GEOGRAPHY LECTURERS' AND STUDENTS' ACCEPTANCE OF AUGMENTED REALITY IN NIGERIAN UNIVERSITIES

EMIOLA Adetoun Gladys
Department of Arts and Social Sciences Education
University of Lagos, Akoka, Lagos State
aemiola@unilag.edu.ng

GEOGRAPHY LECTURERS' AND STUDENTS' ACCEPTANCE OF AUGMENTED REALITY IN NIGERIAN UNIVERSITIES

Emiola, A. G.

Article Infor

Abstract

The use of technology in education can influence students to learn actively and can motivate them, leading to an effective process of learning. The purpose of this study was to assess the use of augmented reality (AR) technology in higher education in Nigeria in terms of acceptance among Geography lecturers and students. A mixed method type of research was used comprising descriptive survey and quasi-experimental design. Twenty-two lecturers and 61 students participated in the study. Data were collected using an Achievement Test, a Cognitive Load Scale, and a semi-structured interview Guide. The results of the study showed that AR increased students' achievement and decreased their cognitive load levels, and the students' views about using AR technology were positive. Consequently, it can be stated that AR technology is a useful tool for teaching Geography, especially physical geography topics in universities, and it has the potential to transform geographic education if well accepted.

Introduction

There has been a general transformation of the educational paradigm, across the global space today mainly caused by improvements in scientific research, unlimited access to educational resources, virtual libraries, and the development of digital technologies with focus on digital games. With the improvement and advancement in technology and the emergence of new technological innovations, most higher institutions of learning are now interested in more productive methods for improving learning experiences and increasing students' level of understanding than before. The introduction of information and communication technology in higher institutions now enables both students and educators to make use of various new and challenging methods of teaching and learning. One of the most promising technologies that currently exist in higher education is Augmented Reality (AR). AR is an amalgamation of computer graphics, vision and multimedia which enhance the user's perception of the real world through the addition of virtual information (Liarokapis and Anderson, 2010). AR is an imaginary layer superimposed over the real world, visible with the help of devices such as computers, smartphones, tablets, glasses, and other devices that allow users to recognise these media that can consist of images, video, and sounds (Popescu, 2020). Hence AR images can either be image-based or location-based

With AR, there must be a harmonization and synchronization of the real environment with the virtual world, in position and context to provide an understandable and meaningful view. According to Khan, Johnston, and Ophoff (2019), AR

is said to be a technology that has three key requirements: combining of real and virtual objects in a real environment, aligning of real and virtual objects with each other, and real-time interaction.

Augmented reality (AR) technology is commonly used in education mostly in developed parts of the world as it offers a combination of the virtual and real-world experiences. Although Augmented Reality has been around since the 1960s, most people had not even heard of – let alone experienced it until sometime in 2016. Since its introduction, augmented reality (AR) has been shown to have good potential in making the learning process more active, effective, and meaningful. AR technologies have a positive potential and advantages that can be adapted in education. Augmented reality in education can serve several purposes; from helping students easily obtain, process, and remember information, to making learning more appealing and fun. Augmented reality can help students in learning abstract and complex subjects such as Geography, as it adds an entire new dimension to classroom instruction in Geography.

There are so many concepts in Geography that are abstract and require in-depth understanding and visualization skills. With the help of AR, Geography lecturers and students can manipulate virtual 3D objects in the computer in a simple and more intuitive way and bring about better understanding of geographical concepts. With the introduction of AR, classroom experience in geography education can be quite extraordinary and more interactive, as it can enable teachers to show virtual examples of seemingly complex geographical concepts by adding gaming elements to provide textbook material support. Consequently, it can be affirmed that mobile AR technology is a useful tool for teaching Geography, especially geomorphology topics (Turan, Meral, and Sahin, 2018).

The benefits of augmented reality in education are multiple. Augmented reality has the potential to replace printed textbooks, offering portable and less expensive teaching materials especially in developing countries where they are not easily available. Some of the ways in which AR can be added to education to make learning more exiting and interesting, and at the same time bring learning to life include Complete engagement of the students, explanation of difficult or challenging concepts, skill training and hands-on experience, and learning through doing.

