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The use of Mobile Learning as a Pedagogical Tool for Physics Education in Nigerian Senior Secondary Schools

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***Abstract* – This study examined the use of mobile learning as a pedagogical tool for Physics education in Nigerian senior secondary schools. The study adopted non-randomized pretest-posttest control group in quasi experimental design. Multi-stage sampling technique was used to select four schools from Ife Central Local Government Area of Osun State, Nigeria. One hundred and twenty senior secondary two (SS 2) Physics students was used for the study in their intact class setting. The study made use of Achievement Test in Physics (ATP) with internal consistency of 0.81 using Kuder-Richardson formula 21. The data collected were analyzed using Analysis of Covariance with pretest scores as covariates. The results showed that Physics students taught with mobile learning achieved and retained significantly better than those taught with expository method. Also, non-significant difference was found between male and female Physics students taught with mobile learning. The finding also indicated that, the effect of instructional strategies is the same at all levels of gender. It is recommended among others that, without discriminating against sexes, Physics teachers should make use of mobile learning to teach various concepts in Physics in order to enhance students' achievement and retention. Also, mobile learning will generate opportunities for the students to make contributions to their learning, develop concepts through collaborative interactions, and model individual plans to solve Physics problems.**

***Keywords* – Mobile Learning, Physics, Pedagogical Tool.**

I. INTRODUCTION

The government of Obasanjo in 1999 exposed Nigeria to massive importation of mobile devices which could be connected via sim card to the World Wide Web (WWW) and exchange information through the internet. Mobile gadgets such as phones, laptops and ipads were imported into the country following the craze by the Nigerian populace to get the "magic tools" at all cost [3]. This has led to the use of social media in Nigeria. Social media refers to the means of interaction among people in which they exchange, share, create and comment among themselves in different networks. Social media is a form of electronic communication which uses web-based technologies to transform and broadcast media monologues into social dialogues [8]. Social media can take different forms including social bookmarking, you-tube, podcast, wikis, micro loggings, web blogs, 2go, and intents forums.

The use of social media in classroom has numerous roles and impact, with the increasing growth of social networking and its wildly spread addiction by students, it becomes evident that the social media is not only meant for interaction and communication with others. It is also used to keep up to date and in touch with existing friends and relations or to create new relationships. It offers the ability to access information and communicate with others at any time and in any place regardless of the physical location of other people. It also provides opportunities for distant learning. Social networking sites promote education and new's communication which is beneficial to education and learning. Social media in Physics classroom is used as a

teaching tool to improve the efficiency of communicating with students as an inexpensive way to gain access to teaching materials which are expensive to create. Hence, the use of mobile learning in this study.

Mobile learning, also known as m-learning, u-learning, learning while mobile, handheld learning, anytime learning, anywhere learning, ubiquitous learning and personalized learning [7]. It is an instructional strategy that is conducted on and delivered through portable devices such as tablets, personal digital assistants (PDAs) and smartphones. It is the ability to obtain or provide digital learning assets which includes any form of media or content made available on a personal device such as smartphones and tablets. Mobile learning is characterized by handheld and wireless devices (Motiwalla, 2007) which is an ability to eliminate limitations of space in which teaching-learning process can be extended beyond the classroom. Hence, mobile learning provides a conducive learning environment for a dependable educational alternative with mobile devices [16].

Mobile learning is defined as an integral part of e-learning that uses learning connected to a mobile device or mobile device which based on mobility of learning, mobility of learners and mobility of technology that assisted the teaching-learning processes. Initially, mobile phones are mainly used totally for communication purposes, but recently, it has started to be used as a core pedagogical activity in educational institutions [11]. Mobile learning is an instructional strategy that involves learning through content and social interactions, and learning through multiple contexts using personal electronic devices. Sharing of knowledge in mobile learning is almost immediate among learners using the same content, which leads to the instantaneous feedback [10] through internet and assist in creating teaching content that can be used both in the classrooms and outside the classrooms [20].

Mobile learning is anytime and anywhere mode of learning which involves instantaneous access to personalized content with the tools and resources such as ipads, smartphones and tablets in order to create new knowledge, satisfy learners curiosities, collaborative learning with others and enhance learning experiences. It promotes flexibility of learning, personalized content, and acquisition of skills, knowledge, information and positive attitude towards learning which enables the learners to see the world as their classroom. Mobile learning involves building and adapting the latest mobile technology, redefining the roles of students and teachers and bridges the gap between informal and formal mode of learning.

