 42) Common immediate source of energy in cellular activity;
- (A) NAD
 - (B) ATP
 - (C) DNA
 - (D) RNA
- 43) What type of organism performs photosynthesis, Choose the BEST answer
- (A) Plants
 - (B) Some photosynthetic protist
 - (C) Autotroph
 - (D) Heterotroph

- 44) The main pigment involved in photosynthesis is
(A) Xanthophylls
(B) Carotene
(C) Chlorophyll
(D) Bromothymol blue
- 45) Carotene reflects ----- Wavelength
(A) Green
(B) Blue
(C) Yellow
(D) Red
- 46) Chlorophyll absorbs -----Wavelengths
(A) Green
(B) Blue
(C) Red
(D) Blue and red
- 47) What is another name for the light independent reactions?
(A) Calvin Cycle
(B) Electron Transport Chain
(C) Krebs cycle
(D) Fermentation
- 48) What powers the light independent reactions?
(A) ATP and NADPH produced by the light dependant reactions
(B) ADP and NADP^+ produced by the light dependent reactions
(C) Sunlight
(D) Glucose
- 49) Photosynthesis is important because
(A) carbon dioxide is used
(B) solar energy is converted to chemical energy
(C) oxygen is produced
(D) carbon dioxide, energy and oxygen is needed
- 50) Bacteroid means
(A) Dead bacteria
(B) Living bacteria
(C) A bacteria like substance
(D) Living bacteria but cannot divide

- 51) Which of the following bacterium brings about *De nitrification*?
- (A) Pseudomonas
 - (B) Rhizobium
 - (C) Azotobacter
 - (D) Nitrobacter
- 52) Ion can be accumulated against concentration gradient due to
- (A) mass flow
 - (B) active uptake
 - (C) passive uptake
 - (D) donnan equilibrium
- 53) Which of the following is essential for Nitrogen Fixation by leguminous plants?
- (A) Chlorophyll
 - (B) Leghaemoglobin
 - (C) Anthocyanin
 - (D) Phytocyanin
- 54) What is the purpose of NADPH in photosynthesis?
- (A) Provide energy
 - (B) Carry electrons
 - (C) Provide Carbon dioxide
 - (D) Store Oxygen
- 55) Which of the following is a characteristic of Xerophytes?
- (A) Large number of stomata
 - (B) Absence of roots
 - (C) Absence of Vascular tissue
 - (D) Leaves with a very small surface area
- 56) Which would be an adaptation of Xerophytes
- (A) Large numbers of Stomata
 - (B) Hairs on the leaves
 - (C) Large air space
 - (D) Reduced roots
- 57) In flowering plants, which of the following do not help seed dispersal?
- (A) Pollen
 - (B) Bees
 - (C) Mammals
 - (D) Germination

- 58) Fertilization, pollination and seed dispersal all occur during the reproduction of a flowering plant, in what sequence do these processes occur
- (A) Pollination, fertilization, seed dispersal
 - (B) Seed dispersal, pollination, fertilization
 - (C) Fertilization, pollination, seed dispersal
 - (D) Seed dispersal, fertilization, Pollination
- 59) Which of the following are products of light reaction of photosynthesis that are utilized in the Calvin Cycle
- (A) CO_2 and glucose
 - (B) H_2O and O_2
 - (C) ADP, Pi, and NADP^+
 - (D) ATP and NADPH
- 60) What are the products of light reactions that are subsequently used by the Calvin Cycle?
- (A) Oxygen and Carbon dioxide
 - (B) Water and Carbon
 - (C) Carbon dioxide and RuBP
 - (D) ATP and NADPH
- 61) Where does the Calvin cycle take place?
- (A) Stroma of the chloroplast
 - (B) Cytoplasm surrounding the chloroplast
 - (C) Chlorophyll molecule chloroplast
 - (D) Outer membrane of the chloroplast
- 62) As a research scientist, you measure the amount of ATP and NADPH consumed by the Calvin Cycle in one hour. You find 30,000 molecules of ATP consumed, but only 20,000 molecules of NADPH. Where did the extra ATP molecules come from?
- (A) Photosystem ii
 - (B) Photosystem I
 - (C) Cyclic electron flow
 - (D) Chlorophyll
- 63) In metabolic processes of cell respiration and photosynthesis, prosthetic groups such as heme and iron sulfur complexes are encountered. What do they do?
- (A) Donate electrons
 - (B) Acts as reducing agents
 - (C) Acts as Oxidizing agents
 - (D) Both oxidize and reduce during electron transport

- 64) In an experiment studying photosynthesis, performed during the day, you provide a plant with radioactive carbon (^{14}C) dioxide as a metabolic tracer. The (^{14}C) is incorporated first into Oxalo acetate. The plant is best characterized as a -----
- (A) C4 plants
 - (B) CAM plants
 - (B) C3 plants
 - (D) Heterotroph

