Pre-service Teachers Readiness to Adopt Augmented Reality for Teaching and Learning in Nigeria

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ABSTRACT

The integration of Augmented Reality (AR) in education has the potential to revolutionize teaching and learning by offering interactive and engaging content. However, its adoption in Nigerian classrooms is limited, particularly among pre-service teachers. This study aims to examine the readiness of Nigerian pre-service teachers to adopt AR for educational purposes. Using a survey design, data were collected from 310 pre-service teachers at the Federal College of Education (Special), Oyo, and its affiliate programmes. The findings revealed that while pre-service teachers have a positive attitude toward AR (mean = 3.40), they lacked adequate training in digital skills and AR integration (mean = 1.95). Additionally, insufficient infrastructure, lack of exposure to 3D modeling and AR tools, and heavy teacher workloads present significant barriers to AR adoption. The study concludes that, although pre-service teachers are open to AR, there are critical gaps in training and infrastructure. Recommendations include revising teacher training curricula to incorporate AR and digital skills, investing in technological infrastructure, and promoting awareness of AR's educational benefits among educators and policymakers.

INTRODUCTION

In recent years, technological advancements in education have provided new learning models and facilitated more effective teaching (Dakhi et al., 2020). These technologies have contributed to more powerful delivery of learning materials and information. They have been applied to education with the intention of presenting more attractive and less traditional lesson content. One of these is augmented reality (AR). Augmented Reality (AR) stands out for its ability to merge the physical and digital worlds, offering students immersive and interactive learning experiences (Jumani et al., 2022). According to Aguilar et al., (2024), AR enhances the learning process by allowing students to visualize and interact with 3D models, simulations, and other educational content, making abstract concepts more concrete and engaging. Hence, AR can enhance students' learning motivation and their academic achievement.

Globally, AR has gained attention as a valuable educational tool, but its integration into classrooms depends heavily on teachers' ability and willingness to use it effectively (Oueida et al., 2023). In many advanced countries, the integration of Augmented Reality (AR) into education has witnessed significant growth, largely due to advancements in technology infrastructure and teacher training programmes (Oueida et al., 2023). Teachers in these countries have received training on how to apply AR to enhance student engagement, improve learning outcomes, and make abstract concepts more tangible (Alalwan et al., 2020). According to Alalwan and Colleagues these teachers have access to well-equipped classrooms with the necessary hardware and software to support AR applications. This infrastructure includes high-speed internet, interactive whiteboards, tablets, and AR-enabled devices. These technological resources make it easier for teachers to experiment with and implement AR tools in their teaching.

However, the use of Augmented Reality (AR) in education in many African countries is still in its early stages (Oke & Arowoiya, 2022). Oke and Arowoiya report that teachers in these countries lack the skills to effectively integrate AR into their classrooms. One of the primary challenges facing these teachers is the lack of adequate technological infrastructure and lack of training on how to use AR (Alzahrani, 2020). In many schools, especially in rural areas, there is insufficient access to basic resources such as reliable electricity, internet connectivity, and digital devices (Oke & Arowoiya, 2022). This lack of infrastructure significantly limits teachers' ability to explore and employ AR in their teaching practices. Despite, these challenges, researchers and educators have advocated for the adoption advanced technologies like augmented reality (AR) to address educational barriers. Similarly, the African Union High-Level Panel on Emerging Technologies (APET) recognized AR as a tool to transform learning by providing immersive experiences that make education more accessible, engaging, and relevant to students across Africa (Mhlanga, 2020). They further added that the use of AR in schools will help improve the standard of education across the continent.

While AR has the potential to transform Nigeria's education system by making learning more interactive, engaging and accessible, its adoption in Nigeria is still at its infancy. AR implementation in Nigeria is faced with challenges like infrastructural deficiencies, limited awareness and teacher readiness, lack of localized AR content, lack of policies or government driven initiatives to promote AR adoption. However, a few private schools and educational technology companies in major cities in Nigeria have started incorporating AR into subjects such as science, geography and history to provide students with interactive and engaging experiences (Adedokun-Shittu et al., 2020).

The integration of AR in teaching and learning in Nigerian schools is confronted with some challenges and they include limited infrastructure, limited awareness and teacher readiness, lack of localized AR content, lack of government initiatives and policy to support the adoption of AR in schools and high cost of AR devices. The inadequacies of the teacher education programme to expose pre-service teachers to emerging technologies like AR in Nigeria have been reported in research. According to Oke, and Arowoiya, (2022), many pre-service and in-service teachers have limited or no experience with AR tools, leaving them unprepared to integrate such technology into their classrooms. Many teacher education institutions focus on the traditional teaching methods, with little emphasis on digital literacy or advanced technologies like AR.