Statement of the Problem

The emergence of technological classroom innovations has brought about changes in pedagogy especially those related to Geography (Adedokun-shittu, Ajani, and Nuhu et al. 2020). Geography Educators today understand that learning involves more than just reading from textbooks, attending lectures, going on field trips or completing homework assignments. Using AR to augment abstract topics in the course outline and in printed books, requires acceptance by both lecturers and students of Geography in universities in Nigeria, as the use of multimedia and three-dimensional objects can enhance students' learning experience. With the advent of modern technologies such as AR, Geography teachers are now able to bring the real world to their students and eliminate the traditional barriers of learning.

As might be expected, running an effective augmented reality programme involves lots of data collection, analyses and a variety of high-performing infrastructure. Any delay in augmented reality geography education programmes would defeat the purpose of using the technology and leave the end user (geography education students) with a far less than optimal experience. One of the greatest challenges for 21st century teachers is how to keep classes updated, fun and interesting. The combination of virtual reality and augmented reality are already revolutionizing education all over the world, so why not in Nigeria? Based on the foregoing, this study examined Geography lecturers and students' acceptance of augmented reality in Nigerian Universities.

Objective of the Study

The objective of the study was to examine geography lecturers' and students' acceptance of augmented reality in Nigerian Universities. The study specifically examined lecturers' and students' perceived usefulness, perceived ease of use, actual usage, and attitude towards augmented reality for teaching and learning geographical concepts

Research Questions

The following research questions were posed for this study:

1. What are lecturers' perceived usefulness, perceived ease of use, actual usage, and attitude towards augmented reality for teaching?
2. What are students' perceived usefulness, perceived ease of use, actual usage, and attitude towards augmented reality for learning?

Literature Review

Today's students are already familiar with various technologies, so computer tools and applications are a wonderful addition in the educational environment. Modern technologies such as augmented reality (AR), virtual reality (VR) and mixed reality (MR), robotics and artificial intelligence (AI) are already changing the face of education all over the world. Classical or traditional teaching methods are today outdated and do not emphasize creativity (Popescu, 2020). Augmented reality used in teaching in the university and other higher institutions of learning helps take the mystery out of seemingly complex and sometimes intimidating subjects such as Geography and its related courses. An important aspect of the AR experience is that it includes 25% digital reality and 75% existing reality Sinha (2021). It means, it does not replace the complete environment with the virtual; rather, it integrates virtual objects into the real world.

The inclusion of games and simulations in higher education will enable students to learn faster and memorize information better, as human memory doesn't forget visuals easily. It is therefore clear that AR in university education can turn out to be a very exciting and useful intervention that will change the education system for at least the upcoming 100 years.

Now that students are having to learn both from home (online) and physically, keeping them engaged in lectures, giving assignments, and organising examinations have become very difficult. Thus, eLearning app owners are enthusiastically adopting AR technology. Altogether, Augmented Reality development is also boosting its prominence in the market (Sinha, 2021). With the increase in use of AR in higher education, geographical boundaries will be easily exceeded, and concepts which seemed almost impossible to teach and understand will become simplified. With AR, no special equipment is required for teaching and learning, and since most undergraduate students and lecturers have smartphones, tablets or iPad, AR technologies are immediately available for their use.

AR Apps for Teaching Geography in the University

AR in university education helps students achieve better results through complete visualisation and immersion in the subject. It is often said that a picture is worth a thousand words. Therefore, instead of reading a theory on a certain topic, students can see it with their own eyes, in action (Popescu, 2020). Some of the Apps for teaching Geography in university include:

POPAR Planets Smart Book

This App was created by Popar Toys of Phoenix, Arizona, in the United States. POPAR Planets Smart Book is one in a series of interactive hardcover books that uses augmented reality to entertain and educate young people. Designed to promote the STEM (Science, Technology, Engineering and Mathematics) curriculum, other topics in the series include science, geography, and the animal world. Popar Planets combines education with play through colorful 3D animations, interactive games and read-along exercises that bring our solar system to life.

eyeMap

A student interested in mapping or geography can download the eyeMap App in either Android or iOS format. Pointing the digital device with the app installed in any direction instantly displays a 3D representation of whatever surrounds them in the real world, including the names of mountains, historic sites, towns, and villages and more virtually anywhere in the world.