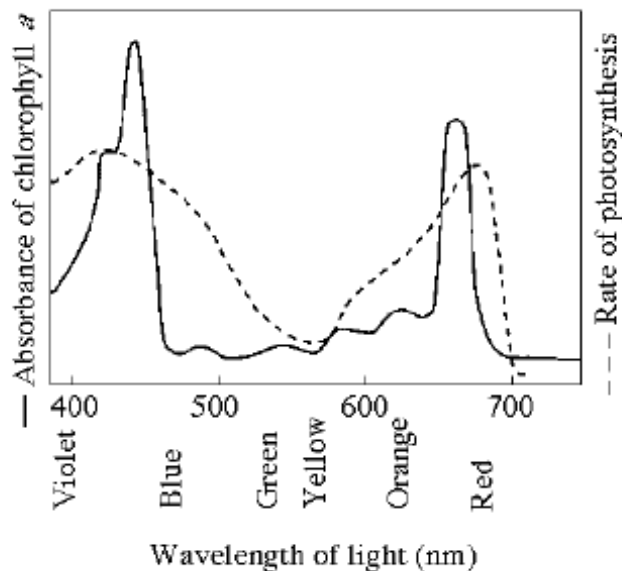


FIGURE 1

- 65) Figure 1 shows the absorption spectrum for chlorophyll *a* and the action spectrum for photosynthesis, why are they different?
- (A) Green and yellow wavelengths inhibit the absorption of red and blue wavelengths
 - (B) Bright sunlight destroys photosynthetic pigments
 - (C) Other pigments absorb light in addition to chlorophyll
 - (D) Oxygen given off during photosynthesis interferes with the absorption of light
- 66) What wavelength of light in Figure 1 is most effective in driving photosynthesis?
- (A) 420nm
 - (B) 475nm
 - (C) 575nm
 - (D) 625nm

APPENDIX III

The following are the index to each of the items:

Item No	RU	RL	Difficulty Index	Discrimination Index
1	2	0	0.125	0.25
2	1	0	0.0625	0.125
*3	7	7	0.875	0
4	3	0	0.1875	0.375
5	5	1	0.375	0.5
6	1	2	0.1875	-0.125
7	1	0	0.0625	0.125
8	2	0	0.125	0.25
9	6	4	0.625	0.25
10	6	1	0.4375	0.625
11	8	4	0.75	0.5
12	1	5	0.375	-0.5
*13	1	1	0.125	0
*14	1	1	0.125	0
15	4	1	0.3125	0.375
16	2	1	0.1875	0.125
17	2	0	0.125	0.25
18	3	0	0.1875	0.375
19	5	1	0.375	0.5
20	4	5	0.5625	-0.125
21	6	4	0.625	0.25
22	6	0	0.375	0.75
*23	0	0	0	0
24	6	2	0.5	0.5
25	0	1	0.0625	-0.125
26	1	2	0.1875	-0.125
*27	1	1	0.125	0
28	2	0	0.125	0.25
29	1	0	0.0625	0.125
30	5	4	0.5625	0.125
31	5	3	0.5	0.25
32	2	3	0.3125	-0.125
33	5	1	0.375	0.5
34	2	3	0.3125	-0.125
35	1	0	0.0625	0.125
*36	0	0	0	0
37	5	1	0.375	0.5
*38	0	0	0	0
39	7	1	0.5	0.75
*40	0	0	0	0
41	0	1	0.0625	-0.125
42	5	4	0.5625	0.125
*43	0	0	0	0
44	1	0	0.0625	0.125

45	5	7	0.75	-0.25
46	8	4	0.75	0.5
47	2	1	0.1875	0.125
48	6	1	0.4375	0.625
49	7	5	0.75	0.25
*50	1	1	0.125	0
*51	0	0	0	0
52	7	4	0.6875	0.375
*53	2	2	0.25	0
*54	5	5	0.625	0
55	2	0	0.125	0.25
56	4	2	0.375	0.25
57	5	2	0.4375	0.375
58	7	1	0.5	0.75
59	3	0	0.1875	0.375
*60	0	0	0	0
61	4	2	0.375	0.25
62	1	0	0.0625	0.125
*63	0	0	0	0
64	6	0	0.375	0.75
*65	0	0	0	0
66	4	3	0.4375	0.125
67	4	3	0.4375	0.125
68	5	1	0.375	0.5
69	1	0	0.0625	0.125
70	3	4	0.4375	-0.125
71	3	4	0.4375	-0.125
72	0	2	0.125	-0.25
*73	4	4	0.5	0
74	5	0	0.3125	0.625
75	1	0	0.0625	0.125

ITEMS ANALYSIS OF ACHIEVEMENT TEST

Key: * Questions to be deleted.

APPENDIX IV

QUESTIONNAIRE ON STUDENTS' ATTITUDE TOWARDS BLENDED LEARNING

Please complete the following questions/ statements to reflect your opinions as accurately as possible to the best of your knowledge. Your information will be kept strictly confidential.

Instruction: Please, do tick as appropriate to you { ☒ }

GENERAL DETAILS

Sex: Male ☐ Female ☐

School:

Level:

Subject Combination:

SECTION A

I	Statement	Yes	No
	Have you heard of the term "Blended learning" before?		

II. What do you use to access online information when doing an assignment? (You can tick more than one, where necessary)

1. Phone ☐
2. Laptop ☐
3. Desktop ☐
4. ipad/tablet ☐

III. What is your main purpose for using technology/internet (You can tick more than one, where necessary)

1. Check mails ☐
2. Complete Assignments ☐
3. Search online ☐
4. Information ☐
5. Recreational use ☐

IV. Where do you most often use internet to access the online information when doing a research project or an assignment (You can tick more than one, where necessary)

1. Home ☐
2. College computer room ☐
3. Cyber café ☐
4. Laptop using wireless technology in college ☐
5. Library ☐

SECTION B

V	Statement	None	Fair	Average	Good	Excellent
1.	What level of computer expertise (literacy) do you feel you have?					
2.	How do you rate your use of the internet?					