As future educators, pre-service teachers play a critical role in the successful integration of AR into classrooms. These teachers, currently undergoing teacher education programs, are expected to be at the forefront of incorporating technological innovations into their teaching practices. However, the question of their readiness to adopt AR for teaching and learning, especially in a developing country like Nigeria, is largely unexplored. Factors such as access to technology, training, and attitudes towards digital tools can significantly influence their ability to integrate AR into their future classrooms. This study seeks to investigate the preparedness of Nigerian pre-service teachers to adopt AR in teaching and learning

Statement of the Problem

The integration of technology into education has become a global priority, offering innovative ways to enhance teaching and learning. Augmented Reality (AR), with its capacity to merge digital content with real-world environments, presents vast potential to revolutionize classroom experiences by making learning more engaging, interactive, and visually immersive. However, the successful adoption of AR in educational settings depends heavily on the readiness and capability of teachers to integrate such technology into their teaching practices.

In Nigeria, where educational resources are often constrained by infrastructural challenges and limited access to technology, the introduction of AR faces additional hurdles. Pre-service teachers, who are being trained to lead future classrooms, are expected to embrace and utilize emerging technologies like AR. However, questions remain about their preparedness to adopt this innovative tool. Factors such as limited exposure to

AR during teacher training, a lack of access to necessary technology, and potential gaps in digital literacy may hinder their ability to effectively integrate AR into the learning environment.

Despite the potential benefits of AR, there is little research focused on assessing the readiness of Nigerian pre-service teachers to use this technology in their classrooms. Teacher education institutions in Nigeria may fail to adequately equip pre-service teachers with the skills needed to leverage AR in meaningful ways, without a clear understanding of their level of preparedness. This presents a significant challenge for the future of technology-enhanced education in Nigeria. This study seeks to address this gap by investigating the readiness of Nigerian pre-service teachers to use AR for teaching and learning

METHODOLOGY

In this study, the researcher employed the survey research design. The population of the study comprised all pre-service teachers from the Federal College of Education (Special), Oyo and its two affiliate programmes, with the University of Ibadan and the Lagos State University, Lagos State. The random sampling technique was used to select 310 pre-service teachers from the Federal College of Education (Special), Oyo and its two affiliation programmes. A self- structured questionnaire was used to collect data from the respondents. The items of the questionnaire were obtained from the research questions. Questions were derived from each research question (A and B) were used in gathering the data from the respondents. Section A of the questionnaire contained personal data of the respondents while section B of the questionnaire consisted of twenty (20) items on the subject of the study. The respondents were expected to choose from Agreed, Strongly Agreed or Disagreed and Strongly disagreed. The correlation value obtained between the mean score was 0.80. the high coefficient value showed that the instrument was reliable and accurate. Data collected were analyzed using mean and standard deviation.

RESULT

TABLE 1: SEX OF RESPONDENTS

	Frequency	Percentage
Male	173	56.0
Female	136	44.0
Total	**310**	**100.0**

Table 1 shows that 56% of the respondents were male, while the other 44% were female. This indicates that the research had more male than female.

TABLE 2: AGE OF RESPONDENTS

	Frequency	Percentage
18-20years	133	43.0
21-25years	99	32.0
26-30years	56	18.0
31years and above	22	7.0
Total	**310**	**100.0**

Table 2 reveals that 43% of the respondents were between the age range of 18-20years, 32% were between the age range of 21-25years, 18% were between the age range of 26-30years and 7% were 31years and above.

TABLE 3: HAVE YOU HEARD OF AUGMENTED REALITY?

	Frequency	**Percentage**
No	190	61.0
Yes	120	39.0
Total	**310**	**100.0**

Table 3 confirms that 61% of the respondents said that they have not heard of augmented reality while 39% of the respondents said they have heard of it.

TABLE 4: HAVE YOU USED AUGMENTED REALITY?

	Frequency	**Percentage**
No	220	71.0
Yes	90	29.0
Total	**310**	**100.0**

Table 4 reveals that 71% of the respondents said they have not used augmented reality before while 29% of the respondents said they have.

TABLE 5: RESEARCH QUESTION 1: What is the attitude of pre-service teachers in the integration of augmented reality in teaching and learning in Nigeria Education?

