UNDERGERADUATES' AWARENESS OF AND READINESS TO ADOPT AUGMENTED REALITY APPLICATIONS FOR LEARNING IN UNIVERSITY OF ILORIN, ILORIN, NIGERIA

By

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Absract, *Augmented Reality (AR) is one of the emerging technologies which allow the co-existing of physical and virtual objects and support real time interaction in the classroom. In spite of its potential, its has not been fully explored for instructional delivery in the classroom. Augmented reality consists of merging live images with virtual layers of information. Hence, this study assessed undergraduates' awareness and readiness to adopt augmented reality applications for learning in University of Ilorin, Nigeria. The study adopted descriptive research design of the survey type. A researcher-designed questionnaire was used to elicit responses from one hundred and sixty (160) undergraduates. Answers were provided to two research questions and one research hypotheses were tested at 0.05 level of significance. The findings of this study revealed that many undergraduates claimed that they have heard of augmented reality and its applications for learning and undergraduates are ready to adopt augmented reality applications for learning. The study concluded that undergraduates' readiness to adopt augmented reality applications for learning is high and so is their awareness of augmented reality applications for learning. Classroom setting of one-on-one teaching to virtual learning. Thus, the study recommended that students should be encouraged to utilize more augmented reality applications thereby giving them more awareness of its wide range of applications.*

Keywords: *Gender, Augmented Reality, Awareness and Readiness*

I. INTRODUCTION

Information and Communication Technology (ICT) as a communication equipment and software required to organize, study, strategize, and provide support to manage information systems dependent on computer software as well as hardware. These technologies can be utilized to offer anticipated results with little error or flawless, steady, reliable and interactivity in the learning process (Alasela, Ogunlade, Obielodan, & Nasiru, 2017). Ajani (2018) averred that many great minds across the world believe that the 18th century way of educating is broken and in this digital age, mobile computing technologies and visualization technologies are believed to be a significant creative breakthrough that will help the students learn better and teachers across the world do their jobs better. Among many of these mobile computing technologies and

visualization technologies emerged Augmented Reality (AR).

Augmented reality (AR) is a smart technological tool that has been considered to be a mid-term technology in terms of education (Spector & Denton, 2016). AR is a type of technology that harmonizes in real time, and with the collaboration of the user, digital information with physical information through different technological supports, being those which are the most common mobile devices such as smartphones and tablets (Cabero, Garcia, 2016; Margaret & Pratt, 2017). AR shows significant benefit to support learning such as supporting visualization, conceptual learning, spatial learning, kinesthetic learning, and individual engagement and so on. Besides that, few comparison studies also revealed that AR offers learning environment which are similar to natural collaborative learning environment. Augmented reality applications are embedded into mobile devices and tablets to provide interactive experiences to the user. These applications turn print materials into more interactive experiences for learners in order to encourage, engage, and motivate them. Augmented Reality enable students' to manipulate virtual objects or representations of real objects that would otherwise be impossible to hold as well as learn a task or skill (Kipper, & Rampolla, 2013).

Augmented Reality has the ability to overlay images, text, video, and audio components into existing images or space. Augmented Reality (AR) is one of the techno-logies which allow the co-existing of physical and virtual objects and support real time interaction. Augmented reality consists of merging live images with virtual layers of information (Vogt & Shingles, 2013). These layers of information consist of three-dimensional (3-D) models that include content, images, sounds, and videos. The principle of AR, in which virtual content is added on top of a real environment, is not to be confused with Virtual Reality, where the environment is mostly or totally virtual. The two types of AR differ in the way the virtual layer is associated with a given environment. The two different types of augmented reality applications are location-based AR and image-based AR. Vogt & Shingles (2013) described the differences between the two forms of AR. Location-based AR applications rely on the spatial position and orientation of the device to select and display location-relevant information. For image-based AR, applications use image recognition algorithms to trigger the display of relevant content over a recognized physical pattern.