VI	Have you ever used the following online tools	Never	Very rarely	Occasionally	Frequently
1.	Synchronous tools e.g instant messaging, chat rooms				
2.	Asynchronous tools e.g forums, discussion				
3.	Social network sites				
4.	Online games				

VII	How can you rate your competency in using the following technologies	Cannot use	Less competent	Competent	Very competent
1.	Email for telecommunication				
2.	Web search Engines				
3.	Word processing packages				
4.	Scanners				
5.	Digital cameras for educational purpose				
6.	Technology for group discussion e.g Power point				

VIII	Statement	Strongly Disagree	Disagree	Agree	Strongly Agree
1.	Using online forum made a positive contribution to my learning in Biology				
2.	Students should be encouraged to use internet for assignment				
3.	Students should be encouraged to use internet for projects				
4.	There was enough interaction among the teachers and the students when blended learning is used				
5.	I found the online part of the course a better learning experience than face to face				
6.	I felt discussions with my classmates with blended learning helped me understand the course content				
7.	This was one of the best course I have taken				
8.	Using blended learning for biology is more convenient				

9.	Taking blended course is boring				
10.	Blended learning is not sufficient as a learning style				
11.	Blended learning helps me to study better				
12.	Blended learning encourages learners to peruse through information using websites				
13.	I get more information in the area of my study through blended learning than through traditional courses				
14.	I enjoy modern tools (computer, internet) required by blended learning				
15.	I am satisfied with my scores with the use of blended learning				
16.	Blended learning should be the medium of instruction at the tertiary level				
17.	Blended learning activities caused me to fail or perform poorly				
18.	Blended learning offers the possibilities to efficiently manage my time				
19.	Blended learning should not prevail in the long run				
20.	The introduction of blended learning to the course has improved the quality of the course				
21.	The introduction of blended learning to the course has improved the structure of the course				
		Strongly Disagree	Disagree	Agree	Strongly Agree
22.	I prefer blended courses to traditional courses				
23.	I found the online part of the course a better learning experience than face to face				
24.	Students put more efforts in completing their assignments when they use the internet				

APPENDIX V

ANSWERS TO MULTIPLE CHOICE QUESTIONS BIOLOGY

1) B		40) B	60) C
2) C	21) B	41) C	61) D
3) C	22) A	42) C	62) A
4) B	23) A	43) C	63) C
5) D	24) B	44) D	64) A
6) C	25) D	45) A	
7) A	26) D	46) A	
8) D	27) A	47) D	
9) C	28) B	48) D	
10) C	29) A	49) A	
11) D	30) D	50) B	
12) A	31) D	51) B	
13) C	32) D	52) B	
14) D	33) C	53) D	
15) A	34) B	54) B	
16) A	35) A	55) C	
17) C	36) C	56) A	
18) D	37) D	57) D	
19) A	38) C	58) D	
20) C	39) B	59) A	

APPENDIX VI

APPLICATION EVALUATION CHECKLIST

Department of Science Education.

University of Ilorin, Ilorin, Nigeria.

Educational Technology Experts' Assessment on Mobile Phone Application.

Dear Respondent,

The researcher is carrying out an investigation on the Effects of Blended Learning on Biology students' attitude and Achievement in Colleges of Education using a mobile application. Thus, this instrument was designed to assess the effect it would have on Biology teaching and learning. Your responses will be used strictly for research purposes only. Thanks.

Yours Faithfully,

Adeoye, O. O.
(Researcher)

SECTION A

RESPONDENTS' DEMOGRAPHY

Institution of the Respondent: -----

Department/ Unit of the Respondent: -----

Highest Qualification: a) Doctorate () (b) Masters' degree ()

(c) Bachelors' degree () (d) Others ()

Gender: Male () Female ()

What is the title of the app: -----

Size of app (MB):-----

Creator of the app: -----

ITunes [URL:-----](#)

Content area(s):-----

Grade Level: -----

Price (free or lite version):-----

SECTION B

	CONTENT AND COMPONENT OF THE APP	YES	NO	N/A
a	Curriculum Connection: Are the skills reinforced connected to targeted skill/concept.?			
b	Authenticity: Are skills practiced in an authentic way?			
c	Feed back: Is the feedback specific and helps improve students' performance? e.g assignments			
d	Differentiation: Does the app give flexibility to meet student needs?			
e	User Friendliness: Is the app user friendly?			
f	Reporting: Is the summary data/assessment available electronically to the teacher?			
g	Sound: Does the sound in the app add any value to the educational aspect of the content?			
h	Instruction: Are the instructions included in the app helpful for students?			
		YES	NO	N/A
i	Visual design: Is it visually appealing?			
j	Support page: Does the app supports web page that provides additional information that could be useful?			
k	Navigation: Can you access the touch screen effectively by using the app throughout its use?			
l	Simplicity: Can the app be used in short bursts between task?			

