

# DEVELOPMENT AND USABILITY OF CHEMISTRY LEARNING-APP FOR NIGERIAN UNDERGRADUATES IN A BLENDED LEARNING ENVIRONMENT

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## ABSTRACT

*Learning-Apps provide educational contents on mobile devices to motivate and enhance students learning. However, in spite of the pervasive use of mobile devices among undergraduates in Nigerian Universities, its usability is for fruitless activities. Thus, there is need to develop learning-Apps for instructional delivery purpose. This study therefore, focused on the development and usability of Chemistry Learning-App for Nigerian Undergraduates in a Blended Learning Environment. This study employed quasi-experimental design involving a pretest posttest of non-equivalent approach. A total of 30 undergraduates were purposively selected for the experimental group, who were also given the usability questionnaire. The study findings showed that undergraduates had positive usability of the Chemistry Learning-App with a mean of (3.99). The implication is that academic performance of undergraduates would improve if students are more often exposed to the use of a developed Chemistry Learning-App. It was recommended among others that undergraduates should complement learning with the use of a developed Learning-App.*

**Keywords:** Usability, Learning-App, Blended learning, Learning environment.

## INTRODUCTION

The significance of Information and Communication Technology (ICT) in improving teaching and learning processes in the 21<sup>st</sup> century proliferation of digital technology cannot be underestimated. ICT is being integrated into education system around the globe due to its significance in effective facilitation knowledge. ICT

motivates both teachers and students. This implies that ICT should be incorporated into the school system to make teachers and students more effective. In this 21st century proliferation of digital technology, any institutions that fail to incorporate ICT into educational system cannot seriously claim any success in getting its learners ready for life after school (Ali, Haolader, & Muhammad, 2013; Ogunlade, 2014). Thus, mobile learning application is one of the current ICTs versatile tools used in teaching and learning process because of its effectiveness (Hartnell-Young., & Heym, 2008).

Mehdipour and Zerehkafi (2013) also posited that one of the components of ICTs is a mobile learning application, which attracts the attention of many researchers in the world. Hence, teaching and learning process is shifting from traditional method of teaching to blended learning environment; that is, from face-to-face classroom activities to mixed method approach. The use of mobile learning-app for teaching-learning process is a relatively new phenomenon and it has been the educational researchers' focus (Khanghah & Halili, 2015). Furthermore, Khanghah and Halili (2015) posited that mobile learning applications help students to learn by themselves without restrictions of location, time, place and age. It encourages student-centered learning which in this case means that students do not necessarily have to attend classes before they can acquire knowledge.

This approach to learning on mobile learning application encourages students to learn on their own and retain greater interest in it. Mobile learning applications assists in delivering of instructional content that easily attracts students' attention and helps them to understand easily. Mobile learning-apps have become increasingly pervasive, as many higher institutions of learning have initiated a number of mobile learning initiatives to support the conventional lecture method (Shiyadeh, Rad, & Jooybari, 2013). This implies that mobile learning-apps have been developed and adopted globally due to its significance and effectiveness in teaching and learning process; as teachers and students are being introduced to mobile learning-apps in the 21<sup>st</sup> century.

The learning-Apps can be used anywhere, anytime and at convenience. Goodwin (2012) also attested that some of the advantages of using electronic technologies in education include re-definition of teachers' role and unrestricted access to learning contents. Mobile learning-app is emerging as one of the solutions to the challenges faced by education; with a variety of tools and resources that are available, mobile learning provides increased options for the personalization of learning. Mobile learning-app in classrooms often assists students to work interdependently, in groups or individually, solve problems, work on projects, meet individual needs, and also allow students to learn at anytime, anywhere and at their own convenience (Ally, 2009).