Mobile learning is not exactly the same as e-learning. Mobile learning is informal in its delivery, self-paced un-tethered (unconnected to something), synchronous and self-paced while e-learning is “asynchronous” learning which is termed to be tethered, structured and formal in its delivery [13]. Also, m-learning occurs anytime and anywhere, involves instantaneous messaging, no geographical boundaries and no travel time with wireless internet connectivity while e-learning involves internet laboratories or lecture in classroom, e-mail to e-mail, private location and travel time to reach to internet site. In term of pedagogical change, mobile learning takes place anytime, anywhere, and learning occurs in the field. It involves more voice, graphics and animation based instructions while e-learning lectures occurs in the classroom or internet laboratories and it involves more text and graphics based instructions. In terms of assignments, examinations and presentations, mobile learning involves practical oriented examination direct on site which is hands-on based. It involves observation in the field and monitoring from remote location. It includes one to one presentations with much richer communication [2].

Mobile learning involves automatic translation for delivery of instructions in many languages with simultane-

-ous cooperative group work using electronic-based assignment delivery. The e-delivery of assignments takes place at anywhere and time, and the teacher uses his time to offer individualized instructions. On the other hand, e-learning involves text-based and theoretical oriented examinations, and the observation and monitoring is in the laboratory. It includes presentations in the classroom, usually with one language and mostly individualized work. E-learning also involves paper-based with hand-delivery of assignments at a given time and place, and the teacher use his time to deliver lectures. In terms of student-student interactions, mobile learning has no geographical boundaries, no travel time with wireless internet connectivity and it is flexible with instantaneous messaging all the time which has audio and video-teleconference. The assignments and tests given to students in mobile learning is conducted at anyplace and anywhere which is instantaneous with individualized tests and no restricted amount of time. On the other hand, the tests and assignments given to students in e-learning take place in the classroom or on computer which may be individualized or group with restricted amount of time. Hence, mobile learning involves the use of smartphones, ipads and tablets which is spontaneous, light weight, connected, net worked, informal situational, constructivism and collaborative while e-learning makes use of computer which is multimedia, hyperlinked, formal, interactive, collaborative, media-rich and involves simulated situation and distance learning ([23]; [15]; [7]; [2]; [19]; [14]).

The benefits of mobile learning include:

- Students access courses online and can access downloaded learning content when they cannot connect to the internet.
- Students learn when it is most convenient for them
- Students could access a course or assignment on a mobile device, sign out and later resume on a smartphone, tablet or laptop.
- Learning through mobile learning is self-paced.
- The user interface is designed to increase the learner's experience and also designed so that various concepts can be viewed optimally on smaller screens on a smartphone or tablet.
- There is no time-bound learning because mobile learning applications are available for 24 hours in a day.
- The mobile applications make it easy for the learners to practice various skills and acquire knowledge in an interactive ways.
- Mobile application enables learners to access materials and e-books from their mobile applications at regular interval without visit the library with just a click at the mobile application.
- With the assistance of mobile applications, learning will not only takes place in the classroom alone since mobile learning can take place anytime and anywhere and this enhances hands-on and minds-on activities.
- Students can make use of their leisure time to study with the aids of mobile applications.
- Mobile learning encourages individualized instruction among students.
- Mobile learning involves active participation of students and helps them to get instant updates about educational activities [18].

Expository method also known as conventional method involves a one-way communication pattern in which the learners' participation is virtually non-existent. It involves the instructor delivering a pre-planned lesson to the learners by doing most of the talking [4]. It is a teacher centred method where learners learn by rote and memorization of principles and concepts which requires little time for preparation, planning and accords the teacher a feeling of security as the authority figure since he is cast in the roll of a monopoly of knowledge [1]. Expository method serves as control in this study since it is the traditional way of teaching.

Gender has become an issue to all educational stakeholders in Nigeria. Gender is a major factor in Nigeria that influences students' interest in a particular field of study and their career choice. Hence, gender is important in this study. This definitely will affect any instructional strategy that will be introduced to Nigerian school curricula in various subjects because, a good instructional strategy should not discriminate against sexes. Refers to gender as the cultural socially constructed features, relationship and roles which are attributed to females and males in any society based on their biological make up [4]. It also describes females and males behaviour which grant them different obligations and rights based on their biological sex.