S/N	Items	SD	D	A	SA	X	SD	Decision
		1	2	3	4			Most agreed
1	I believe it is a good idea to use Augmented Reality in teaching in Nigeria	47	68	543	192	2.74	0.16	**Positive**
2	Using Augmented Reality makes teaching more interesting	40	50	306	572	3.12	0.18	**Positive**
3	I have a generally favorable attitude towards using Augmented Reality in teaching	82	56	420	240	2.57	0.15	**Positive**
4	I like to experiment with new digital technologies	37	38	336	568	3.16	0.18	**Positive**
5	If I hear about a new digital technology, I will look for ways to experiment with it	25	62	567	260	2.95	0.17	**Positive**
6	I feel positive regarding the use of Augmented Reality in Teaching	43	38	474	360	2.95	017	**Positive**
	Cumulative mean					**3.40**	**0.14**	

Table 5 presents data relating to pre-service teachers' attitudes towards using Augmented Reality (AR) in teaching in Nigeria. The cumulative mean suggests an overall strong positive attitude toward the use of AR in teaching. The mean is above 3.0 and this indicates that the majority of respondents agree or strongly agree that AR has a beneficial impact on teaching, making it a promising tool in the Nigerian education context. This implies that the pre-teachers are open to adopting AR for teaching and believe in its potential benefits, suggesting a fertile ground for AR integration in Nigerian education

TABLE 6: RESEARCH QUESTION 2: To What extent is the training received by pre-service teachers adequate for the integration of augmented reality in teaching and learning in Nigeria Education?

S/N	Items	SD	D	A	SA	X	SD	Decision
		1	2	3	4			
1	Students are taught basic digital skills that are required in the 21st century	161	192	66	124	1.75	0.09	**Inadequate**
2	We were introduced to Game-based learning, project-based learning, interactive learning and Collaborative Learning.	112	218	177	155	2.16	0.12	**Inadequate**
3	Pre-service teachers take a course in computer programming	68	298	222	76	2.14	0.12	**Inadequate**
4	Our curriculum includes Augmented Reality skills and 3D modeling, design and animation	161	112	186	124	1.88	0.10	**Inadequate**
5	Students received training in the creation of digital 3D models	162	148	111	148	1.84	0.10	**Inadequate**
	Cumulative mean					**1.95**	**0.11**	

Item 1 in Table 6 has a mean of 1.75, which indicates that a significant majority of respondents believe that students were not adequately taught the basic digital skills needed for the 21st century. Item 2 has a mean of 2.16, this suggests an inadequate introduction of pre-service teachers to innovative learning methods such as game-based, project-based, interactive, and collaborative learning. Response to item 3 also indicate that the exposure to computer programming for pre-service teachers is generally perceived as inadequate, with a mean of a mean of 2.14. Item 4 has a mean score of 1.88 reflecting a significant deficiency in the teaching of Augmented Reality (AR) skills, 3D modeling, design, and animation. Most respondents believe that these important 21st-century skills are not adequately included in the curriculum, highlighting a gap in advanced digital literacy. Item 5 also has a mean score of 1.84 indicating that training in the creation of digital 3D models is also perceived as inadequate. This further emphasizes the lack of comprehensive training in emerging digital skills that are crucial for future-ready teaching professionals. The cumulative mean of 1.95 reveals an overall inadequacy in the curriculum regarding digital skills, innovative learning methods, and advanced technology training such as AR, 3D modeling, and programming. The analysis reveals an overwhelming perception that the current curriculum is insufficient in preparing students, especially pre-service teachers, for the digital demands of the 21st century.

TABLE 7: RESEARCH QUESTION 3: What the level of competence of pre-service teachers in the integration of augmented reality in teaching and learning in Nigeria?

S/N	Items	SD	D	A	SA	X	SD	Decision
		1	2	3	4			
1	I can design Augmented Reality Educational Experiences using Augmented Reality applications and tools to meet specific educational objectives	164	100	186	136	**1.89**	**0.10**	Low
2	I can design Augmented Reality educational resources using easy to use templates and asset libraries	74	298	168	124	**2.14**	**0.12**	Low
3	I can modify and adapt Augmented Reality educational resources to my teaching goals	75	316	120	148	**2.13**	**0.12**	Low
4	I can use Augmented Reality educational resources and tools to present, demonstrate and explain concepts to my students	186	136	120	64	**1.63**	**0.09**	Low
5	I can use Augmented Reality educational resources and tools to assess my students' progress	115	310	84	48	**1.80**	**0.10**	Low

6	I can use Augmented Reality educational resources and tools to collaborate with students as well as enable students' collaboration among themselves.	121	284	48	124	**1.86**	**0.10**	Low
	Cumulative mean					**1.91**	**0.11**	

Table 7 reveals that the respondents lack the skills to integrate AR into their teaching practices effectively, with a cumulative mean of 1.9. The result shows that the participants feel that they lack the needed skills to design AR resources, customize AR content for their instructional purposes, use AR tools to present and explain concepts to students, use AR tools for assessing students' progress and use AR tools to facilitate collaboration between students.