Mehdipour and Zerehkafi (2013) posited that notebooks, mobile Tablets, iPod touch, and iPads are very popular devices for mobile learning due to its features and function, such as mobility, portability, availability of apps and cost effectiveness. Thus, the development of mobile learning-apps must follow good instructional design principles aimed at the achievement of specific learning outcomes. The design and development of mobile learning application with no doubt is complex process which

requires standard proficiency in software programming and knowledge in graphic, instructional design and content localizing (Khanghah & Halili, 2015). When all these skills are combined and utilized appropriately, it determines the quality of the mobile learning-App. This implies that there is need for software developers who want to design and develop mobile learning application for students learning to be adequately equipped with the aforementioned programming skills required for developing such application.

One of the key components to consider for the development of an acceptable educational application is ease of use. The usability of mobile leaning-app is the extent to which the learning-apps can be used to facilitate learning so as to enhance students' academic performance without restriction of time or location but with utmost efficiency, effectiveness and satisfaction of the learning-app (Hujainah, Dahlan, & Al-haimi, 2016). As the name suggests, usability has to do with bridging the gap between people and machines (Wang & Dey, 2013). Learning-Apps have been developed and adopted globally due to its significance and effectiveness in teaching and learning process, because learning-Apps have revitalized learning process by making learning to be more interesting, interactive, stimulating, motivating, effective and efficient.

Academic performance of students can be improved when learning-app is used to support learners learning activities. Enhancing student teachers learning experiences has become more important in higher institutions in recent time due to increased students' enrollment and diversification. Educational approaches that represent a shift in instructional strategy are often described as blended learning and virtual reality learning environments often considered as educational environments for blended learning. Elfeky and Masadeh (2016) in a study examined the effect of Mobile Learning on the development of students' academic achievement and conversational skills; found out that mobile learning had quite significant effect on both students' academic achievement and conversational skills.

In another study, Rabi, Muhammed, Umaru and Ahmed (2016) investigated the influence of mobile phone usage on academic performance among secondary school students. Findings of the study, revealed that mobile phone usage has significant influence on academic performance among male and female senior secondary school students, and that the frequency of mobile phone usage does not significantly influence academic performance among male and female senior secondary school students. Bonk and Graham (2006) described blended learning as the combination of web-based and face-to-face learning. The study further explained that blended learning is learning environment where there is an effective integration of different modes of transfer knowledge, models of instruction and style of learning as a result of adopting a strategic and systematic approach to the use of technology linked with the best features of face to face classroom instruction.

Singh and Reed (2001) posited that blended learning is a learning program where more than one delivery mode is being implemented for optimization of learning outcome and cost. It focuses on optimizing achievement of learning objectives by applying the right technologies in order to match the right personal learning style and to transfer the appropriate skills and knowledge to the learner at the right time. The study

further reiterated that blended learning referred to courses that combine face-to-face classroom instruction with online learning, form of enhanced classroom online instruction, mixed mode learning or hybrid learning, and it is not representing face-to-face learning program but constitutes a redesign of the teaching and learning relationship. Hence, blended learning is adopted with the aim of impacting knowledge easily more than the traditional method.

Science is the study of natural things while Chemistry is not only a branch of science that deals with the practical and experimental understanding of natural phenomena, but also one of the fundamental ingredients of technology (Abanikannda, 2016). Many students found it difficult to appreciate the chemistry of atom if not supported using ICT components like mobile learning-app (Aina, 2013). The study further buttressed that the other area of chemistry that were difficult to teach and learn if not supported by ICT components are quantum theory, radioactivity, chemical reaction, chemical kinetic, ionization, electrochemistry, chemical equilibrium, and atomic theory and nature of atom, and many more. There are rate of reactions and graph that are so complex to teach by the teacher which learning-app can help the teacher to manipulate for the student proper understanding.

### **Statement of the Problem**

Despite the relevance of learning-Apps in educational system, a developing nation like Nigeria is still not very keen in developing such blended learning environment in her institutions. The educational system of Nigeria is still backward in comparison with the advance nations which have developed learning-Apps and blended it to their learning environment. This is because learning-Apps have revitalized learning process by making learning to be more effective and efficient. This informed the need to develop a Learning-App that can be used to improve the effectiveness of learning in our schools. Thus, looking at the effectiveness of blended learning in our school environment, the rate at which undergraduates of Chemistry are finding it difficult to pass "Introductory Chemistry" can be further improved through the use of Chemistry Learning-App.

