Rima International Journal of Education (RIJE)
ISSN: 2756 – 6749 (p); 3141-2033 (e)
Volume 5, Issue 3, June. 2026; Page: 171—186 DOI: https://doi.org/10.65760/rijessu.v5.3.12

Awareness of Augmented Reality Applications in Chemistry Teaching among University Lecturers in Sokoto State, Nigeria

Sharhabilu Malami Yusuf

Department of Science Education, Faculty of Education, Sokoto State University, Sokoto, Sokoto State, Nigeria.
Email: sharhabilumyusuf12@gmail.com

Abstract

The integration of emerging technologies such as augmented reality (AR) has gained increasing attention in science education due to its potential to enhance the teaching and learning of abstract concepts, particularly in chemistry. Despite growing evidence supporting the effectiveness of AR in improving students' understanding and engagement, its successful implementation largely depends on lecturers' awareness and familiarity with its applications. This study investigated the level of awareness of augmented reality applications in chemistry teaching among university lecturers in Sokoto State, Nigeria. The study adopted a descriptive survey research design. The population comprised all chemistry lecturers in the three universities in Sokoto State, and a census sampling technique was employed to include all respondents. Data were collected using a structured questionnaire designed to assess lecturers' awareness, knowledge of AR applications, and factors influencing their awareness. The instrument was validated by experts and its reliability established using appropriate statistical methods. Data collected were analyzed using descriptive statistics such as mean and standard deviation. The findings revealed that lecturers possess a moderate level of awareness of augmented reality applications, with relatively higher awareness of general concepts but limited familiarity with specific AR tools and applications used in chemistry teaching. Furthermore, factors such as access to technological devices, internet availability, training in educational technology, and institutional support were found to significantly influence lecturers' awareness. The study concludes that although awareness of AR exists among university lecturers, it is not sufficiently developed to support effective pedagogical integration. It is therefore recommended that universities and relevant stakeholders provide adequate training, improve technological infrastructure, and promote institutional support to enhance lecturers' awareness and facilitate the integration of augmented reality in chemistry teaching.

Keywords*:* Augmented Reality, Chemistry, Pedagogy, Awareness and Integration

Cite this as: Yusuf, S. M. (2026). Awareness of Augmented Reality Applications in Chemistry Teaching among University Lecturers in Sokoto State, Nigeria. *Rima International Journal of Education, 5*(3), 171—186. DOI: https://doi.org/10.65760/rijessu.v5.3.12

Introduction

In an ideal educational setting, teaching and learning processes in science disciplines such as chemistry are expected to be highly interactive, visual, and student-centred, enabling learners to understand abstract and complex concepts through meaningful engagement fully. Emerging technologies such as Augmented Reality (AR) have been identified as powerful tools that bridge the gap between theoretical knowledge and real-world understanding by overlaying digital information onto physical environments. Studies have shown that AR enhances learners' motivation, conceptual understanding, and cognitive engagement by making abstract scientific ideas more concrete and observable (Lidiastuti, 2024; Radianti, 2020). Ideally, university lecturers are expected to be well-informed and competent in integrating such innovative technologies into their instructional practices to promote 21st-century science education.

However, in many higher education contexts, particularly in developing countries, the current reality indicates a gap between technological advancement and classroom practice. Although AR has gained increasing attention in science education research, its actual awareness and adoption among university lecturers remain limited. Evidence suggests that while educators recognize the potential benefits of AR, many still lack adequate exposure, training, and practical experience with its applications in teaching (Ateş & Garzón, 2023; Chang, 2022). Furthermore, challenges such as inadequate technological infrastructure, limited access to digital devices, and insufficient professional development opportunities continue to hinder effective integration of AR in instructional delivery (Duc, 2025; Lidiastuti, 2024). This situation creates a disconnect between research findings on AR effectiveness and its actual utilization in classroom practice.

In response to this gap, there is a need to examine the level of awareness of augmented reality applications among university lecturers, particularly in chemistry education. Understanding lecturers' awareness, familiarity with AR tools, and factors influencing their knowledge is essential for guiding effective pedagogical integration. Addressing this gap will provide valuable insights for educational stakeholders in designing targeted training programmes, improving institutional support, and promoting the adoption of innovative teaching technologies. Ultimately, enhancing lecturers' awareness of AR is

critical for ensuring its successful integration into chemistry instruction and improving students' learning outcomes in higher education (Zawacki-Richter, 2019; Garzón & Acevedo, 2019).