Statement of the Problem

Many guardians and parents have expressed their concern that they could no longer get the attention of their wards and children, as they seem to have been carried away by the social networks. It is observed that students devote more attention to social media such as face book, 2go, you tube, BB chart, instagram, podcast, whatsapp and blogging than they do to their studies. There is also a distraction, deviation and divided attention between social media networking activities and their academic studies. However, students can make use of mobile learning devices such as ipads, smartphone and tablets to function cooperatively or individually through exploring the opportunities given by online social atmosphere to improve academic achievement and retention in Physics. Hence, using mobile learning as a pedagogical tool for Physics education in Nigeria should be further investigated.

Purpose of the Study

The study was designed to achieve the following objectives:

1. To investigate the effect of mobile learning and expository method on students' achievement in Physics.
2. To assess the effect of mobile learning and expository method on students' retention in Physics.
3. To examine the influence of gender on students' achievement in Physics when taught with mobile learning.
4. To determine the interaction effect of treatment and gender on students' achievement in Physics.

Hypotheses

Ho1: There is no significant difference between the achievement of Physics students taught with mobile learning and those taught with expository method.

Ho2: There is no significant difference between the retention of Physics students taught with mobile learning and those taught with expository method.

Ho3: There is no significant difference between the achievement of male and female Physics students taught with mobile learning.

Ho4: There is no significant interaction effect of treatment and gender on students' achievement in Physics.

II. RESEARCH METHOD

The study adopted non-randomised pretest-posttest control group design in quasi experimental design. The population of the study consisted of all the 852 senior secondary two (SS 2) Physics students in the 12 co-educational secondary schools in Ife Central Local Government Area of Osun State, Nigeria. A total of 120 Physics students from four (4) schools in their intact class setting took part in the study. Multi-stage sampling technique was used in the study. The first step involved the use of purposive sampling technique. The criteria include:

(i) Schools that allow their students to use mobile devices such as smartphones, ipads and tablets.

(ii) Schools that have well equipped and functional Physics laboratories.

(iii) Schools in which the concept of energy quantisation and duality of matter have not been taught.

(iv) Schools that have at least one professional graduate Physics teacher with at least five years of teaching experience.

(v) Schools that are currently presenting candidates for Senior Secondary School Certificate Examination (SSSCE) in Nigeria.

(vi) Schools that are co-educational.

Six schools met the above criteria.

The second stage involves the use of simple random sampling technique. Four (4) schools among those that met the above criteria were randomly selected and assigned to treatment and control groups.

The instrument used for the study was Achievement Test in Physics (ATP). The ATP consisted of 50 multiple choice items which were constructed in the concept of energy quantisation and duality of matter. The choice of the topic is due to the fact that, it is one of the difficult concepts as reported by the West African Examinations Council Physics Chief examiners report (WAEC, 2016). The instrument (ATP) was validated by two (2) experienced Physics teachers. The average difficulty and discrimination indices of ATP were 58.20 and 0.51 respectively. ATP was trial tested with 25 students who were not part of the main study. The data collected from trial testing were analysed using Kuder-Richardson formula 21 and the result indicated an internal consistency of 0.81.

Teacher quality variables were controlled by using research assistants who are Physics teachers in each of the selected school to teach each group. The Physics teachers (research assistants) were trained for two weeks and they were also given detailed instructions with well articulated lesson packages on the concept of energy quantisation and duality of matter. The students in the experimental group were also trained for three weeks with their smartphones and tablets using another concept that was not part of the main study. In order to account for possible pre-existing differences in the learning outcomes between the experimental and control groups, pretest was administered to the two groups and the results were used as covariate measure. After the administration of the pretest, the teaching of the concepts, energy quantisation and duality of matter was done by the research assistants in each school for six (6) weeks. The control group was taught using expository method

(conventional method) while the experimental group was taught using mobile learning. In experimental group, the course materials, assignments and feedback were given to students through their mobile devices.

The posttest was administered immediately after the completion of teaching to both experimental and control groups. Retention test took place three weeks after the posttest. The pretest, posttest and retention test contained the same items except that, it was reshuffled before administration in each case. The data collected were analysed using Analysis of Covariance with pretest scores as covariates. All hypotheses were tested at .05 level of significance.

III. RESULTS

Hypothesis One

There is no significant difference between the achievement of Physics students taught with mobile learning and those taught with expository method.

The analysis is as shown in Table 1.