In spite of the rapid increase in mobile device ownership among undergraduates in Nigerian universities, there is need to provide course materials in form of mobile learning-apps. Many students use mobile devices for fruitless or non-academic related activities like chatting, financial frauds, downloading applications, pornography, listening to music, watching video and playing games, amongst other non-academic related activities students use mobile phones for. Hence, there is need for Nigerian educationists, curriculum planners, instructional designers, educational technologists, and software developers to explore the opportunities in mobile learning and produce contextually relevant curriculum based mobile learning-apps for all courses offered in Nigerian Universities. Therefore, this study explores the need to develop and determine the usability of a Chemistry Learning-App for Nigerian undergraduates in a blended learning environment.

## **Purpose of the Study**

The main purpose of this study was to develop, and determine the usability of Chemistry Learning-App for Nigerian Undergraduates in a Blended Learning Environment. Specifically, the study:

1. Developed Chemistry Learning-App for undergraduates in a blended learning environment;
2. determined the usability of Chemistry Learning-App by undergraduates in a blended learning environment; and
3. determined the influence of gender on the usability of Chemistry Learning-App by undergraduates in a blended learning environment.

## **Research Questions**

Answers were sought for the following research questions:

1. What are the processes involved in the development of Chemistry Learning-App for undergraduates in a blended learning environment?
2. What is the usability of Chemistry Learning-App by undergraduates in a blended learning environment?

## **Hypothesis**

The only hypothesis raised for the study was tested as thus:

**H<sub>01</sub>:** There is no significant difference between male and female undergraduates on the usability of Chemistry Learning-App in a blended learning environment.

## **METHODOLOGY**

This study adopted a quasi-experimental research design-based approach, together with the use of mixed method. The entire population for the study included all undergraduates of Universities in Osun State. The target population for the study was all 100 level undergraduates in Obafemi Awolowo University Ile-Ife offering Chemistry Education. Also, a sample of 30 undergraduates of Chemistry Education from Obafemi Awolowo University Ile-Ife was purposively selected to make the experimental group (using the developed chemistry learning-app). This selection was drawn from undergraduates having a functional Android device or tablet phone from the department of Chemistry. A researcher adapted questionnaire was used to determine the usability of the chemistry learning-app. Statistical Products for Social Sciences (SPSS) version 20.0 software was used to perform descriptive and inferential analysis of all data collected. Frequency counts, simple percentages, and mean scores were used to analyze demographic characteristics of the respondents and to answer research questions respectively, while t-test was used to test the study hypothesis at significant level of 0.05.

## **RESULTS**

Analysis of data collected for the study are represented on presentation tables and subsequently interpreted. The distribution of sample for the study in which data were

collected and analyzed includes; the experimental and control group based on gender, which are presented on the table below:

**Table 1:** Distribution of Sample for the Study

Sample	Gender		Total
	Male	Female	
Experimental group	13	17	30

Table 1 shows the distribution of sample for the study. From the above table, the group comprised of a total of 30 undergraduates that were selected as samples for this study and they were exposed to the Chemistry Learning-App.

**Research Question One:** What are the processes involved in the development of Chemistry Learning-App for undergraduates in a blended learning environment?

ADDIE model was used as an instructional design model for the development of Chemistry Learning-App, the acronym; ADDIE model consists of five stages; Analysis; Design; Development; Implementation and Evaluation stage. At the analysis stage of the study, learners' characteristics was analyzed such as cultural background, individual differences, cost effective of the chemistry learning-App, availability of mobile devices, device compatibility and learning style of learners where considered which constituted factors required for designing of the chemistry learning-App. The design stage encompassed activities that enabled the incorporation of the lesson plan in-line with lesson note which formed the development of instructional content of the chemistry learning-app. These include preparing lesson note, compatibility of mobile devices, determination of the type media and getting other things needed ready for the effective development of chemistry learning-App.