Levels of Blooms Taxonomy addressed with this app

(Tick all that applies to the content in the app)

Remembering ()

Understanding ()

Applying ()

Analyzing ()

Evaluating ()

Creating ()

Using the data provided earlier above, explain why you would recommend this application for use in classroom

iTunes Application Ratings:

4+ ()

9+ ()

12+ ()

17+ ()

APPENDIX VII

TRAINER MANUAL FOR PLANT PHYSIOLOGY (Control group)

Level: Year II

Lecture 1

Topic: Photosynthesis

Objectives: At the end of the lecture, students should be able to:

- 1) List the raw materials required for photosynthesis
- 2) Explain where green plants get carbon dioxide from.
- 3) List the three main limiting factors of photosynthesis
- 4) Explain light reaction and its conversion into energy
- 5) Describe calvin cycle

Course content

- Plants as primary producers of food for populations
- General description of the process
- Raw materials and products of photosynthesis
- Mechanism of photosynthesis
- Chloroplast as the site for photosynthesis
- Light reaction, conversion of light energy into energy
- Photochemical splitting of water
- Calvin cycle, Dark reaction

Assignments

- 1) What are the raw materials required for photosynthesis
- 2) Where do green plants get carbon dioxide?
- 3) What are the three main limiting factors of photosynthesis?
- 4) Describe by drawing, the Calvin cycle in photosynthesis

Lecture II

Topic: Mineral Nutrition

Objectives: At the end of the lecture, students should be able to:

- 1) Describe the various mineral elements in plant metabolism
- 2) Describe the sources of mineral element in plants metabolism
- 3) List the deficiency in nutrition in plants
- 4) Describe and list the various types of diseases in plants

Course Content

- The various mineral requirements of plants
- Sources and roles of each mineral element including trace elements in plant metabolism
- Nutrient deficiency, diseases in plants

Assignments:

- 1) Give examples of Macronutrients
- 2) Give examples of Micronutrients

Lecture III

Topic: Water Relation

Objectives: At the end of the lecture students should be able to:

- 1) Know the various process of absorption of water in plant
- 2) Describe transpiration in plants
- 3) Define transpiration in plants

Course Content

- Absorption of water
- Transpiration in details

Assignments:

- 1) What are the two main types of transpiration in plants?
- 2) What composition in terms of the elements are the stomata made up of?

APPENDIX VIII

Shuffled Biology Blended Learning Achievement Test Level: SBBLAT

Sex:

Instruction: Answer all Questions

Duration: 1hr 30 mins

- 1) Transpiration helps in
 - (A) ascent of Sap
 - (B) mass flow of mineral along with water
 - (C) active Absorption of water
 - (D) temperature
- 2) Wilting occurs due to excessive
 - (A) guttation
 - (B) absorption
 - (C) transpiration
 - (D) imbibitions
- 3) In what direction does the phloem transport materials
 - (A) Up the plant at night and down the plant during the day
 - (B) Up and down the plant all the time
 - (C) Up the plant only
 - (D) Down the plant only
- 4) What treatment is most likely to lead to germination
 - (A) Increasing light intensity
 - (B) Dehydrating the seeds
 - (C) Increasing CO₂ Concentration
 - (D) Soaking the seeds in a solution of gibberellins
- 5) When a farmer sprays a chemical on crop plants, how does the chemical travel to the roots of the plants
 - (A) In the xylem, by transpiration pull
 - (B) In the phloem, by transpiration pull
 - (C) In the xylem, by active translocation
 - (D) In the phloem, by active translocation
- 6) What causes movement of water through xylem
 - (A) Evaporation

- (B) Active transport in the root tissue
 - (C) Active translocation
 - (D) Gravity
- 7) Micronutrients are
- (A) Available in the soil only in small amount
 - (B) Required by plants in small amount
 - (C) Small Molecules required by plants
 - (D) Useful but not required by plants
- 8) Which of the following is a correct list of contents of the organic material in soil?
- (A) Humus, roots and decomposed material
 - (B) Roots and small animals
 - (C) Minerals, small animals and root
 - (D) Small animals, humus and roots
- 9) Turgor pressure is also referred to as
- (A) Solute potential
 - (B) Water potential
 - (C) Pressure potential
 - (D) Osmotic potential
- 10) The main pigment involved in photosynthesis is
- (A) Xanthophylls
 - (B) Carotene
 - (C) Chlorophyll
 - (D) Bromothymol blue
- 11) Carotene reflects ----- Wavelength
- (A) Green
 - (B) Blue
 - (C) Yellow
 - (D) Red
- 12) Chlorophyll absorbs ----- Wavelengths
- (A) Green
 - (B) Blue
 - (C) Red
 - (D) Blue and red
- 13) What is another name for the light independent reactions?
- (A) Calvin Cycle

- (B) Electron Transport Chain
- (C) Krebs cycle
- (D) Fermentation

14) The cooling of plant is caused by

- (A) Guttation
- (B) Photorespiration
- (C) Transpiration
- (D) Assimilation

15) Active uptake of minerals by roots mainly depends on the

- (A) Availability of oxygen
- (B) Temperature
- (C) Light
- (D) Availability of CO_2

16) The hormones which indicate the closure of stomata is

- (A) Auxins
- (B) Cytokinin
- (C) Gibberelline
- (D) Absciscic acid

17) Water Absorption takes place through

- (A) Lateral roots
- (B) Roots cap
- (C) Root hairs
- (D) Tap root

18) What is the action spectrum of transpiration?

- (A) Orange and red
- (B) Green and ultraviolet
- (C) Blue and red
- (D) Blue, red, orange

19) Which one of the following is used for measuring the rate of transpiration?