AR applications are at a comfortable level of technology integration where they are used fairly often by teachers and students. Some schools incorporate AR applications in project-based activities. Students can learn with mobile and tablet devices by using AR applications. Augmented reality applications are able to engage learners by bringing a new dimension to learning. Vogt & Shingles (2013) stated, AR is an emerging concept, but it is now transitioning to a more firmly established technology. Furthermore, educators need to adopt new technological trends in their instruction. These media have changed the standards and the traditional practices in education. The involvement of educators is important to facilitate the development of favorable AR applications for teaching, which increases the potential for AR to be

incorporated in education (Wei, Weng, Liu, & Wang 2015).

Awareness is the basic pre-requisite for the readiness to adopt educational applications for learning. Awareness of Augmented reality (AR) has gained much research attention in recent years as new possibilities and innovative applications for teaching and learning by educational researchers (Wu, Lee, Chang, Liang, & Jyh-Chong, 2013). AR is applied in different fields, including industry and military, training and education, travel and tourism, medicine and health care, and retail and marketing (Martínez, Skournetou, Hyppölä, Laukkanen, Heikkilä, 2014). AR brings new opportunities and channels for education, and can be helpful in addressing various students' difficulties with learning and understanding subjects such as chemistry, physics, and mathematics. The affordances of AR technology and portability could be used to coordinate study activities in which students communicate with each other and with their real environment (Cheng, & Tsai, 2013).

Once an individual encounters an innovation the readiness depends on the level of awareness. The adoption process begins as they become aware and interested in the innovation, gather more information, and possibly experiment with the innovation to determine if the effort to adopt it is reasonable in terms of time and other resources. One could argue that the adoption of AR into instruction in schools is very early in the adoption process and that those educators who are using it or advocating for its use fall into the Innovators or Early Adopters categories (Cavanagh, 2019).

Goswami and Dutta (2016) findings indicated that male students rather than females are inclined to be more interested in technology. A review of the findings of this study indicates that there are no statistically significant differences between males and females in regard to their awareness of the benefits of AR. Gender plays a significant role in determining the intention of accepting new technology, in the context of usage of Information and Communication Technology. Gender acts as an influencing factor in technology adoption as men are claimed to be more technologically adept compared to women (Goswami & Dutta, 2016).

Statement of the Problem
Augmented Reality is one of the most emerging technologies that can be used in teaching and learning. The main purpose of every learning and teaching process is to create meaningful learning experiences that can be used in real-life situations. In any educational setting, there are often limitations in the various resources available. This is often seen foremost in the traditional classroom. Due to the budget restraint or constraint on time, the means to teach students in a scenario that allow them to learn by doing can be a challenge. Classrooms can shift from the traditional learning style setting to one that is more lab and student-oriented. A study conducted with a virtual art class noted that students were allowed to freely explore a room that was set up with webcams and desktops encouraged more activity while the student perceived that they are motivated to learn (Siros 2013). Instead of receiving information via images and lectures, students can also have also have access to multimodal representations including text, image, video, audio and 3D models.

The work of Goswami and Dutta (2016); Amir, Aria and Jyria (2019) revealed that gender has a significant impact on the adoption of new technologies. There are significant differences in male and female perception of new technology use. Female students show more interest in new technology use and experimentation. Most of the researchers in the literature Investigated, examined, determined the awareness, adoption, and attitude towards the use of augmented reality applications for learning in a specific locality. None of the researches focused on undergraduates' awareness of and readiness to adopt augmented reality applications for learning in university of Ilorin, Ilorin. Also none of the researchers used the sample size used in this study. This is regarded as the gap to be filled in this study.

Research Questions

The following research questions were raised to guide this study.

1. What is undergraduates' awareness of augmented reality applications for learning?
2. What is undergraduates' readiness to adopt augmented reality applications for learning?
3. What is the influence of undergraduates' gender on the awareness of augmented reality applications for learning?
4. What is the influence of gender on undergraduates' readiness to adopt augmented reality applications for learning?

Research Hypothesis

The following hypothesis were formulated and answered based on the research questions

H_{01}: There is no significant difference between male and female students' awareness of augmented reality applications for learning.

H_{02}: There is no significant difference between male and female students' readiness to adopt augmented reality applications for learning.

