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GeoNaija: Enhancing the Teaching and Learning of Geography through Mobile Applications

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Received: 21 August 2019; Accepted: 15 October 2019; Published: 08 November 2019

Abstract

Recently, researchers have identified several challenges attendant to the teaching and learning of Geography in Nigerian secondary schools. Consequently, in order to address these issues we propose GeoNaija – an educational mobile application platform that aid the teaching and learning of Geography. For the development of the application, we employed the cyclical ever-evolving analysis, design, development, implementation, and evaluation (ADDIE) instructional design method. This method was chosen due to the fact that it is popular, easy to apply, allows for rapid prototyping, saves times and provides continual feedback. The newly developed mobile app will make the teaching and learning of Geography concepts easier, captivating and delightful for both the students and the teachers. The significance and value of the research was made clearly evident through a survey that elicited students' responses on questions relating to the app's presentation, visual, navigation and accessibility design. 90 secondary students was used for the survey. The study affirmed that developed mobile application will positively change the perspectives of the students and help eliminate the gap between the conventional and other informal forms of education.

Index Terms: Geography, Secondary Schools, Smart Phones, Nigeria, Mobile Applications, User Studies

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1. Introduction

With the passage of time, the learning of geography has evolved through four phases. First, collating and keeping inventory of geographical phenomena on the earth's surface. Then it moved to interrelationships between processes and results, regional differentiation and the origin of Geographical phenomena. On the third phase, geography teachers focused on the quantification initiated with the quantitative revolution as statistical methods were used to analyze relationships that exist among Geographical phenomenon [1]. At the fourth and final stage, the focus is on neo-environmentalism (a scenario of action and reactions between human activities and environmental responses) [2].

Geography is one of the requisite subjects in the secondary school curriculum; it is mostly combined with Arts, Social science or other science for the upper classes of secondary schools in Nigeria [3]. Using various methodologies alongside instructional materials, secondary school teachers teach the Geography curriculum [4]. The teaching approaches include, "lecture method, inquiry method, inductive method and deductive method" [5]. Other teaching approaches include, "discussion method, textbook method, problem solving method, project method, field trip method, question and answer method, experimentation and discovery method and the expository method" [6].

As Oyesiku [7] puts it, "Geography as a discipline provides an integrative knowledge platform between the natural and social sciences that form the basis for the millennium development goals and sustainable development goals to which Nigeria is a signatory". Consequently, the emphasis in Nigeria for the teaching and learning of Geography include local geography, map work and fieldwork [2]. During the delivery of the courseware (curriculum), the average Nigerian secondary student is intimated with the Nigerian landscape.

Several challenges have been experienced by geography teachers and these have been identified by authors in recent times. As Khalil, et al. [1] puts it, "the problems are related to the use of instructional materials or in most cases lack of them, inadequate funds to purchase some text books and equipments, shortage of time allocated, inadequate qualified teachers and attitude/level of interest of students towards the subject." Their paper confirmed that Geography does not command a wider appeal amongst the secondary school students. This is due to some reasons which include the broad nature and complexity of the curriculum/courseware. Another challenge is the lack of trained Geography teachers. It was observed that most school authorities disregard and trivialize Geography in such a manner that they be taught by any individual who call him/herself a teacher. Osirike [8] highlighted some missing links in the teaching Geography, they include "the inability of geography teachers to highlight the relevance of the subject to national objectives and problems, ineffective utilization of teaching aids, the negligence of field excursions, and the inadequate utilization of local examples coupled with lack of emphasis on local geography".

In the words of Ajibo [9], "Geography is a complex discipline that nothing reasonably good can be achieved if it is not handled by trained teachers". Amongst the numerous recommendation made by Khalil, we selected the use of more educational material...and new technologies like geographical information system (GIS) and/or global positioning system (GPS) as well as the need for more student-teacher interaction that involves idea sharing. In 2013, Geography as a single subject was removed from the Nigerian senior secondary school curriculum and sandwiched within some parts of Social Studies [7]. This may be traceable to the fact that few senior secondary students offer Geography because they think it's uninteresting and difficult.