- (A) Porometer
- (B) Osmometer
- (C) Moll's experiment
- (D) Potometer

- 20) Reduction of NADP^+ occurs during
- (A) photosynthesis
 - (B) respiration
 - (C) both photosynthesis and respiration
 - (D) neither photosynthesis nor respiration
- 21) Krebs cycle takes place in
- (A) Vesicles of Endoplasmic Reticulum
 - (B) Mitochondrial Matrix
 - (C) Lysosomes
 - (D) Dictyosomes
- 22) Common immediate source of energy in cellular activity;
- (A) NAD
 - (B) ATP
 - (C) DNA
 - (D) RNA
- 23) What type of organism performs photosynthesis, Choose the BEST answer
- (A) Plants
 - (B) Some photosynthetic protist
 - (C) Autotroph
 - (D) Heterotroph
- 24) The opening of the stomata is effected by all of the following except
- (A) Oxygen concentration
 - (B) Temperature
 - (C) Light
 - (D) Carbon dioxide concentration
- 25) The process of respiration in green plant occurs
- (A) only when stomata are open
 - (B) only when photosynthesis ceases
 - (C) only when photosynthesis is in progress
 - (D) at all times.
- 26) The annual plant exchange of gases takes place mainly through
- (A) Leaf scars
 - (B) Lenticels
 - (C) Stomata
 - (D) Stem

27) The rate of photorespiration in most plants increases at higher temperature. Some plants have evolved a somewhat round-about system to deal with this problem. This series of reactions is called

- (A) Dead bacteria
- (B) Living bacteria
- (C) A bacteria like substance
- (D) Living bacteria but cannot divide

28) Which of the following bacterium brings about *De nitrification*?

- (A) Pseudomonas
- (B) Rhizobium
- (C) Azotobacter
- (D) Nitrobacter

29) Ion can be accumulated against concentration gradient due to

- (A) mass flow
- (B) active uptake
- (C) passive uptake
- (D) donnan equilibrium

30) Which of the following is essential for Nitrogen Fixation by leguminous plants?

- (A) Chlorophyll
- (B) Leghaemoglobin
- (C) Anthocyanin
- (D) Phytocyanin

31) What is the purpose of NADPH in photosynthesis?

- (A) Provide energy
- (B) Carry electrons
- (C) Provide Carbon dioxide
- (D) Store Oxygen

32) Which of the following is a characteristic of Xerophytes?

- (A) Large number of stomata
- (B) Absence of roots
- (C) Absence of Vascular tissue
- (D) Leaves with a very small surface area

33) Which would be an adaptation of Xerophytes

- (A) Large numbers of Stomata
- (B) Hairs on the leaves
- (C) Large air space
- (D) Reduced roots

34) The rate of photorespiration in most plants increases at higher temperature. Some plants have evolved a somewhat round-about system to deal with this problem. This series of reactions is called

- (A) ETS (electron transfer system in light reaction)
- (B) C4 pathway
- (C) Photosystem ii
- (D) Calvin cycle.

35) NADP^+ is reduced to NADPH during

- (A) Light dependent reactions
- (B) Photorespiration
- (C) Calvin cycle
- (D) None of the above

36) Plant requires Fe and Mg for

- (A) synthesis of chlorophyll
- (B) opening and closing of stomata
- (C) translocation of carbohydrates
- (D) transpiration

37) Plant absorbs the element Nitrogen in the form of

- (A) Nitrogen gas
- (B) Nitrites
- (C) Nitrates
- (D) Nitric acid

38) Of all the environmental factors, which is the most influential in determining the rate of transpiration

- (A) Light
- (B) Relative Humidity of Atmosphere
- (C) Temperature
- (D) Water

41) In flowering plants, which of the following do not help seed dispersal?

- (A) Pollen
- (B) Bees
- (C) Mammals
- (D) Germination

42) Fertilization, pollination and seed dispersal all occur during the reproduction of a flowering plant, in what sequence do these processes occur

- (A) Pollination, fertilization, seed dispersal
- (B) Seed dispersal, pollination, fertilization
- (C) Fertilization, pollination, seed dispersal
- (D) Seed dispersal, fertilization, Pollination

43) Which of the following are products of light reaction of photosynthesis that are utilized in the Calvin Cycle

- (A) CO₂ and glucose
- (B) H₂O and O₂
- (C) ADP, Pi, and NADP⁺
- (D) ATP and NADPH

44) What are the products of light reactions that are subsequently used by the Calvin Cycle?

- (A) Oxygen and Carbon dioxide
- (B) Water and Carbon
- (C) Carbon dioxide and RuBP
- (D) ATP and NADPH

45) Where does the Calvin cycle take place?

- (A) Stroma of the chloroplast
- (B) Cytoplasm surrounding the chloroplast
- (C) Chlorophyll molecule chloroplast
- (D) Outer membrane of the chloroplast

47) As a research scientist, you measure the amount of ATP and NADPH consumed by the Calvin Cycle in one hour. You find 30,000 molecules of ATP consumed, but only 20,000 molecules of NADPH. Where did the extra ATP molecules come from?

- (A) Photosystem ii
- (B) Photosystem I
- (C) Cyclic electron flow
- (D) Chlorophyll

48) In metabolic processes of cell respiration and photosynthesis, prosthetic groups such as heme and iron sulfur complexes are encountered. What do they do?