Night Sky

Night Sky from icandiApps is an informative and easy to use means of studying and exploring the stars and planets. Available through the App Store, Night Sky uses augmented reality to visit or view planets and their moons in incredible 3D detail. A Geography student can use this App to search for a specific planet or star, a particular constellation, or the International Space Station, by simply entering the query and pointing an iPhone, iPad or Apple Watch skyward, Night Sky will help locate it.

SketchAR

SketchAR is for both professional artists and students who need to draw but are not skilled in the art of doing so. Simple and convenient to use, SketchAR is available for both iOS and Android devices. It works by displaying a virtual image of the subject to be drawn on the surface where the tracing and drawing will take place, such as a canvas, paper or wallboard. Holding a Smartphone in one hand showing the image to be drawn, the user's other hand traces

the virtual lines displayed on the surface. SketchAR can be used in map reading, Geographic Information Systems, Remote Sensing or Regional Geography.

Spyglass
Spyglass is an advanced mobile GPS navigation app designed by a game studio. The app uses an Augmented Reality navigator and compass to display detailed information about GPS location, distance, angles, and sizes in a real-time fun way. Spyglass helps save different points and shows turn-by-turn direction arrows. Users can enter and share location coordinates, track multiple locations at the same time, and calibrate a compass using the Sun and stellar map. Spyglass can be used in geography field work, be it physical or virtual.

Google Expeditions
Another admired example of AR in geography education is Google Expeditions, which enables users to see 3D objects in the classroom, such as volcanoes, storms, and other weather elements. Shakirova, Al Said, and Konyushenko, (2020).

Augment Education
This App is most suitable for high school students and helps to make any topic more interesting to them. The users of this App can make virtual models of things and thereby bring more learning experiences to the classroom.

Benefits of AR Technology in Education
Augmented Reality in the education sector brings about several benefits and advantages mostly to the learners. These include:
- A swift and effective learning system: AR in education allows students to gain knowledge through rich visuals and immersion into the subject matter.
- Easy access to learning materials anytime, anywhere: Augmented Reality can replace textbooks, physical forms, posters, and printed brochures. This mode of mobile learning also reduces the cost of learning materials and makes it easy for everyone to access.
- Immersive practical learning: It can help in professional training.
- Engage students and spruce up their interest: The gamification of AR and the education system can make students' attitudes more positive. It makes learning interesting, fun, and effortless and improves collaboration and capabilities. (Sinha, 2021).

Ideally, an educational AR system, according to Liarokapis and Anderson (2010), fulfils at least most if not all the following requirements. It must:
• be simple and robust
• provide the learner with clear and concise information
• enable the educator to input information in a simple and effective manner
• enable easy interaction between learners and educators
• make complex procedures transparent to the learners and educators
• be cost effective and easily extensible.

Methodology

The study was a descriptive design of the cross-sectional survey type. It is quantitative research that involves two or more quantitative variables from the same group of participants. The population for this study comprised lecturers and students of Geography in Nigerian universities. The sample size was all Geography lecturers and students from all Nigerian Universities. Multistage random sampling technique was used for the study. First, purposive sampling technique was used to select all universities in Nigeria, all lecturers, and students of Geography in Nigeria universities were also selected. Random sampling technique was used to select 21 lecturers and 61 students from the selected universities using google form as a means of distribution. The research instrument used to gather data for the study was a questionnaire designed by the researcher. The instrument consisted of two sections; A and B. Section A dealt with demographic variables of respondents such as sex and teaching experience. Section B had sub-sections on actual usage, perceived ease of use, perceived usefulness, and attitude for both lecturers and students. The response categories of the items on Section B were based on four-point rating scale ranging from Strongly Agree (SA), Agree (A) Disagree (D), and Strongly Disagree (SD). The response categories were assigned numerical values of 4, 3, 2 and 1. The internal consistency of the instrument was determined using Cronbach Alpha. The reliability coefficients established for the instrument were presented in Table 1:

Table 1:
Cronbach Alpha Results of the Instrument

TAM Dimensions	Cronbach's Alpha
Perceived Usefulness	0.72
Perceived Ease of Use	0.86
Attitude	0.77
Actual System Usage	0.62