II. METHODOLOGY

This study adopted descriptive research of the survey type. It had been considered appropriate because it involves systematic collection and analysis of knowledge collected from a large population that helps to explain the characteristics of population or event as they seem to support the phenomenon into account for this study without external manipulations by the researchers. The population for this study was undergraduates of University of Ilorin. Target population of the study consists of the students of Faculty of Physical Sciences in the Departments of Mathematics, Physics, Chemistry and Statistics. Simple random sampling technique was used to select students that participated in the study. This allows the respondents to have equal chance of being selected on the population. 160 students were randomly selected from Faculty of Physical Science.

Research Instruments
The instrument was a researcher-designed questionnaire titled Undergraduates' Awareness of and Readiness to adopt

Augmented Reality Applications for Learning in University of Ilorin, Ilorin. It was used in this research to gather information from the selected sample units for this study. The data collection instrument comprised of structured multiple choice questions. The questionnaire for this study consists of three section, A, B and C. Section A contained the demographic information of the respondents, Section B contained items to investigate the students Awareness of Augmented Reality Applications, the items in section B were rated on a response mode of Aware (AW) and Not Aware (NAW). Section C contained items to investigate students Readiness to adopt Augmented Reality Applications; the items in section C were rated on a response mode of Strongly Agree (SA), Agree (A), Strongly Disagree (SD) and Disagree (D).

Validity and Reliability of the Instrument

The instrument was validated for face and content validity by three lecturers in the Department of Educational Technology, University of Ilorin, Nigeria. Following the lecturers' validation reports, some items of the research instrument were corrected, adjusted and modified as directed to reinforce the validity. Reliability concerns the extent to which a measurement of a phenomenon provides a stable and consistent result. A pilot study was carried out in Kwara State University for the reliability of the research instrument. The research instrument was reliable at 0.84 for items on Awareness and 0.85 for items on readiness at 0.05 level of significance, using Cronbach Alpha SPSS statistical tool.

Procedure for Data Collection

Permission of the selected faculties was sought via letter of introduction from the Department of Educational Technology, University of Ilorin to seek permission from the acceptable authority within the sampled faculties to facilitate easy administration of the questionnaires. The researcher distributed copies of the questionnaire while the respondents got sufficient time to answer the questionnaire. After which, the researcher personally collected the answered questionnaire. Through the assistance of the statistical analyst, the researchers tabulated the data collected from the participants using Microsoft Excel and eventually process the data collected using SPSS (Statistical Package for Social Sciences). Ethical consideration was maintained through the period of data collection. The researcher ensured that respondents were not coerced to fill the questionnaire and respondents were allowed to participate voluntarily. Also, utmost confidentiality and secrecy of the respondents was maintained during the administration, collation, and report of research findings.

Data Analysis Techniques

The data collected were analyzed employing descriptive and inferential statistics. According to Bhat (2019), descriptive design may be a research design that aims to explain the participant or a phenomenon of the study. Moreover, it aims to answer the question which focuses on the demographic information of the study. This defines respondent characteristics, data trends, and comparison of groups validating existing conditions and duplicating research.

Table 1: Presentation of Demographic Information of the Respondents Based on Gender

Gender	Frequency	Percentage (%)
Male	106	66.25
Female	54	33.75
Total	**160**	**100**

Table 1, shows the demographic data of the 160 respondents, of which 106 (66.25%) were male while 54 (33.75%) were female respectively. The respondents were all students of the University of Ilorin.

Table 2: Distribution of University Students According to Department

Department	Frequency	Percentage (%)
Mathematics	28	17.5
Physics	59	36.88
Chemistry	40	25.00
Statistics	33	20.33
Total	**160**	**100**

Table 2, reveals the distribution of university students according to their department. Total number of 160 respondents participated in this study. It shows that 28 respondents with the percentage score (17.5%) of the total respondents are from Mathematics department, 59 respondents with the percentage score (36.88%) of the total respondents are from Physics department, 40 of the respondents with the percentage score (25%) are from Chemistry department and the remaining 33 respondents with the percentage score of (20.33%) are from the department of Statistics.

III. RESULTS

Research Question One: What is the undergraduates' awareness of augmented reality applications for learning in University of Ilorin?