- (A) Donate electrons
- (B) Acts as reducing agents
- (C) Acts as Oxidizing agents
- (D) Both oxidize and reduce during electron transport

49) In an experiment studying photosynthesis, performed during the day, you provide a plant with radioactive carbon (^{14}C) dioxide as a metabolic tracer. The (^{14}C) is incorporated first into Oxalo acetate. The plant is best characterized as a -----
--

- (A) C4 plants
- (B) CAM plants
- (B) C3 plants
- (D) Heterotroph

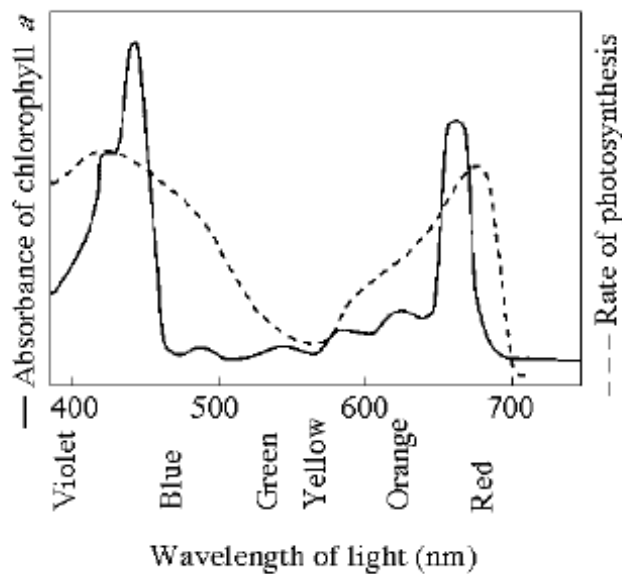


FIGURE 1

50) Figure 1 shows the absorption spectrum for chlorophyll *a* and the action spectrum for photosynthesis, why are they different?

- (A) Green and yellow wavelengths inhibit the absorption of red and blue wavelengths
- (B) Bright sunlight destroys photosynthetic pigments
- (C) Other pigments absorb light in addition to chlorophyll
- (D) Oxygen given off during photosynthesis interferes with the absorption of light

52) What wavelength of light in Figure 1 is most effective in driving photosynthesis?

- (A) 420nm
- (B) 475nm
- (C) 575nm

(D) 625nm

53) The water readily available to plants for absorption by root is

- (A) Gravitational water
- (B) Capillary water
- (C) Rain water
- (D) Hygroscopic water.

54) The water potential of pure water at atmospheric pressure is

- (A) -2.3 bar
- (B) +2.3 bar
- (C) Zero bar
- (D) One bar.

55) Loss of water from the stomata of leaves is known as

- (A) Guttation
- (B) Exudation
- (C) Transpiration
- (D) Evaporation.

56) During rainy season, wooden doors are difficult to open or close because of

- (A) Plasmolysis
- (B) Imbibition
- (C) Osmosis
- (D) Diffusion

57) Plasmolysis occurs due to

- (A) Absorption
- (B) Osmosis
- (C) Endosmosis
- (D) Exosmosis

58) The essential element for the synthesis of Auxin is

- (A) Zinc
- (B) Sulphur
- (C) Potassium
- (D) Phosphate

- 59) The disease “die back of shoots” is caused due to the deficiency of the following micro elements
- (A) Copper
 - (B) Chlorine
 - (C) Manganese
 - (D) Molybdenum
- 60) Hydroponic is
- (A) growing of aquatic plants
 - (B) growing of floating aquatic plants
 - (C) soilless cultivation of plants
 - (D) growing of plants inside water
- 61) Molybdenum is involved in plant metabolism in
- (A) translocation of solute
 - (B) tryptophan synthesis
 - (C) ABA synthesis
 - (D) nitrate reduction
- 62) The light reactions of photosynthesis supply the Calvin cycle with
- (A) Light energy
 - (B) CO₂ and ATP
 - (C) ATP and NADPH
 - (D) H₂O and NADPH
- 63) The splitting of carbon dioxide to form oxygen and Carbon Compounds occurs during
- (A) photosynthesis
 - (B) respiration
 - (C) both photosynthesis and respiration
 - (D) neither photosynthesis nor respiration
- 64) Reduction of NADP⁺ occurs during
- (A) photosynthesis
 - (B) respiration
 - (C) both photosynthesis and respiration
 - (D) neither photosynthesis nor respiration
- 65) Krebs cycle takes place in
- (A) Vesicles of Endoplasmic Reticulum
 - (B) Mitochondrial Matrix
 - (C) Lysosomes

(D) Dictyosomes

66) Common immediate source of energy in cellular activity;