Significance of the Study

This study will help lecturers understand the relevance of augmented reality in chemistry teaching and encourage them to explore innovative instructional strategies, the findings will provide evidence on the current level of awareness of AR, thereby guiding decisions on training, resource allocation, and technology integration in universities. The study will also highlight the need to incorporate emerging technologies like AR into teacher education and chemistry curricula.

Scope and Delimitation of the Study

This study will Assess the level of awareness of augmented reality application, identifying types of AR applications known to lecturers and Examining factors influencing awareness however the study is restricted to chemistry lecturers in universities within Sokoto State, will not assess the effectiveness of AR in teaching chemistry and It will not measure actual classroom usage or implementation of AR, but rather awareness and related factors.

Studies on Awareness of AR in Chemistry Education

Studies on augmented reality (AR) in chemistry education within Nigeria are still emerging, and only a limited number have directly examined lecturers' awareness, particularly in the North-West region. However, existing studies provide useful insight into educators' exposure and readiness to adopt this technology. For example, a study conducted in Kaduna State reported that students taught using AR performed better and showed greater interest in chemistry compared to those taught using conventional methods (Aliyu et al., 2025). Although the study focused on students' outcomes, it emphasized the need for teacher training and institutional support, suggesting that many educators are not yet sufficiently aware of or prepared to integrate AR into their teaching. This highlights a gap between the recognized benefits of AR and its actual use in classrooms, especially in Northern Nigeria.

Similarly, a study carried out in Osun State found that students perceived AR as helpful in understanding complex chemistry concepts, particularly those

involving visualization such as molecular structures (Abanikannda & Anu, 2024). Despite these positive perceptions, the study noted that the adoption of AR in Nigerian schools is still at a developing stage due to limited exposure among teachers. In addition, a related study on the development of AR-based instructional modules for chemistry revealed that many educators continue to rely on traditional teaching methods due to lack of awareness, training, and access to appropriate technological tools (Aliyu, 2020). Taken together, these studies suggest that while AR has strong potential to improve chemistry instruction, its integration remains limited by low awareness and insufficient practical knowledge among educators. This therefore justifies the need to investigate lecturers' awareness, particularly in regions such as Sokoto State where empirical evidence is still scarce.

Theoretical Framework

This section reviews the theories related to the study. It focuses on one major theory, the Technology Acceptance Model (TAM), which provides a suitable framework for understanding lecturers' awareness and acceptance of augmented reality in chemistry teaching.

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), developed by Davis (1989), explains how individuals come to accept and use new technologies. The model is based on two key constructs: perceived usefulness and perceived ease of use. Perceived usefulness refers to the degree to which an individual believes that using a particular technology will enhance their job performance, while perceived ease of use refers to the extent to which a person believes that using the technology will be free of effort. According to TAM, these two factors influence an individual's attitude toward using a technology, which in turn affects their intention to use it and ultimately their actual usage behavior. In the context of education, TAM has been widely used to explain teachers' adoption of digital tools and emerging technologies in teaching and learning processes.

In relation to this study, TAM is relevant in explaining university lecturers' awareness and potential acceptance of augmented reality applications in chemistry instruction. Lecturers are more likely to become aware of and adopt AR technologies if they perceive them as useful for improving teaching effectiveness and easy to integrate into their instructional practices. However,

if lecturers lack exposure, training, or institutional support, their perception of ease of use may be low, which can limit both awareness and adoption. Therefore, the Technology Acceptance Model provides a useful lens for understanding how factors such as access to technology, training, and institutional support can influence lecturers' awareness and readiness to integrate augmented reality into chemistry teaching.

Statement of the Problem

Augmented reality (AR) has emerged as an innovative instructional technology capable of enhancing the teaching and learning of chemistry by improving visualization of abstract concepts and promoting interactive learning. Despite growing empirical evidence supporting the effectiveness of AR in chemistry education, the successful integration of this technology in university classrooms largely depends on lecturers' awareness and familiarity with its applications. However, in many Nigerian universities, particularly in Sokoto State, it is unclear whether chemistry lecturers are sufficiently aware of AR applications and their pedagogical relevance. A lack of awareness may hinder the adoption and integration of AR into instructional practices, thereby limiting the potential benefits observed in prior studies. While previous research has established the effectiveness of AR in improving students' learning outcomes, there is limited evidence regarding whether lecturers possess the necessary awareness to utilize such technologies. Therefore, this study seeks to investigate the level of awareness of augmented reality applications among university lecturers in Sokoto State, the types of AR applications they are familiar with, and the factors influencing their awareness, with a view to informing strategies for effective pedagogical integration.