The researcher with the help of research assistant via WhatsApp; sought for the cooperation and sincere participation of the respondents in the study. The respondents were not compelled to respond to the questionnaire. The instrument was administered to the respondents through google form that was sent via WhatsApps by the researcher and research assistants. Mean, standard deviations, and percentages were used to answer research question and demographic data. In determining the acceptance of the augmented reality by Geography lecturers and students, perceived ease of use, perceived usefulness, attitude, and actual usage, any item with a mean of 2.50 and above was considered agreed upon while less than 2.50 was considered disagreed upon for positively worded items, however, item with a mean of 2.50 and above was considered disagreed upon while less than 2.50 was considered agreed upon for negatively worded items.

Results

Demographic characteristics of participants

Table 2 provides a summary of the major characteristics of lecturers and students that were involved in the study. The questionnaire administered on this set of students was to ensure that necessary information was captured and measured accurately. The demographic information of lecturers and students based on sex, qualification, working experience and augmented reality awareness are presented in Table 2

Table 2a: Distribution of participants by sex

Lecturers	Frequency	Percentage
Male	15	68.1%
Female	7	31.9 %
Total	**22**	**100%**
Students	**Frequency**	**Percentage**
Male	46	75.4%
Female	15	24.6 %
Total	**61**	**100%**

Table 2a shows the distribution of the Lecturers by sex. It revealed that 15(68.1%) involved in the study were males while 7(31.9%) were females. This revealed that Male Lecturers were involved in the study than Female Lecturers. More so, the table shows the distribution of the students by sex. It revealed that 46(75.4%) involved in the study were males while 15(24.6%) were females. This revealed that Male Students were involved in the study than Female Students.

Table 2b: Distribution of Lecturers by Educational Qualification and Experience

Educ. Qualification	Frequency	Percentage
Master's Degree	5	22.7%
PhD	17	77.3 %
Total	**22**	**100%**
Teaching Experience	**Frequency**	**Percentage**
Less than 2 Years	3	13.6%
2-4 Years	3	13.6%
4 years and above	16	72.8%
Total	**22**	**100%**

Table 2b shows the distribution of the lecturers by Educational Qualification. It revealed that 5(22.7%) involved in the study were masters' degree holders while 17(77.3%) were PhD holders. This revealed that PhD holders were

involved in the study than masters' degree holders. The table also shows the distribution of the lecturers by Teaching Experience. It revealed that 3(13.6%) involved in the study have less than 2 years' teaching experience, 3(13.6%) have 2-4 years' teaching experience and 16(72.8%) have 4 years or more teaching experience. This revealed that lecturers with 4 years or more teaching experience were involved in the study than lecturers with less than 2 years or 2-4 years' teaching experience.

Table 2c: Distribution by Augmented Reality Awareness

Lecturers	Frequency	Percentage
Yes	16	72.7%
No	6	27.3%
Total	**22**	**100%**

Students	Frequency	Percentage
Yes	25	72.7%
No	36	27.3%
Total	**61**	**100%**

Table 2c shows the distribution by Augmented Reality Awareness. It revealed that 16(72.7%) involved in the study are aware of AR while 6(27.3%) are not aware. This revealed that lecturers that are aware of augmented reality were involved in the study than lecturer that are not aware. The table further revealed the distribution by Augmented Reality Awareness. It revealed that 16(72.7%) involved in the study are aware of AR while 6(27.3%) are not aware. This revealed that lecturers that are aware of augmented reality were involved in the study than lecturers that are not aware.