Researchers are yet to proffer IT-related solutions to the problems identified above, therefore we propose the use of a mobile application in order to enhance the teaching and learning of Geography in Nigerian secondary schools. Note that the conventional method of teaching Geography has been fraught with limitations such as the lack of appropriate teaching aid that encapsulates GIS/GPS technologies. Most schools consider the use of smart phones as an offense that is mostly punishable. Even with these punishments meted

to offenders, students still adamantly bring in their phones into classrooms and lecture halls. The implication is that educators and teachers in Africa should explore ways to turn the ubiquity of smart phones into ways that may enhance teaching and learning. Even though there are several mobile applications developed for the purposes of teaching and learning (*See the Related work section*), we discovered they do not cater for the specific challenges observed while teaching and learning Geography.

In this paper, we strongly anticipate ways of turning the teaching and learning of Geography (mostly filled with difficulties) into an exciting experience through the development of GeoNaija – a mobile application. This is largely because of the evolution of this technology in several areas of life. Specifically, arming educators with the appropriate teaching and learning software can aid the effectual shaping of other educational interests such as documenting attendance and behavior. Therefore, the development of GeoNaija mostly promises the move beyond the usual dimensions of classroom environment even up to developing lessons, preparing lecture topics, using images and pictures and improving the student's interests. More so, the mobile applications promotes and sustains learning beyond the classroom. Other objectives pursued include performing a survey to elicit the responses on questions regarding the presentation, visual, navigation and accessibility design metrics of the developed application.

2. Related Work

Under the review of pertinent literature we presented several mobile applications for education and administration.

2.1 Mobile applications for Education and its Administration

Mobile applications have been used in recent times to facilitate teaching and learning in institutions. For Africa, the presence of mobile software application and internet connectivity [10] could potentially address the teaching and learning difficulty associated with certain subjects which require physical presence and material for delivery for the curriculum. A quick Google search availed the following top best mobile applications for teachers and educators. These mobile apps are available on android and IOS platforms. One of the most revered mobile apps in education is Kahoot [11]. This app transforms a dull and uninteresting into a pleasurable play time out between students and the teachers. On the Get Kahoot site, teachers can arrange questions and answers which the app transforms (with the aid of a browser) into a games that can be played by the students.

Google Classroom [12] is another educational app from the G Suite; it is used for distributing the class tasks to students and grading them afterwards. This classroom mobile application serves as a storage of different class materials. These materials are stored in the G drive in such a manner that easy access is guaranteed when a particular material is needed urgently. Additionally, this app is also used to make announcements and debates.

Third, is Teach Learn Lead [13] – a social media-like platform for teachers. Here, teachers from different schools meet, interact and remain in a loop of constant communication. A set of teachers who are interested in a certain issue discuss experiences, challenges, highs and lows and specific aspects of teaching/learning such as writing lesson plans/notes, polls, the choice of set induction for their students and their perceptions about the students etc.

Seesaw [14] was designed to mimic a student's folder of progress and achievement or lack of. Parents can look at the works of their children in so manner that they understand the rate of improvement of their kids. On the part of the teachers, the app allows them to document the annual deficiencies/flaws and areas of strength.

In order to ensure that teaching and learning does not end in/outside the classroom, Slack [15] was created. It was discovered that students encounter some difficulty in reaching teachers after classes. Therefore, the app

helps both the student, teacher to be in a constant loop of communication even after the usual school hours. The app can aid the teachers in arranging text-based office hours and for sending alert notifications to students during times of emergency.

Unlike Slack, which was created for communication between teacher and students, Remind [16] is in form of group chat application that adds the parents to this loop of communication. Communication is usually outside the classroom. The app allows the faster dissemination of information (announcements) and private chats. Note that the app can translate above 70 teacher languages to non-native English speaking parents.

To automate the paper-based nature of exam and other records such as notes and attendance, Additio [17] was conceived. This app acts as a digital classroom and grade book management app where the teachers are allowed to take records of the attendance, plan the timetable and calculate the grades of the students in their smart phones and tablets. The teachers can also opt for the \$8 per month Plus edition of Additio for getting the additional features like note keeping and performance analytics.