(A) NAD

(B) ATP

(C) DNA

(D) RNA

APPENDIX IX

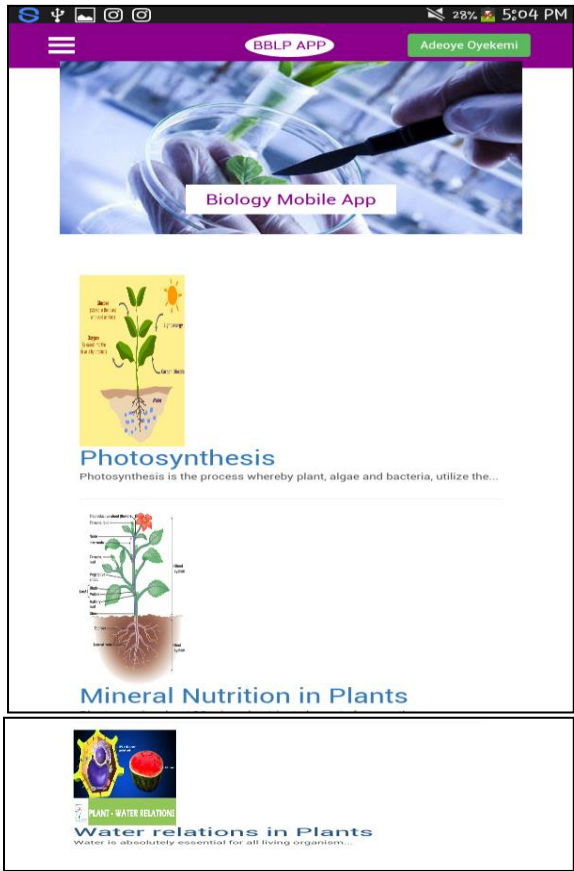
BUDGET PROPOSAL

DESCRIPTION OF ITEMS	EXPECTED FROM			TOTAL
	Sponsor (Self)	Students	Others	
1.0 PERSONAL COST/ALLOWANCES				
1.1 Research Assistants	5, 000 × 4	-	-	20,000
1.2 Research informants	-	-	-	
1.3 Technical Assistant	40,000	-	-	40,000
Subtotal		-	-	100,000
2.0 Equipment (List & specify)				
2.1 Dell Laptop	100, 000	-	-	100,000
2.2 HP Laser Jet professional P1102	30,000	--	-	30,000
2.3 Toner	13,000	-	-	13,000
2.4 Flash Drive	8,000	-	-	8,000
2.5 Modem (Etisalat), MTN	20,000	-	-	20,000
Subtotal				156,000
3.0 SUPPLIES AND CONSUMABLES				
3.1 Oxford English Learning Dictionary	1,200	-	-	
3.2 Research Methodology in Education by Cohen et al	2,500	-	--	
3.3 SPSS Hint book	4,000	-	-	
3.4 Design of the Software Application	145,000	-	-	

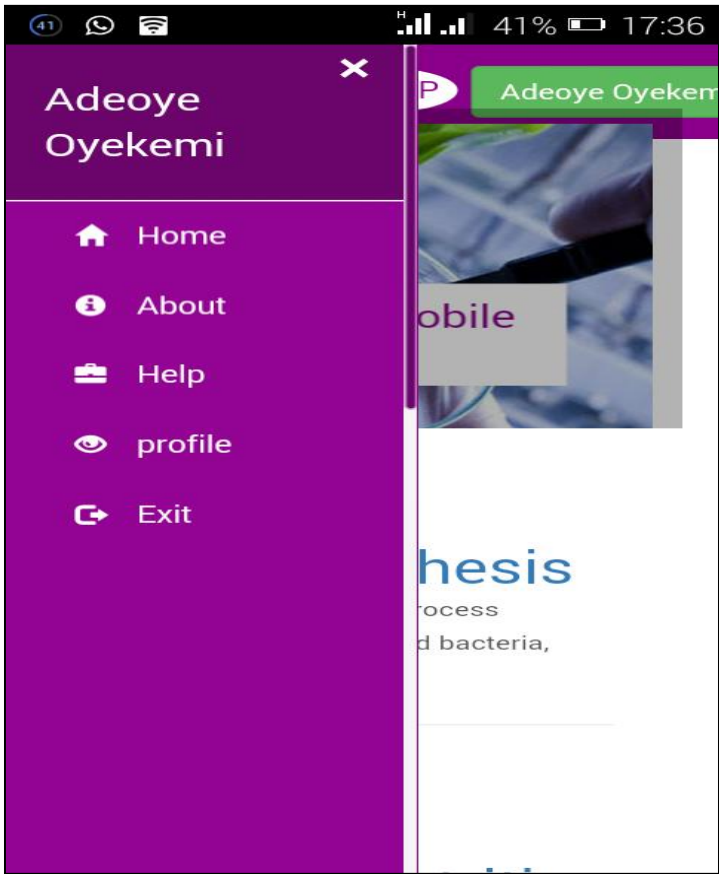
plus yearly Subscription for 2years				
3.5 Purchase of Data Bundle (28 months)3k/month	150,000	-	-	
3.6 Purchase of papers (A4)	70,000	-	-	
Sub total				372,700
4.0 DATA COLLECTION ANALYSIS				
4.1 Photocopies Of materials	80,000	-	-	80,000
4.2 Test Administration and collection	20,000	-	-	20,000
Sub total				100,000
5.0 Travels	30,000	-	-	30,000
5.1 Local Run Around	30,000	-	-	30,000
Sub total				60,000
6.0 DISSEMINATION				
6.1 Conferences	70,000	-	-	70,000
6.2 Journal Publication	20,000	-	-	20,000
Sub total		-	-	90,000
7.0 OTHERS AND MISCELLANEOUS				
7.1 Thesis Preparation and Binding	150,000	-	-	150,000
Sub Total				330,000
GRAND TOTAL				N1,018,700

APPENDIX X

A



B



C

Glucose
(stored in the plant
and used as food)

Oxygen
(Released into the air
as a by product)

Light energy

Carbon Dioxide

Water

Photosynthesis

Photosynthesis is the process whereby plant, algae and bacteria, utilize the energy of the sun to synthesize organic compound from inorganic compound. It provides oxygen for us to breathe, food, energy, fibers and materials necessary for our day to day living and consumes much of the CO₂ produced within our environment.