In addition, instructor worked out instructional strategies, wrote instructional objectives and appropriate method was selected. Also, instructional designer generates a plan according to the lesson note that was designed by the instructor. The Chemistry Learning-App was designed based on four modules that consisted of; Atomic Theory and Nature of Atom; Chemical Equilibrium; Chemical Kinetics and Radioactivity. Chemistry Learning-App is a mobile application that runs on Android OS phones and tablets. The output of design stage is development stage which was the actual production stage where methodology was tested and lesson plan was executed. The chemistry learning-App was developed on a with a combination of three programming languages, namely Hyper Text Mark-up Language 5 (HTML5), JavaScript, Cascading Style Sheet 3 (CSS 3) and some Java plugins named Cordova. These programming languages and plugins were used at various stages to bring about the developed mobile application. Adobe Dreamweaver was used in the writing of the programming codes

and development of the user interface. The HTML 5 code was used for formatting the content of the app, while CSS3 was used for styling the content and the user interface of the application. JavaScript was added to improve the user interactivities with the App. jQuery, A JavaScript library was deployed for improved structuring of the App Document Object Model (DOM). Adobe Firework CS6 was used for all the graphics in the App. Graphics were generated in the Portable Network Graphics (PNG) format to enable it adhere to the W3 consortium standard for the web.

At implementation stage the chemistry learning-App was put to work. Instructor exposed undergraduates to chemistry learning-App alongside with conventional lecture method to achieve the blend of the learning-App. This stage is crucial and complex because it required well defined objectives, pedagogy and technical skills. At the evaluation stage, students' academic performance was evaluated through Students' Academic Performance Test on Chemistry Learning-App to examine the effectiveness of the learning-App.

**Research Question Two:** What is the usability of Chemistry Learning-App by undergraduates in a blended learning environment?

**Table 2:** Usability of Chemistry Learning –App by Undergraduates

S/N	Questionnaire Items	Mean
1	I would like to use the chemistry Learning-App frequently	4.01
2	I found the Chemistry Learning–App unnecessary	3.52
3	The Chemistry Learning App was easy to use	4.01
4	I would need support to be able to use the Chemistry Learning- App	4.00
5	Icons in the Chemistry Learning-App are to be integrated to other learning-App	3.46
6	There was too much inconsistency in this chemistry Learning App	3.63
7	I would imagine that most people would learn to use this Chemistry learning-app very quickly	4.23
8	I found this Chemistry Learning-App very cumbersome to use	4.33
9	I felt very confident using this learning App	3.32
10	I need to learn a lot of things before I could get going with this learning App	3.56
11	The Chemistry Learning-App load is reasonable	4.23
12	There is adequate text –to –background	4.23
13	Space/ font size is easy identifiable	4.38
14	Main navigation is easily identifiable	3.42
15	I prefer reading Chemistry on the Learning-App than in the textbook, or in the classroom	3.60
	<b>Grand Mean</b>	<b>3.99</b>

Table 2 showed a grand mean of 3.99 for undergraduates' usability of chemistry learning-App which is above the average mean of 2.5. This indicated undergraduates' positive usability of the chemistry learning-App for learning. The implication of this

finding is that the chemistry learning-App is a useful technological tool/application that should be adopted in a blended learning environment to further enhance students' academic performance.

### Hypothesis One

**H<sub>01</sub>:** There is no significant difference between male and female undergraduates on the usability of Chemistry Learning-App in a blended learning environment.