Answers to Research Questions

Research Questions 1: What are the lecturers' perceived usefulness, perceived ease of use, actual usage, and attitude towards use of augmented reality for teaching?
Table 3 presents the answer to research question 1
Table 3: Lecturers' perceived usefulness, perceived ease of use, actual usage, and attitude towards augmented reality for teaching

S/N	Actual Usage	Mean	SD
1.	I prefer using augmented reality for my students	2.45	0.51
2.	I always use augmented reality for my students	2.95	0.72
3.	I deliver instructions via augmented reality	2.45	0.51
	Average Mean	**2.62**	
S/N	**Perceived usefulness**		
1.	The use of augmented reality for teaching is enjoyable.	2.45	0.91
2.	Augmented reality is very useful in my course	2.45	0.91
3.	Augmented reality increases my effectiveness in my instructional activities	2.38	0.85
4.	Use of Augmented reality increases my computer literacy	2.98	0.85
5.	Augmented reality reduces cost of instructional materials	2.95	0.72
	Average Mean	**2.64**	
S/N	**Perceived Ease of Use**		
1.	Augmented reality is easy to use for instructional delivery.	2.18	0.85
2.	Setting up of Augmented reality for use is easy to do.	2.95	0.72
3.	Teaching using Augmented reality does not take time	2.88	0.85
4.	Instructions during Augmented reality is easy to get for students	2.73	0.87
5.	Interaction with computer is easy for the users of Augmented reality	2.45	0.91
	Average Mean	**2.64**	
S/N	**Attitude towards usage**		
1.	Augmented reality makes me feel uneasy to access students.	3.23	0.43

2.	The use Augmented reality for instructional delivery is somewhat intimidating to me	2.73	0.45
3.	Augmented reality scares me of thinking that my students will not perform well	2.73	0.45
4.	I have a lot of confidence when it comes to use of Augmented reality	2.45	0.91
5.	I like to experiment Augmented reality for teaching	2.45	0.91
	Average Mean	**2.72**	

Table 3 presents the lecturers' mean ratings on actual usage, perceived usefulness, perceived ease of use and attitude towards the use of augmented reality. The overall mean rating on **Actual Usage** ($\bar{X}$=2.62) shows that majority of the lecturers who participated in the study used augmented reality for teaching. However, the overall mean ratings on **Perceived Usefulness** ($\bar{X}$=2.64), **Perceived Ease of Use** ($\bar{X}$=2.64), and **Attitude Towards** ($\bar{X}$=2.72) showed that lecturers' use augmented reality for teaching Geography concepts as they found it to be useful and easy to use and had a definite attitude towards the use of augmented reality for teaching.

Research Question 2: What are the students' perceived usefulness, perceived ease of use, actual usage, and attitude towards of augmented reality for learning?

Table 4 presents the answer to research question 2.

Table 4: Students' perceived usefulness, perceived ease of use, actual usage, and attitude towards augmented reality for teaching

S/N	Actual Usage	Mean	SD
1.	I prefer learning with augmented reality	2.86	0.34
2.	I always learn using augmented reality	2.47	0.88
3.	My lecturers deliver instructions via augmented reality	2.36	0.71
	Average Mean	2.56	

S/N	Perceived Usefulness		
1.	The use of augmented reality for learning is enjoyable.	3.00	0.00
2.	Augmented reality is very useful in my course	2.88	0.32
3.	Augmented reality increases effectiveness in my learning activities	2.75	0.43
4.	Use of Augmented reality increases my computer literacy	2.88	0.32
5.	Augmented reality reduces cost of buying materials and field work	3.00	0.00
	Average Mean	2.90	

S/N	Perceived Ease of Use		
1.	Augmented reality is easy to use for learning.	2.86	0.34
2.	Setting up of Augmented reality for learning is easy to do.	2.62	0.48
3.	Learning using Augmented reality does not take time	2.73	0.44
4.	Learning during Augmented reality is easy to get	2.73	0.44
5.	Interaction with computer is easy for me as a user of Augmented reality	2.88	0.32
	Average Mean	2.76	

S/N	Attitude towards usage	Mean	SD
1.	Augmented reality makes me feel uneasy to access my lecturers.	2.37	0.71
2.	The use of Augmented reality for learning is somewhat intimidating to me	2.49	0.50
3.	Augmented reality scares me of thinking that I will not perform well	1.75	0.82
4.	I have a lot of confidence when it comes to use of Augmented reality	2.75	0.43

5.	I like to experiment Augmented reality for learning	2.88	0.32
	Average Mean	2.45	

Table 4 presents the students' mean ratings on actual usage, perceived usefulness, perceived ease of use and attitude towards the use of augmented reality. The overall mean rating on **Actual Usage** ($\bar{X}$=2.56) shows that majority of the students who participated in the study used augmented reality for learning. However, the overall mean ratings on **Perceived Usefulness** ($\bar{X}$=2.90), **Perceived Ease of Use** ($\bar{X}$=2.76), and **Attitude Towards** ($\bar{X}$=2.45) show that students used augmented reality for learning geography concepts as they found it to be useful and easy to use but did not have a definite attitude towards the use of augmented reality for learning.