The Doceri app [18] has the ability to turn the tablets and smart phones into portable whiteboards by taking the advantage of the portability and touchscreen of the iPad. This app helps with the explanation process of the materials that are on screen and this makes the teaching lesson more interactive. With the help of this app, the teachers do not have to handwrite the complicated diagrams and equations as they can simply post the materials online from their iPad.

The proliferation of smart mobile phones, the emerging technologies and the numerous ways it has modified the teacher-student interaction spurred Truong [19] to investigate the usage of mobile applications for education in high schools and to support comprehension and enhance learning results of college students. He named the resulting application, "Business Study Flash Card". Note that this app does not exist in the Apple store as at the time of development. The beauty of this application is that aside its ability to be used anywhere and at any time, the users does not need internet connection.

Khanghah & Halili [20] developed a mobile learning application for distance education. This application emphasizes that in deploying mobile teaching and learning tools a feedback system is essential for application success. Equally, Bele, et. al. [21] emphasized that the utility of Learning Management System (LMC) can help in providing native e-learning activities with friendly features. The authors carried out some technical studies on the use of specific learning activities comparing the efficiency of different devices and users' preferences. These comparisons helped in considering which features was relevant and what efficiency. Mohamed, et al. [22] identified human factors as critical developing problems mobile learning applications. Their user study with 23 higher education providers in Oman, was made up of administrators, instructors and students. Therein, they identified six human challenges including flexibility, suitability, sociability, efficiency, enjoyment, and economics.

In another study (web-based mobile learning), the user studies enabled the authors to accommodate challenges in the prototype features which started by building mock-ups of applications, and testing mock-up of applications to users [23]. Also Object Oriented Analysis and Design (OOAD) were analysed whereas Unified Modelling Language (UML) as a system design tool was adopted in the methodology [23]. Critical themes which emanated from the user studies influenced the methodology considered, design interaction between users, data design, and interface design. In order to successfully deploy edu-mobile or mobileLearn a number of factors ought to count in the design consideration. Sultan [24] maintained that innovative mobile and social learning platforms can enhance learning if critical pedagogical (curriculum content issues) and technical issues (easy to use features) were taken care of and tested against known smart system using one or two universal acceptance models.

X-raying the reviewed applications, we distilled several functions that was included in the design of GeoNaija. The concept of arranging questions and answers seen in Kahoot [11] was included under the test menu of GeoNaija. This menu has other submenus and the include Testing Self, Random Tests and Store Tests. From Google Classroom [12], we identified 'storage of different class materials' and integrated the

functionality for several electronic documentation, web links and book chapters on Geography education. From Teach Learn Lead [13], we took ‘increased interaction/constant communication’ and included the functionality in our application as “Chat” under the Student Support menu. From Seesaw [14], we identified ‘student’s folder of progress and achievement or lack of’ and included ‘Student Profile’ under the Student Support menu. This functionality that helps document all data and information concerning a student. From Slack [15] and Khanghah & Halili [20], we identified the difficulty of reaching teachers, and included the ‘Give Feedback’ functionality. The Chat functionality also caters for the ‘announcement/information dissemination’ concept identified from Remind [16]. The Learning Tools submenu addresses also the attendances and timetables creation identified in Additio [17] while explanation process identified in Doceri [18] was addressed using the Education menu. Other functionality included in the application include Geography education, multimedia geography and local geography. Performing user studies was identified in Fachrizal, *et al.* [23] and performed at sub-section 5.2.

From reviewing the above applications for learners and teachers, we noticed that they were not developed with a particular course or subject in mind. There is also the peculiarity of the Nigerian terrain i.e. local geography which would be absent had there been a Geography application in existence. Therefore, in the light of this reasons, we embarked on the development of a mobile application for the teaching and learning of Geography in Nigerian secondary schools.