**Table 3: *t*-test of the significant difference between male and female undergraduates on the usability of Chemistry Learning-App**

Gender	N	$\bar{X}$	SD	df	T	Sig	Remarks
Male	13	17.87	0.388	28	0.00	0.740	Accepted
Female	17	15.80	0.678				

It can be deduced from table 3 that there was no significant difference between male and female undergraduates on the usability of Chemistry Learning-App in a blended learning environment. This is reflected in the result:  $df(28) = 0.00, p > 0.05$ . Thus, the hypothesis is accepted. By implication, the stated null hypothesis was established thus: There was no significant difference between male and female undergraduates on the usability of the Chemistry Learning-App.

### DISCUSSIONS

Findings of research question one revealed that a Chemistry Learning-App was designed and developed using ADDIE model to guide and analyze the processes involved in the development of Chemistry Learning-App for the study. ADDIE model was used as an instructional design model for the design and development of Chemistry Learning-App, the acronym; ADDIE model consists of five stages; Analysis: Design; Development; Implementation and Evaluation stage. After the processes involved using ADDIE model as guide, the chemistry learning-app was therefore found suitable and appropriate for the study. Students' academic performance was evaluated through Students' Academic Performance Test using the developed Chemistry Learning-App to examine the effectiveness of the learning-App on students' performance. Undergraduates have positive reaction towards the usability of the developed Chemistry Learning-App.

Findings of research question two revealed undergraduates' positive reaction towards the usability of the chemistry learning-App which confirmed that the chemistry



learning-App is very useful for learning if properly integrated into teaching and learning. The finding concurs with the earlier findings of Parsons and Ryu (2006) whose findings revealed that mobile learning application can be a successful educational platform when researches are carried out on the aspects of usability; learnability, understandability, ease of use, effectiveness, and efficiency of mobile applications. Findings of the current study also agreed with the earlier findings of Hartnell-Young and Heym (2008) which revealed that the use of mobile learning application has improved students' academic performance in many subjects' areas at all levels of education. Similarly, Mohammad (2015) experimented in a study on the relationship between mobile learning application, student's academic performance and satisfaction of the new learning process. The study found out that the use of mobile learning applications for teaching and learning has greatly improved students' academic performance.

Findings of the study hypothesis revealed that there was no significant difference between male and female undergraduates' in the usability of Chemistry Learning-App in a blended learning environment. The result agreed with the earlier findings of UNESCO, (2014) which revealed no gender differences in the use of mobile learning devices. Although the researcher admits the important role gender plays in determining students' academic performance. Similarly, Grimus (2016) findings revealed in another study, that using smartphones to support different learning tasks did not show much significant differences on gender. On the other however, UNESCO, (2000) found out in a study that gender differences exist in the use of social and web-based media, consumption arrangements, attitudes and attraction towards technological tools including mobile learning applications.

## **CONCLUSIONS**

Findings of this study showed that chemistry Learning-App is a valuable online learning technological tool that can be incorporated into school curriculum for the study of Chemistry and other subject areas or concepts. It pleased the students because they could learn at their own pace and convenience anywhere, anytime. Many preferred learning chemistry concepts using Chemistry Learning-App to the lecture-based approach because it was a different way of learning and at the same time have fun and be motivated. The Chemistry Learning-App therefore, brings about effective learning of chemistry concepts and positive improvement in the academic performance of students. This is an indication that it is an interesting and engaging alternative to complement the various teaching and learning strategies.

## **RECOMMENDATIONS**

Based on the findings and conclusions made in this study, the following recommendations were made:

1. The design and development of a Chemistry Learning-App is an innovative technological tool that compliments the conventional approach to instruction. Hence, lecturers are encouraged to develop learning-apps on more concepts in chemistry and other subject areas. Even as students are also encouraged to support their learning process with learning-apps, thereby enhancing their academic performance.

2. The study revealed a positive use of the Chemistry Learning-App, but would like to recommend further use of learning-apps in instruction, so as to further enhance students' academic performance.
3. The study though found no differences in gender usability of chemistry learning-app. The study still recommends that both genders should be encouraged to continuously use learning-apps as a complimentary tool to their learning process. In other to further enhance their academic performance and chances of achievement of overall learning outcome.

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