Table 3: Mean of Undergraduate's Awareness of Augmented Reality Applications for Learning in University of Ilorin

S/N	Dispositions	Mean
1.	I have heard of Augmented reality applications	2.45
2.	I am aware that augmented reality combines real and virtual reality	2.57
3.	I am aware that augmented reality is interactive	2.90
4.	I am aware that augmented reality applications is in three dimensions	2.22
5.	I am aware of some of these applications such as Aurasma, Layar, Cospaces edu, Snapchat, AR maker, Shapes 3D, Pokemon GO, Elements 4D	2.14
6.	I am aware that the use of augmented reality can engage and encourage learners	2.38
7.	I am aware that augmented reality applications can motivate learners	2.45
8.	I am aware that augmented reality applications can be embedded into computers, smartphones and tablets	2.72
9.	Augmented reality applications can be applied in medicine, education, entertainment and so on	2.58
10.	I am aware that augmented reality applications can help students with special needs	2.41
	Grand Mean	**2.49**

Table 3, reveals the mean scores of items in the section B (Awareness of Augmented Reality Applications) of the questionnaire administered. Many undergraduates claimed that they have heard of augmented reality and its applications, this means that they have come in contact with it directly or indirectly in their everyday learning activities and this item has a mean score of 2.45. The second item which sought to know if undergraduates are aware that augmented reality combines real and virtual reality has a mean score of 2.57 implying that the response to it was positive. This was followed by item 3 which sought to know if undergraduates knows and are aware that augmented reality is interactive; this item has a mean score of 2.90 making it the highest responded to of all the items. This item was followed by item 4 seeking to know if undergraduates are aware that AR is in three dimension (3D) format and it

has a mean score of 2.22. Item 5 sought to know if undergraduates were aware of some AR applications like Snapchat, Pokemon GO and Arlon geometry among others which has a mean score of 2.14. Item 6 which sought to know if undergraduates were aware that using AR can engage and encourage learners has a mean score of 2.38 and item 7 which sought to know if augmented reality can motivate learner also has a mean score of 2.45.

Item 8 which sought to know if undergraduates were aware that AR is embeddable into computers and smart phones has a mean score of 2.72. This was closely followed by item 9 which sought to know if AR can be applied in medicine, education and entertainment which has a mean score of 2.58. Lastly, item 10 which sought to know if undergraduates were aware that augmented reality applications can help students with special needs also has a mean score of 2.41. It is evident in the table above that all items were responded to positively and has a grand mean total of 2.49.

Research Question Two: What is the undergraduates' readiness to adopt augmented reality applications for learning in University of Ilorin?

Table 4: Mean of Undergraduates Readiness to Adopt Augmented Reality Applications for Learning

S/N	Dispositions	Mean
1.	I am prepared to adopt augmented reality for my learning activities	3.73
2.	I am ready to adopt augmented reality for Learning because it is attractive	3.11
3.	I am ready to adopt augmented reality for learning because it is interactive	3.31
4.	I am prepared to adopt augmented reality. because it reduce frustration in students with special needs	3.40
5.	I am ready to adopt augmented reality so it will enable me to learn new things	3.47
6.	Augmented reality applications can improve learners' knowledge and skills	3.45
7.	Augmented reality applications can be used to learn anytime and anywhere	3.82
8.	I am prepared to adopt augmented reality applications because it increases student's motivation towards learning	3.31
9.	I am ready to adopt augmented reality because it awakes student's interest in learning	3.50
10.	Augmented reality applications create lasting	3.10

experience that stays in student's memory

Grand Mean	3.42

Table 4, shows undergraduates' readiness to adopt augmented reality applications for learning, the table showed that item 7 has the highest mean score of 3.82 and it sought to know if undergraduates agree that augmented reality applications can be used anywhere and anytime. This was followed by item 1 which sought to know if undergraduates are prepared to adopt augmented reality applications for their learning activities which has a mean score of 3.73. Item 5 sought to know if undergraduates are ready to adopt augmented reality applications because it enables them to learn new things and it has a mean score of 3.47. Item 6 which sought to know if augmented reality can improve learners' knowledge and skills which has a mean score of 3.45. This was followed by item 4 which sought to know if undergraduates are ready to adopt augmented reality because it reduces frustration in special need students which has a mean score of 3.40. Item 9 which also sought to know if undergraduates are ready to adopt augmented reality applications because it awake students interest in learning and has a mean score of 3.50. Item 2 and 10 which sought to know if undergraduates are ready to adopt augmented reality applications because it is interactive and if augmented reality creates experiences that stays in students' memory and has means scores of 3.11 and 3.10 respectively. It can be deduced from the table 4 that all items were responded to positively with a grand mean total of 3.42.