TABLE 8: QUESTION 4: What are the challenges affecting the successful integration of augmented reality in teaching and learning in Nigeria?

S/n	Items	SD	D	A	SA	X	SD	Decision
		1	2	3	4			
1	Most schools in Nigeria lack the required infrastructure to integrate Augmented Reality in teaching and learning in Nigeria	62	56	93	756	3.12	0.17	**Agreed**
2	Students' Knowledge level on ICT is a barrier to integrating Augmented Reality in teaching and learning in Nigeria	12	62	447	472	3.20	0.18	**Agreed**
3	Students Attitude towards technology is a barrier to integrating Augmented Reality in teaching and learning in Nigeria	143	220	144	36	1.75	0.10	**Disagreed**
4	Teachers are reluctant to implement a integrate Augmented Reality in teaching and learning in Nigeria	102	254	186	248	2.55	0.14	**Agreed**
5	Teachers lack the skills to integrate Augmented Reality in teaching and learning in Nigeria	62	12	297	572	3.04	0.17	**Agreed**
6	The time allocated to each subject on the timetable is inadequate to integrate Augmented Reality in teaching and learning in Nigeria	28	38	483	408	3.09	0.18	**Agreed**
7	Teachers' workload is a barrier to integrate Augmented Reality in teaching and learning in Nigeria	47	68	327	480	2.97	0.17	**Agreed**
	Cumulative mean					**2.82**	**0.16**	

Table 8 shows that the successful integration of augmented reality in teaching and learning in Nigeria is confronted with numerous challenges. The study identified the following challenges: lack of infrastructure to integrate Augmented Reality in teaching and learning, teachers' lack of skills to integrate Augmented Reality in teaching and learning, inadequate time allocated to each subject on the timetable and teachers' workload. The table also showed that the respondents' perception to using technology in learning was positive and their attitude is not an obstacle to AR adoption in Nigeria.

DISCUSSION OF FINDINGS

The findings of this study revealed several insights on the integration of Augmented Reality (AR) in teaching and learning within Nigerian education. The results in Table 5 showed that pre-service teachers in Nigeria hold a strongly positive attitude towards the use of AR in education. The cumulative mean of 3.40 suggests that a majority of the respondents are positive about the potential of AR to enhance teaching and learning. They view AR as a tool that can make teaching more engaging and interesting. This positive attitude is significant because teachers' receptiveness to new technologies is a key factor in the successful adoption of

innovations like AR in education. The findings are consistent with Oueida et al. (2023), who noted that the effective integration of AR depends heavily on teachers' willingness and openness to use it. The positive attitude reflected in this study indicates that pre-service teachers are open to experimenting with AR and other digital technologies, providing a driver for the integration of AR into Nigerian classrooms in the future.

Despite the positive attitude toward AR, the findings in Table 6 reveal a different picture when it comes to the adequacy of training received by pre-service teachers. The cumulative mean of 1.95 across the items shows that pre-service teachers perceive their training in digital skills and emerging technologies like AR as inadequate. Data from the study suggest that pre-service teachers are not adequately taught the basic digital skills required for the 21st century. This aligns with Alzahrani (2020), who reported similar deficiencies in digital literacy among teachers in other developing regions. Result also showed that pre-service teachers had limited exposure to modern teaching approaches like game-based learning and collaborative learning, which could complement AR integration. The study also showed that the lack of exposure to Augmented Reality skills, 3D modeling, design, and animation (mean = 1.88) is a significant barrier, as these skills are crucial for the effective use of AR in education. These findings reflect a gap in the curriculum and teacher education programmes in Nigeria. The inadequacy in training is a critical issue because, as Alalwan et al. (2020) pointed out, teacher competence and training are crucial to the success of AR integration.

The results from Table 7 reveal that pre-service teachers lack the skills needed to effectively integrate AR into their teaching practices, with a cumulative mean of 1.91. The findings highlight reveal that pre-service teachers feel unprepared to design AR educational experiences. Similarly, the study also reports a low confidence level of pre-service teachers to adapt AR resources to meet educational objectives. The study further added that the pre-service teachers felt unskilled in using AR tools to present and explain concepts to students. This lack of competence can be attributed to the inadequate training received. Teacher readiness is a critical factor in technology adoption, and without sufficient competence, teachers are unlikely to integrate AR effectively into their classrooms. This aligns with findings from Oke and Arowoiya (2022), who reported similar challenges among teachers in other African countries, emphasizing the need for more professional development programs focused on AR skills.