3. The Concept – Geonaija App

The study proposes the development of a mobile application called GeoNaija – an educational application that would aid the teaching and learning of Geography in Nigerian Secondary schools. The newly developed mobile app will make the teaching and learning of Geography concepts easier, captivating and delightful for both the students and the teachers. More so, it will fill the lacuna between the conventional and other informal forms of education. Obviously this is line with Guzman, *et al.* [25] who proposed the use of a model for “active learning practices, test method, computer-aided instruction in Geography lesson” after eliciting the difficulties experienced during geography education.

GeoNaija aims at bringing the fundamental concepts relevant to the Geography curriculum in Nigeria. These concepts include the Nigerian ecosystem, development and population; they are extracted from the focus (local geography, map work and fieldwork) of the Geography curriculum in Nigeria. The learning purposes of the GeoNaija are to aid the students through the following areas; 1) developing knowledge and understanding about the local landscape, the changing development of geographical phenomena, the characteristics and functioning of major natural environments. 2) developing geographical inquiry skills i.e. identify and ask questions from a geographical perspective, locate appropriate information and data from primary and secondary sources ; as well as to present and organize information and data. 3) cultivating generic skills of communication, critical thinking, problem-solving skills and creativity through geographical inquiry and 4) developing values and behavior that mirror a sense of wonder, enjoyment and curiosity about peoples, places and environments, show respect for all peoples, their cultures, values and ways of life, recognize environmental problems, cultivate a sense of belonging to society and nation at large.

GeoNaija can be employed in such a manner that the student can learn on his own or as a teaching material for the Geography teacher. The application possesses a dynamic, analytic learning approach situate in a rich multimedia online domain that consists of smooth access to hypermedia learning documentations in the form of HTML web pages and interactive learning-assisted games.

The development of the GeoNaija app involves Platform Design and System Design which consists of numerous captivating and interrelated attributes include student profiles, geography textbooks, videos, tests, games, chats and the opportunity to request feedback from the instructor. Other learning materials include the visual components of local geography i.e. maps, charts, aerial and ground photos as well as Geographic Information System (GIS) data and information. The application contains these elements and submenus

depicted in the schematic diagram (Fig. 1.).

Fig. 1 depicts the system components of the application called GeoNaija. Once a user logs into the application, it displays the following menu items; Education (Geography Textbooks), Multimedia Geography, Tests, Student Support and Local Geography/Gallery. GeoNaija is developed in such a manner that related submenu items are grouped together under one menu item. The Education menu has the following submenus; electronic documents, website links to important Geography tests and book chapters. The Multimedia Geography menu has the following submenus; videos, mobile enrichment and games. The Test menu has the following submenus; testing self, random tests and store tests. The Student Support menu has the following submenus; student profile, interact, give feedback and learning tools. Finally, the Local Geography menu has the following submenus; maps, charts, aerial photos and GIS data and information. The exit and back buttons are used to ensure seamless navigation through the application elements.

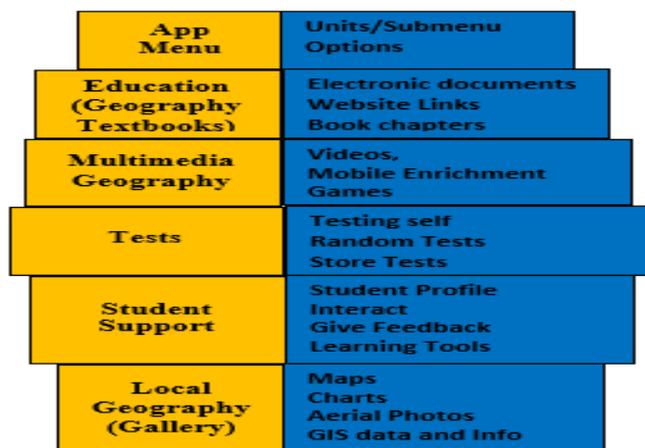


Fig. 1. System Components of GeoNaija

4. Methodology

This research For the development of the mobile application we employed the ADDIE instructional design model proposed by Peterson [26]. In order to create effectual Geography instruction, all design models needs the following stages: analysis, design, development, implementation, and evaluation; these stages are abbreviated as ADDIE. The efficacy of ADDIE is found in its next-phase-informing nature, making it logical and viable for the development any kind of mobile education tool. More so, it can therefore be used to produce a captivating educative experience for the secondary school learner.