Hypothesis Testing
This hypothesis was tested at 0.05 level of significance

Hypothesis One
H_{01}: There is no significant difference between male and female student's awareness of augmented reality applications for learning

Table 5: *t*-test Analysis of Differences in the Student's Awareness of Augmented Reality Applications for Learning Based on Gender

Gender	N	X	SD	df	*t*	Sig. (2-tailed)	Remark
Male	106	3.01	.32	148	-1.508	.134	Accepted
Female	54	3.09	.32				

From Table 5, it can be deduced that there was no significant differences in the male and female awareness of augmented reality applications for learning. This is reflected in the findings of the hypotheses tested df (148), t= -1.508, p>0.05. Thus, the proposed hypothesis is accepted.

H$_{02}$: There is no significant difference between male and female student's readiness to adopt augmented reality applications for learning.

Table 5: *t*-test Analysis of Differences between male and female students' Readiness to Adopt Augmented Reality for Learning

Gender	N	X	SD	df	*t*	Sig. (2-tailed)	Remark
Male	39	3.11	.29	148	-.805	.422	Accepted
Female	61	3.08	.24				

From Table 5, it can be deduced that there was no significant differences in the male and female student's readiness to adopt augmented reality applications for learning. This is reflected in the findings of the hypotheses tested df (148), t= .805, p>0.05. Thus, the hypothesis which states that "there is no significance difference between male and female student's readiness to adopt augmented reality applications for learning" is accepted.

IV. DISCUSSION OF FINDINGS

This study assessed undergraduates' awareness and readiness to adopt augmented reality applications for learning in University of Ilorin, Nigeria. Research question one seeks to determined undergraduates' awareness of augmented reality applications for learning. Different items were tested and from the data gathered, it was revealed that undergraduates' students are aware of augmented reality applications for learning. This is seen in the grand mean score of table 3. This view aligned with the finding of Alahmari, (2019) who conducted a study on Students' Awareness of Augmented Reality Adoption in Saudi Arabia Universities. The study confirms that there are positive expectations and awareness of the adoption of AR in education as a useful learning tool that provides students and teachers with several pedagogical benefits. Research question 2 examined undergraduates' readiness to adopt augmented reality applications for learning. The findings revealed that undergraduates are willing and ready to adopt augmented reality applications for learning. This finding is in line with the finding of Alkhattabi (2017) on Augmented Reality as E-learning Tool in Primary Schools' Education, the study concluded that there is readiness to use and high acceptance rate towards AR by primary school teachers. In addition, the finding of Alessi & Trollip (2018) posited that multimedia and multisensory abilities of computers are so advanced that skilled designers have the hardware needed for creating and implementing better software. It is no longer necessary to convince people that computers can be advantageous for learning.

The differences between male and female students' Readiness to Adopt Augmented

Reality for Learning was research question 3 and the hypothesis formulated for this study. From the analyzed data, it was deduced that there is no significant difference between male and female undergraduate students' readiness to adopt Augmented Reality Applications for learning. It showed that male and female undergraduate students are ready to use AR applications for their learning. This finding against the view of Alahmari (2020) who indicated that male students rather than female are inclined to be more interested in technology adoption for learning. Bohlin (2016) did not find differences between Swedish males and females in the use of mobile applications, except that males were more active online ticket shoppers, whereas females used more social-media applications.

V. CONCLUSIONS AND RECOMMENDATION

This study assessed undergraduates' awareness and readiness to adopt augmented reality applications for learning in University of Ilorin, Nigeria. The findings revealed that undergraduate students are aware of Augmented Reality applications for learning. The findings also established that undergraduate students are willingly ready to adopt AR for their learning activities. The finding also established no significant difference between male and female undergraduate students' readiness to adopt AR application for learning. This serves as eye-opener that there is no gender bias in the utilization of AR for learning.

The study therefore recommended that augmented reality applications should be encouraged for academic purpose by teachers, as it will provide Avenue for learners to learn in a personalized and self-paced level, which will in turn translate to better academic performance

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