Table 1. Analysis of Covariance of the achievement of Physics students taught with mobile learning and expository method using pretest scores as covariates

Sources of Variation	Sum of Squares	Df	Mean Square	F-cal.		
Corrected Model	452.16	4	113.04	18.62	.000	*
Intercept	1443.27	1	1443.27	237.77	.000	*
Pretest	7.82	1	7.82	1.29	.362	NS
Treatment	378.46	1	378.46	62.35	.000	*
Gender	4.29	1	4.29	0.71	.586	NS
Treatment x Gender	2.65	1	2.65	0.44	.642	NS
Error	697.56	115	6.07			
Total	120434.45	120				
Corrected Total	1149.72	119				

R. Squared = .724

Adjusted R. Squared = .719

* = Significant at P<.05 alpha level

NS = Not Significant at P<.05 alpha level

The analysis in Table 1 shows that, the main effect of treatment on students' achievement in Physics was significant ($F_{(1, 119)} = 62.35$, P = .000). Therefore, the null hypothesis stating a non-significant difference in the achievement of Physics students taught with mobile learning and those taught with expository method was rejected. Since the mean achievement score of mobile learning ($\bar{x}$= 74.28) is higher than that of expository method ($\bar{x}$ = 60.36), it implies that, students taught with mobile learning achieved significant better than those taught with expository method. With adjusted R. squared of .719, it implies that 71.9% of the total variance in the achievement of students in Physics is attributable to the joint influence of instructional strategies and gender.

Hypothesis two

There is no significant difference between the retention of Physics students taught with mobile learning and

those taught with expository method.

The analysis is as shown in Table 2.

Table 2. Analysis of Covariance of retention of Physics students taught with mobile learning and expository method using pretest scores as covariates.

Sources of Variation	Sum of Squares	Df	Mean Square	F-cal.	P-value	Decision
Corrected Model	390.78	4	97.70	17.48	.000	*
Intercept	1412.84	1	1412.84	252.74	.000	*
Pretest	6.25	1	6.25	1.12	.372	NS
Treatment	398.56	1	398.56	71.30	.000	*
Gender	5.27	1	5.27	0.94	.563	NS
Treatment x Gender	3.36	1	5.36	0.60	.625	NS
Error	643.36	115	5.59			
Total	1223412.71	120				
Corrected Total	1034.14	119				

R. Squared = .843

Adjusted R. Squared = .825

* = Significant at P<.05 alpha level

NS = Not Significant at P<.05 alpha level

The analysis in Table 2 shows that, the main effect of treatment on students' retention in Physics was significant ($F_{(1, 119)} = 71.30$, P = .000). Therefore, the null hypothesis stating a non-significant difference in the retention of Physics students taught with mobile learning and those taught with expository method was rejected. Since the mean retention score of mobile learning ($\overline{x} = 77.49$) is higher than that of expository method ($\overline{x} = 61.73$), it implies that, students taught with mobile learning retained significant better than those taught with expository method. With adjusted R. squared of .825, it implies that 82.5% of the total variance in the retention of students in Physics is attributable to the joint influence of instructional strategies and gender.

Hypothesis Three

There is no significant difference between the achievement of male and female Physics students taught with mobile learning.

The analysis is as shown in Table 3.

Table 3. Analysis of Covariance for male and female Physics students' achievement taught with mobile learning.

Sources of Variation	Sum of Squares	Df	Mean Square	F-cal.	P-value	Decision
Corrected Model	262.04	2	131.02	9.04	.000	*
Intercept	489.42	1	489.42	33.75	.000	*
Pretest	9.21	1	9.21	0.64	.592	NS
Gender	12.78	1	12.78	0.88	.486	NS
Error	623.52	43	14.50			
Total	76024.38	46				
Corrected Total	885.56	45				

* = Significant at P<.05 alpha level

NS = Not Significant at P<.05 alpha level

The analysis in Table 3 shows that, the influence of gender on students' achievement in Physics was not significant ($F_{(1, 45)} = 0.88$, P = .482). Therefore, the null hypothesis stating a non-significant difference between the achievement of male and female Physics students taught with mobile learning was retained. This means that, both male and female Physics students achieved equally when taught with mobile learning.

Hypothesis Four

There is no significant interaction effect of treatment and gender on students' achievement in Physics.

The analysis is as shown in Table 1.

The interaction effect of treatment and gender on students' achievement in Physics as shown in Table 1 was not significant ($F_{(1, 45)} = 0.44$, P = .642). Hence, the null hypothesis stating a non-significant interaction effect of treatment and gender on students' achievement in Physics was retained. This implies that, the effect of instructional strategies is the same at all levels of the gender.