Acclaimed for its resounding popularity in the development of educational instruction, it also presents an easy process which even the amateur analyst can follow. It also has the advantage of rapid prototyping and possesses the capacity for continual and formative feedback during instructional materials creation. Most importantly, the ADDIE model conserves the precious time of the developer due to the early fixes it allows at the initial phases. The description of the stages of the original model is described with the aid of Fig. 2. – the diagram depicting the ADDIE framework.

Here, the stages of the development of the GeoNaija app using the cyclical ever-evolving ADDIE framework are briefly described hereunder.

Analysis phase: here, there is the need for an investigation which is aimed at pinpointing the learning aims and instructional directions in the Geography curriculum of secondary schools. Therefore, we elucidated the instructional challenges, elicited the learning terrain as well as the students' prior knowledge and skills.

Design Phase: is aimed at developing instructional materials. Therefore, we achieved that by pinpointing the applicable learning theory, managing learning aims, test content, topics, lesson plans, instructional approach and the selection of the appropriate media of instruction.

Development Phase: the aim here was to create prototypes and to perform initial tests to generate feedback. First, the alpha tests using experts and then the pilot test using the students. Consequently, we created and managed the materials whose contents were conceived at the design phase. Specifically, we generated storyboards, scripts, graphics, video and audio. Additionally, we specified the computer and software to be used. Note that we did the actual coding of the mobile app at this phase.

Implementation Phase: at this phase we intend to administer the developed application and to assess its efficacy in a real Geography teaching environment. To achieve this aim, part of the Geography curriculum was taught and learned by teachers and students respectively. On the other hand, we carried out some training sessions for the target audience of students and their instructors.

Evaluation Phase: here we aimed at conducting both formative assessment. This is to generate opinions, recommendations and reports from the prototypes.

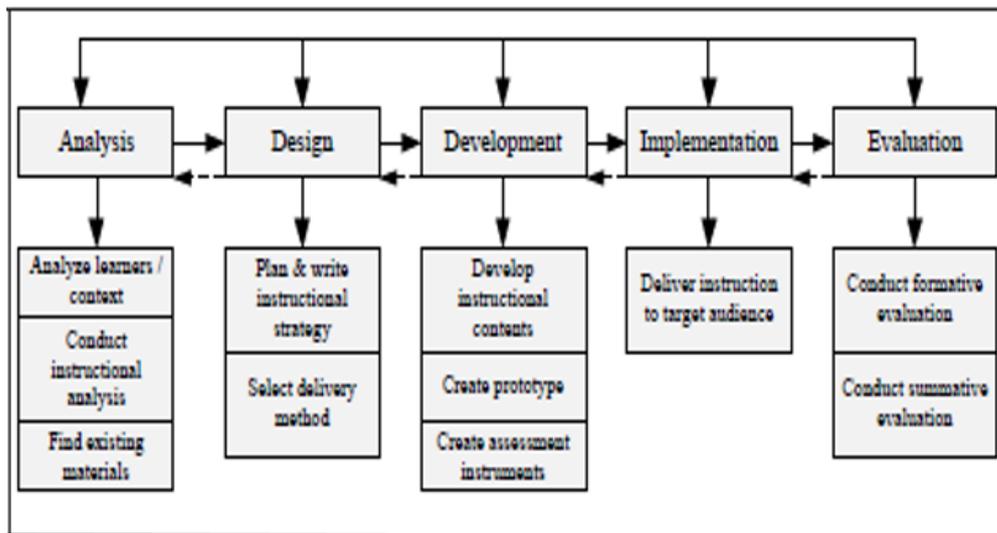


Fig. 2. The ADDIE Framework [26]

5. Results and Discussion

Here, we present the results of developing GeoNaija for the effective teaching and learning of Geography. First of all, we present prototypes developed as a result of the development phase. Second, we present the result of questionnaires (on presentation, visual, navigation and accessibility design analysis) given to senior secondary school students of Christ the King College and Queen of the Rosary College, both situated at Onitsha, Anambra state, Nigeria.