The findings in Table 8 point to several significant barriers to the successful integration of AR in Nigerian schools, with a cumulative mean of 2.82 indicating strong agreement on these challenges. Most schools in Nigeria lack the required infrastructure to integrate AR. The study identifies infrastructural deficiencies as a primary barrier to AR adoption in Nigeria. This includes a lack of high-speed internet, AR-enabled devices, and reliable electricity, as also noted by Oke and Arowoiya (2022). Teachers and students will not be able to access and use AR tools effectively, without the necessary hardware and connectivity. The also report that the pre-service teachers were not well-equipped with the technical skills needed to integrate AR in their lessons. This barrier is further worsened by teachers' reluctance to adopt AR (mean = 2.55) and their workload (mean = 2.97), which leaves little room for exploring new technologies. These findings align with Alzahrani (2020), who also pointed out the challenge of teacher readiness in adopting digital technologies. The study's findings indicate that the limited time available for each subject in school schedules poses a significant challenge to AR integration. Teachers may find it difficult to integrate AR into their lessons without extending the time allocated for subjects. The study shows that pre-service teachers' lack of ICT skills also hinders the integration of AR. This supports the findings of Oueida et al. (2023), who emphasized the need for both students and teachers to be digitally literate for successful AR adoption. However, the study showed that pre-service teachers' attitude toward technology are not a significant barrier (mean = 1.75), which contrasts with some earlier studies that suggested resistance to new technologies among students. This finding suggests that students are generally open to using AR if given the opportunity, further reinforcing the need for infrastructure and teacher preparedness.

CONCLUSION

This study examined the readiness of pre-service teachers in Nigeria to adopt Augmented Reality (AR) for teaching and learning, as well as the challenges affecting its integration into Nigerian education. The

findings reveal that: Pre-service teachers in Nigeria have a strongly positive attitude toward the use of AR in teaching. They are open to adopting new technologies like AR and believe in its potential to enhance learning by making teaching more engaging, interactive, and effective. Despite their positive attitude, the study found that pre-service teachers' training in digital skills and emerging technologies like AR is inadequate. This gap is particularly evident in their exposure to basic digital skills, AR, 3D modeling, and advanced teaching methods like game-based learning and project-based learning.

The pre-service teachers demonstrated low competence in using AR tools and applications for educational purposes. They lack the skills to design AR educational experiences, adapt AR resources to teaching goals, and use AR tools for instruction, assessment, and collaboration. The study identified several barriers to the successful integration of AR in Nigerian education. These include a lack of infrastructure, such as high-speed internet and AR-enabled devices, teachers' lack of skills, heavy teacher workloads, and the limited time allocated for subjects in the curriculum. However, students' positive attitude towards technology indicates a readiness to engage with AR, if given the opportunity.

There is a pressing need for significant investment in technological infrastructure, for AR to be successfully integrated into Nigerian classrooms. Schools must be equipped with the necessary hardware, including AR-enabled devices, reliable internet connectivity, and other digital tools to support the use of AR in teaching. The current curriculum does not adequately prepare pre-service teachers for the demands of a digital and technology-driven educational landscape. The curriculum must be updated to include digital literacy, AR skills, programming, and the use of emerging technologies in education. This reform is crucial for fostering future-ready teachers and students.

RECOMMENDATIONS

Based on the findings of this study on the readiness of Nigerian pre-service teachers to adopt Augmented Reality (AR) in teaching and learning, the following recommendations are made:

1. The Nigerian government and educational stakeholders should invest in developing the technological infrastructure necessary to support AR in classrooms.
2. Teacher training institutions should revise their curricula to include digital literacy and emerging technologies like AR. Courses on basic ICT skills, AR design and application, 3D modeling, and interactive teaching methods (such as game-based and project-based learning) should be integrated into the training programs.
3. There is a need to raise awareness among educators, administrators, and policymakers about the benefits of AR in education through seminars and workshops.
4. Educational technology companies and developers should work in collaboration with Nigerian educators to create localized AR content that is relevant to the Nigerian curriculum and culturally appropriate.
5. The Nigerian government should implement policies and initiatives that support the adoption of AR and other emerging technologies in education.
6. Curriculum planners should review the current school timetables and allocate more time for the integration of technology-enhanced learning methods, including AR.

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