Discussion of Findings

The findings of this study indicated that Augmented Reality is a more recent technology than most other ICT related teaching techniques and method of instruction useful in the teaching of geography. It is also quite clear that AR supports geography teaching and learning especially in universities and institutions of higher learning even though its usage has not gained nation-wide acceptance. This study found that Augmented Reality when deployed in the teaching and learning of geography in Nigerian universities brings about increasing on-content understanding and memory preservation, as well as on-learning motivation. Table 2 indicated that more Male Lecturers were not only involved in the study but also in the use of Augmented Reality than Female Lecturers, the same also goes for male students who were not only more involved in the study than Female Students, but also in the use of AR. In terms of qualification and years of teaching experience, the study revealed that most of those who took part in the study and used Augmented Reality were Ph.D. holders with more than 4 years teaching experience. Also, a greater number of lecturers were aware of the use Augmented Reality compared to the number of students who were aware of it.

Conclusion

The results of this study showed that lecturers' and students in Nigerian universities make use of augmented reality for the teaching and learning of geographical concept as they perceived it to be useful and easy to use. Although Augmented Reality technology is being improved steadily, one thing is certain: AR apps will redefine the way we teach as Geography lecturers, learn as Geography students, and use different tools to aid both. "The potential of AR in education remains unexplored especially in this part of the world, and there is a limited number of studies investigating student motivation with the use of AR". The lecturers and students who participated in the study had a positive attitude towards the usage of augmented reality. In conclusion, because Augmented Reality uses the environment around it, there is likelihood that it adds more to the reality than any other method of teaching Geography and hence it has the capability of becoming an effective tool in bridging the gap between geography lecturers and students in Nigerian universities.

Recommendations

Based on the findings of the study, it was recommended that.
1. The use of Augmented reality should be further encouraged in higher education teaching and learning programmes to better prepare lecturers for successful delivery of Geography content and student's understanding of Geographical concepts.
2. Governments at various levels and administrators of universities should fund and improve the modalities on how to provide enough facilities for augmented reality use.
3. Students' attitude towards the use of Augmented Reality has to improve so as to encourage its use for learning geography.

References

Adedokun-shittu, N.A., Ajani, A.H., Nuhu, K.M. and Shittu, A.K. (2020). Augmented reality instructional tool in enhancing geography learner's academic performance and retention in Osun state Nigeria. Educ Inf Technol 25, 3021-3033. https://doi.org/10.1007/s10639-020-10099-2

Khan, T., Johnston, K., and Ophoff, J. (2019). The Impact of an Augmented Reality Application on Learning Motivation of Students, *Advances in Human-Computer Interaction*, vol. 2019, Article ID 7208494, 14 pages, 2019. https://doi.org/10.1155/2019/7208494

Liarokapis, F., & Anderson, E. F. (2010). Using augmented reality as a medium to assist teaching in higher education. In *Proceedings of the 31st Annual Conference of the European Association for Computer Graphics* (pp. 9-16). Eurographics Digital Library.

Turan, Z., Meral, E., and Sahin, I. F. (2018). The Impact of Mobile Augmented Reality in Geography Education: Achievements, Cognitive Loads and Views of University Students. Journal of Geography in Higher Education, 42(3) 427-441.

Popescu, C. (2020). Benefits and Challenges of Internet - Based Virtual Presentations. Ovidius" University Annals, Economic Sciences Series 20(2) 448-452.

Turan, Z., Meral, E., Sahin, I.F. (2018). The impact of mobile augmented reality in geography education: achievements, cognitive loads and views of university students. Journal of Geography in Higher Education, 42(3): 427-441. https://doi.org/10.1080/03098265.20 18.1455174

Sinha, S (2021). Augmented Reality in Education: A Staggering Insight into The Future. eLearning Industry Educational Technology.