5.1 Prototypes

In the development of GeoNaija, user-friendliness was upper most in our minds. Since the phones wherein the application would be used is considered “smart”, the menu appears once the user touches the screen. The

mobile application divides its total contents into menu elements such as education, multimedia geography, test, student support and local geography. The student support interface allows several actions that aid learning, these activities include the other geography information section, the chat section, the feedback and the learning tips section.

While Fig. 3 shows the interfaces for login and Geography education, Fig. 4 shows the interfaces for student support and Geography content. While Fig. 5 depicts the interfaces for test and electronic-quiz, Fig. 6 depicts the interfaces for tutorial and electronic documents.

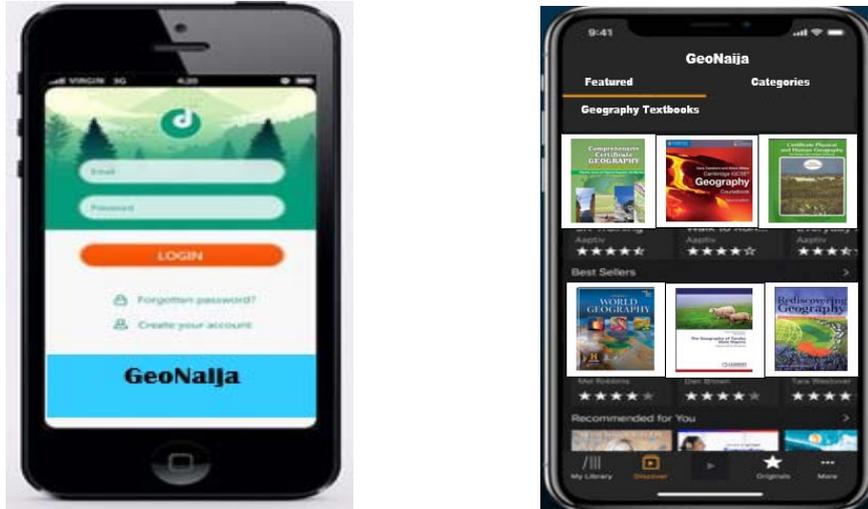


Fig. 3. Login and Geography Education Interfaces



Fig. 4. Student Support and Geography Content Interfaces

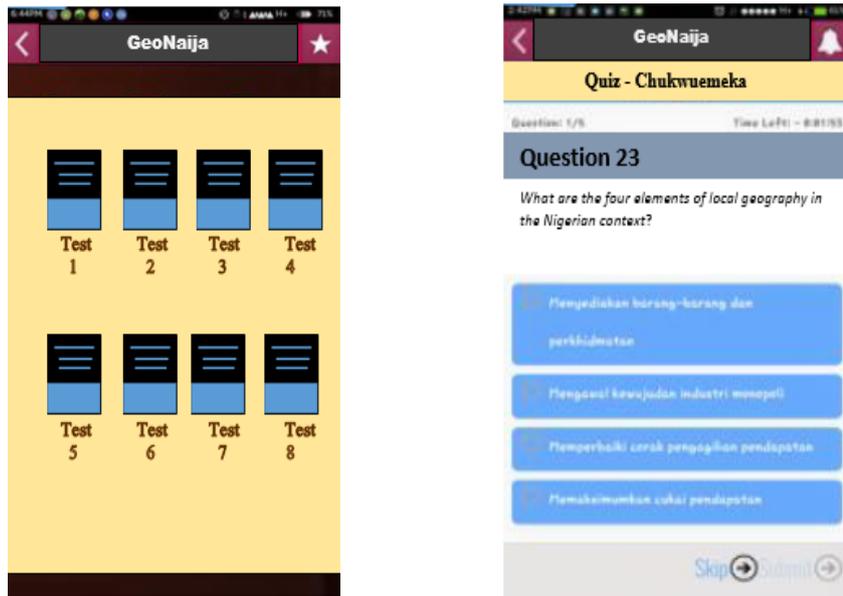


Fig. 5. Test and Electronic Quiz Interfaces



Fig. 6. Tutorial and Electronic Documents Interfaces

5.2 Result of the Analyses on Presentation, Visual, Navigation and Accessibility Design

Basically, the participants for the pilot study involved a total of 90 students offering geography in the above mentioned schools. All these students used devices such as mobile phones and tablets. On the gender,