IV. Discussion of Findings

The results of the investigation as shown in Tables 1 and 2 indicated that, students taught with mobile learning achieved and retained better than those taught with expository in the concept of energy quantisation and duality of matter. This might be due to the fact that the course materials in mobile learning can be accessed at anytime and anywhere from mobile devices such as ipads, smartphones and tablets which enhance more readily accessible information. Students can also work cooperatively through online groups and chats since learning is not limited to a predetermined location and time. Also, mobile learning encourages individualized learning which makes teachers to more easily look into students, assign course work, class assignment and home work accordingly. As a form of blended learning, it combines face-to-face interactions with the use of mobile devices to form an integrated pedagogical strategy. It also provides ways of motivating learners by providing high levels novelty and engagement, autonomy and personalization. The use of mobile devices for academic purposes gives excitement to lessons and encourages taking learning opportunities outside the four walls of the classroom. Mobile devices provide excellent, state of the art technology for a relatively affordable price. Since majority of the students can afford it, the ever-increasing rate of using smartphone, ipads and tablets is an indication of the changing values and norms of our culture which affect the way we communicate, socialize, learn, access information, and interaction with colleagues and peers. The results is in agreement with the findings of [17], [6], and [14] that, blended learning and e-learning enhance students' performance and retention of the concept taught.

The results of investigation as shown in Table 3 indicated that, both male and female Physics students achieved equally when taught with mobile learning. This might be due to the fact that the enthusiasm exhibited by both male and female Physics students who showed equal zeal when they were taught using mobile learning may have led to equal achievement at given tasks. Also, both male and female Physics students interact with each other freely in groups through their mobile devices have led to increasing collaborative learning, promoting motivation and enhancing problem solving skills. The study is in agreement with the findings of [18] and [5] that, no significant gender difference exists in the achievement of male and female students in science. The findings of this study is however in disagreement with [1] that, there was a significant difference in the achievement of male and female students in Physics concept in favour of the females.

The result in Table 1 also showed that, there is no significant interaction effect of treatment and gender on students' achievement in Physics. This implies that, the effect of instructional strategies is the same at all levels of the gender. This might be due to the fact that, this study is in support of the mode of learning through hands-on (use of mobile devices) and minds-on (asking questions and interaction with teachers and peers) activities as parts of the strategies for impacting knowledge to learners. The result is in line with the finding of [22], [12], [1] and [5] that, non-significant interaction effect exists between the treatment and gender.

V. CONCLUSION

Physics students taught with mobile learning achieved and retained significantly better than those taught with expository method. 71.9% and 82.5% of the total variance in the achievement and retention of students in the concept of energy quantisation and duality of matter in Physics respectively is attributable to the joint influence of instructional strategies and gender. The use of mobile devices such as ipads, smartphones and tablets embraced leaners-centred and active participation of Physics students. It also emphasized active intellectual involvement of learners by providing opportunities for students to interact with their peers and teachers through mobile devices, read, chats, solve problems and reflect on the ideas, content, issues and concerns of energy quantisation and duality of matter.

The influence of gender on students' achievement in the concept of energy quantisation and duality of matter in Physics was not significant. It is made clear in this study that, the treatment administered (mobile learning) are more practical and involving, capable of enhancing the students' achievement and retention in the concept of energy quantisation and duality of matter in Physics effectively, irrespective of the gender of the learners. Hence, mobile learning does not discriminate against sexes. Also, there is no significant interaction effect of treatment and gender on students' achievement in Physics. This means that, the effect of instructional strategies and gender is the same at all levels of the gender.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

1. Mobile learning should be adopted at all levels of educational system in Nigeria to teach various concepts in Physics.
2. In order for the students not to be addicted to mobile devices for entertainment, amusement and social vices, mobile devices should be used by the students for educational purposes.
3. All educational institutions in Nigeria should be equipped with Information Communication Technology (ICT) facilities so as to enhance effective use of mobile learning.
4. Parent should procure mobile learning devices such as ipads, smartphones and tablets for their children in order to make use of them for educational purposes. However, they should be properly monitored because most students spend too much time on chating, playing video games and sharing irrelevant contents, alongside social activities.
5. Electronic-based instructional strategy such as mobile learning should be incorporated into Nigerian Physics curriculum in order to make the school programme be in line with global trends in education.

6. Conferences, workshops and seminars should be organized for Physics teachers by the professional bodies and government in order to acquaint them with the mode of using mobile learning.

7. Without discriminating against sexes, Physics teachers should make use of mobile learning to teach various concepts in Physics in order to enhance students' achievement and retention. Also, mobile learning will generate opportunities for the students to make contributions to their learning, develop concepts through collaborative and cooperative interactions, and model individual plans to solve Physics problems.

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