Click each of the following links to read more

- [What is Photosynthesis? \(HTML PAGE\)](#)
Photosynthesis is the process by which plants, some bacteria, and some protists...
- [Photosynthesis Explained \(Animation\)](#)
Energy from the sun is absorbed by plants...
- [The Purpose and Process of Photosynthesis](#)
The process of photosynthesis converts light energy to chemical energy, which can be used by organisms for different metabolic processes...
- [Main Structure and Summary of Photosynthesis](#)
In multicellular autotrophs, the main cellular structures that allow photosynthesis...
- [Photosynthesis Q & A](#)
How much have you learnt photosynthesis? Try yourself here...
- [Photosynthesis: An Overview](#)
There are 3 basic types of photosynthesis: C3, C4, and CAM. Each has....
- [Basic Photosynthesis](#)
The functioning of the Earth's ecosystem is dependent upon a continuous input of light energy in the form of photons coming from the sun.

Assignment

D

bud

Vegetative shoot

Leaf { Blade, Petiole, Axillary bud }

Stem

Taproot

Shoot system

Mineral Nutrition in Plants

Plants require about 13 mineral nutrient elements for growth. These elements are necessary for plants to complete its life cycle and they are called Essential plant nutrient. Each has a critical function in plants and is required in varying amount in plant tissue.

Click each of the following links to read more

- [Plant Nutrition](#)
A much in-depth into plant nutrition
- [Important Economic Minerals](#)
The importance of Economic mineral...
- [Soil Minerals and Soil Prescriptions for Organic Gardeners](#)
The process of photosynthesis converts light energy to chemical energy, which can be used by organisms for different metabolic processes...
- [Soil Minerals and Plant Nutrition](#)
The Function of Soil Minerals and Trace Elements in Soil, Plant, Animal, and Human Nutrition and Health..
- [Soil Minerals and Plant Nutrition](#)
How do chemical reactions involving soil minerals play a crucial role in controlling the availability of essential plant nutrients?...
- [What is Plant Nutrition?](#)
Plants use inorganic minerals for nutrition, whether grown in the field or in a container....
- [Plant Nutrition](#)
Learn Plant Nutrition from Kid world...

Assignment

BBLP APP Adeoye Oyekemi



Water Relations in Plants

PLANT - WATER RELATIONS

Water is absolutely essential for all living organism. Living cells are composed of 70-95% of water. It is a limiting resource for crop productivity. Where water goes either through the ground or plant body, it takes along valuable chemicals, minerals and nutrient. Water is a solvent for uptake of molecules and plays a role in cell elongation and growth.

Click each of the following links to read more

- [Water Relation in Plant](#)
Plant-water relations concern how plants control the hydration of their cells, including the collection of water from the soil, its transport within the plant and ...
- [Plant-Water Relation](#)
Just another questions and Answer on plant water relation...
- [Transpiration in Plant \(Google Search\)](#)
Searches on transpiration in plant...
- [Transpiration in the cloud \(PDF\)](#)
Here Transpiration is defined and clarified...
- [Transpiration \(virtual Lab\)](#)
Open the Virtual Lab entitled "Plant Transpiration". 2. The left side of the page contains background information and instructions in the "Question" area. e...
- [Transpiration](#)
Transpiration is the evaporation of water from plants. It occurs chiefly at the leaves while their stomata are open for the passage of CO₂ and O₂ during photosynthesis...

Assignment

UNIVERSITY OF ILORIN, ILORIN, NIGERIA

UNIVERSITY ETHICAL REVIEW COMMITTEE

Vice-Chancellor: Prof. A.G. Ambali
DVM (ABU), M.V. Sc., Ph.D (Liverpool, UK),
MVCN, MCVSN, MNVMA, FCVSN
Registrar: Mr. E.D. Obafemi
B.A (Hons), Cert. Public Information (Kaduna),
MNIPR



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Website: ethicalreview.unilorin.edu.ng
www.unilorin.edu.con

Our Ref:

UIL/UERC/90/022018

Date:

13TH April, 2017

Protocol Identification Code: UERC/EDU/116

UERC Approval Number: UERC/ASN/2017/759

EFFECTS OF BLENDED LEARNING ON STUDENTS' ATTITUDE AND BIOLOGY ACHIEVEMENT IN COLLEGES OF EDUCATION, IN KWARA STATE, NIGERIA

Name of applicant/Principal Investigator: ADEOYE, Oyekemi Olubunmi
Address of Applicant: Department of Science Education
Faculty of Education
University of Ilorin, Ilorin.

Type of Review: Full Committee Review

Date of Approval: 13/4/2017

Notice of Full Committee Approval

I am pleased to inform you that the research described in the submitted proposal has been reviewed by the University Ethical Review Committee (UERC) and given full Committee approval.

This approval dates from 13/04/2017 to 12/04/2020, and there should be no participant accrual or any activity related to this research to be conducted outside these dates.

You are requested to inform the committee at the commencement of the research to enable it appoints its representative who will ensure compliance with the approved protocol. If there is any delay in starting the research, please inform the UERC so that the dates of approval can be adjusted accordingly.

The UERC requires you to comply with all institutional guidelines and regulations and ensure that all adverse events are reported promptly to the UERC. No charges are allowed in the research without prior approval by the UERC. Please note that the UERC reserves the right to conduct monitoring/oversight visit to your research site without prior notification.

Thank You


Ismaila Isah
For: University Ethical Review Committee



"....if it's not ethical, it's not scientific, if it's not scientific it's not ethical"