we got 40 female and 50 male students from Queen of the Rosary College and Christ the King College respectively. The age range of the participants at the time of the study was between 13 to 20 years. The classes involved are senior secondary one (SS1) to senior secondary three (SS3). On the data collection, we distributed 120 questionnaires to the students through their Geography teachers; the extra number was to ensure that the teachers have surplus that would enable them eliminate invalid responses. It took almost two weeks (July 1st – July 15th, 2019) to complete the filling and collection of the questionnaires. Finally, we collected, selected 90 sound ones and analysed them. To reduce ambiguity and to ensure that the secondary school students understand the questionnaire, we designed the survey instrument (questionnaire) to have only two points (agree and disagree). The rationale behind choosing a simple scale is because the participants are teenagers, more so, they may get confused if the scale is increased to four or five. The survey instrument comprises of two major sections, the first of which contains questions on demographic factors, followed by 20 questions concerning several GeoNaija's feature descriptions. After using the mobile application, they were instructed to respond to the questionnaires regarding its feature descriptions i.e. presentation, visual, navigation and accessibility design. We presented (in the following tables) the simple percentages of the participants that agreed with the stated feature description of GeoNaija.

Table 1 contains the result obtained for presentation design analyses. When assessing the judgements of the students on good-looking design for the screen and seamless transition between interfaces; the table shows that the students chose "Agree" with a sizeable rate of 83.3% and 76.6% respectively. On the user-friendly nature of the app and the organized structure of the app content, 82.2% and 85.5% respectively, agreed. 86.6% agreed that the main menu is easy to use for the learning geography. These results depicts that there is a general acceptance of GeoNaija's presentation elements. It became obvious that owing to the easily assessable nature of the app, the students enjoyed using it; the intrigue and excitement on their faces says it all. This in line with Wong, et al. [27] recommendations on using beautiful visuals to attract users.

Table 1. Result of the presentation design analysis

No.	Feature description	Choice (Agree)	%
1.	Captivating screen design	75	83.3
2.	Organized content structure	77	85.5
3.	Seamless transition between interfaces	69	76.6
4.	GeoNaija is user friendly	74	82.2
5.	Easy to use main menu	78	86.6
Total Average		75	82.8

Table 2 contains the result obtained for visual analyses. By evaluating the opinions of the visual effects of the app design, it was discovered that the 91.1% and 87.7% of the survey participants agreed on the user-friendly nature of the app and the use of suitable colours for the app design respectively. Additionally, 87%, 92% and 93% of the population agreed that the icons can be assessed easily, the app has an organized composition and a suitable graphics respectively. This in line with the recommendations of Salemi & Walstad [28], on how using both visual and verbal formats of design can aid faster learning of new conceptions.

Table 2. Result of the Visual Design Analysis

No.	Feature description	Choice (Agree)	%
1.	Interface display is user-friendly	82	91.1
2.	Suitable colours are used	79	87.7
3.	The icons can be accessed easily	78	86.6
4.	Organized app composition	83	92.2
5.	Suitable graphics	84	93.3
Total Average		81	90.2

Table 3 contains the result obtained for navigation analyses. 88% and 99% of the participants agreed that users can choose icons easily and students can determine their pace learning pace respectively. 89% confirm that the app can aid the learning of geography while all of the participants agreed that entering and exiting the application is not difficult. Additionally, 94% affirmed that the application has an interface layout that emphasizes categorical sort pattern

Table 3. Result of the Navigation Design Analysis

No.	Feature description	Choice (Agree)	%
1.	Can choose any icon easily	79	87.7
2.	Students can determine their pace during learning	89	98.8
3.	The app contents can aid learning	80	88.8
4.	App entry and exit is easy	90	100
5.	Categorical sorting of interface layout	85	94.4
Total Average		85%	93.9

Table 4 contains the result obtained for navigation analyses. Here, while 78% affirmed that users have access to the education menu, 76% equally confirmed that installation of the app is easy. 77% agreed that menu icons are functional. 80% and 83% of the respondents confirm that the app allows the acquisition of information and assists all-time usage, respectively.

Table 4. Result of the Accessibility Design Analysis

No.	Feature description	Choice (Agree)	%
1.	Fast access to the education menu	70	77.7
2.	GeoNaija installation is easy	68	75.5
3.	Functional menu icons	69	76.6
4.	App allows getting more information	72	80.0
5.	App can be explored at any time	75	83.3
Total Average		71	78.6

6. Conclusion and Future Directions

In this study we displayed the possibility of ending the challenges associated with teaching and learning Geography through the design and implementation of a mobile application called GeoNaija. The ADDIE framework was adapted in such a manner that an interesting and captivating instructional tool was developed.

Tests were performed using the developed prototypes. Additionally, questionnaires that elicited students' responses on some attributes of the application (such as presentation, visual, navigation and accessibility design analysis) were also used to affirm that the newly developed mobile application will change the perspectives of the students and fill the existent gap between the traditional and other unconventional forms of teaching and learning Geography in secondary schools in Nigeria. Specifically, on presentation design analysis, majority of the students agreed that the app has a delightful screen, has an organized structure, allows smooth movement between screens and the menu/submenus can be easily used, with a total average of 82.8%. On visual design, a total average of 90% agreed that GeoNaija's interface was designed using suitable colors, has appropriate graphics, and due to a well-structured menu/submenu composition allows the icons to be accessed easily and quickly. On navigation design analysis, a total average of 93.9% affirm that the users feel in control when using GeoNaija because the interface layout is organized categorically, and they can

choose icons easily. On the accessibility design analysis, an average of 79% affirmed that when using GeoNaija, the education menu can be accessed easily and its installation is without any form of hitches. They also confirmed that the application has functional menu icons, allows getting additional information and can be explored at any and anywhere.

From the results, one can deduce that the application would encourage the students to learn more about geography, thereby potentially enhancing their exam scores. In view of the geography books integrated into the application, the student would benefit from efficient education, and ensuring faster and more growth. Additionally, the app encourages learning in a collaborative IT-assisted manner. Of course, GeoNaija introduces a new approach in learning subject in Nigerian Schools. This is traceable to the fact that it strengthens the connection between the students and their teachers in as much as it emphasizes a personalized form of learning that allows the learner determine pace and content. More so, the use of the app provides complimentary support for the learner. The visual devices as well as the inclusions of geography-related games implies that the app would reduce any form complexity and oblige a wider appeal for secondary school students. This a factor that hasn't been achieved/altered using the conventional teaching and learning methods [1]. Most importantly, with the integration of map works, charts of the Nigerian landscape and local geography, application fulfills the emphasis of teaching and learning Geography as identified by Adewale [2].

In future, we would deploy the mobile application on Apple store so that any student in the country can download GeoNaija for self-learning and other purposes. Note that for use of GeoNaija in other climes suffering similar learning difficulties, we advocate the inclusion of a language translator as well as the addition of the students' parents in the loop of communication.

Acknowledgements

First we acknowledge and thank the experts that lent their expertise during the alpha tests. Additionally, we thank senior secondary students of Christ the King College, Onitsha, Anambra State; their patience during the pilot study greatly encouraged us. Finally, we thank the anonymous reviewers who took time out of their busy schedules to read and correct this work.

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How to cite this paper: ChukwuNonso Nwokoye, Ikechukwu Umeh, Njideka Mbeledogu," GeoNaija: Enhancing the Teaching and Learning of Geography through Mobile Applications ", International Journal of Education and Management Engineering(IJEME), Vol.9, No.6, pp.11-24, 2019.DOI: 10.5815/ijeme.2019.06.02