Objectives of the Study

The main objective of the study is to assess the level of Awareness of Augmented Reality Applications in Chemistry Teaching among University Lecturers in Sokoto State and its Implications for Pedagogical Integration, more specifically the objectives are:

I. To assess the level of awareness of augmented reality applications in chemistry teaching among university lecturers in Sokoto State

II. To identify the types of augmented reality applications that are known to university lecturers for teaching chemistry

III. To determine the factors that influence university lecturers' awareness of augmented reality applications in chemistry teaching

Research Questions

I. What is the level of awareness of augmented reality applications in chemistry teaching among university lecturers in Sokoto State?

II. What types of augmented reality applications are known to university lecturers for teaching chemistry?

III. What factors influence university lecturers' awareness of augmented reality applications in chemistry teaching?

Methodology

This study adopted a descriptive survey research design to investigate the awareness of augmented reality applications in chemistry teaching among university lecturers in Sokoto State, Nigeria. The population of the study comprised all chemistry lecturers in the three universities within the state, totalling 92 lecturers. Due to the relatively small and manageable size of the population, a census sampling technique was employed, whereby all members of the population were included in the study this sampling technique is considered appropriate because all the 92 respondents were reachable and accessible to the researcher. Data were collected using a structured questionnaire designed by the researcher titled Questionnaire: Awareness of Augmented Reality in Chemistry Teaching (AARCTQ), the questionnaire consists of two main Parts A and B. part A consists of demographic information of the respondents including gender and academic qualification of the respondents, section B consist of 15 questions designed to answer the three research questions of the study designed in 4 likert scale from strongly agreed=4, Agreed=3, Disagreed=2 and strongly disagreed=1. The instrument was subjected to face and content validation by experts in science education and educational technology, while its reliability was established using Cronbach's alpha method and found to be 0.73. The questionnaire was administered directly to the respondents by the researcher with the assistance of trained research aides, ensuring a high retrieval rate. Data collected were

analysed using descriptive statistics, including frequency counts, percentages, means, and standard deviation to answer the research questions.

Data Analysis

This section analyses data collected for the study based on the objectives of the study, it begins with analysis of demographic information of the respondents and, answering research questions and the discussion of the findings.

Table 1: Demographic information of the respondents

S/N	Gender	Frequency	Percentage
1	Males	78	85%
2	Females	12	15%
	Total	**92**	**100%**

The data presented in Table 1 show the distribution of respondents based on gender. The table indicates that out of the total respondents, 78 were males, representing 85%, while 12 were females, representing 15%. The total number of respondents was 92, which represents 100% of the sample used for the study.

Table 2: Qualification of the Respondents

S/N	**Qualification**	**Frequency**	**Percentage**
1	BSc.	22	24%
2	MSc.	43	47%
3	PhD	27	29%
	Total	92	100%

The data presented in Table 2 show the distribution of respondents based on academic qualification. The table indicates that 22 respondents possessed a B.Sc. qualification, representing 24% of the total sample. In addition, 43 respondents had an M.Sc. qualification, representing 47%, while 27 respondents possessed a Ph.D. qualification, representing 29%. The total number of respondents was 92, representing 100% of the sample used for the study.

Table 3: Years of Teaching Experience of the Respondents

Yeas	**Frequency**	**Percentage**
1-5 years	35	38.0%
6-10 Years	25	27.1%
More than 10 Years	32	34.9%
Total	92	100%

Answering Research Question

Research Question One: What is the level of awareness of augmented reality applications in chemistry teaching among university lecturers in Sokoto State?

Table 4: Level of awareness of AR Applications

Questions	Mean	SD	Decision
I am aware of augmented reality technology in education.	2.82	0.91	High
I am familiar with the use of augmented reality in teaching chemistry.	2.58	0.96	High
I have seen augmented reality applications used in science instruction.	2.43	1.02	Low
I understand how augmented reality can enhance visualization of chemical concepts.	2.67	0.89	Moderate
I am aware of the benefits of augmented reality in teaching abstract chemistry topics.	2.52	0.94	High
Grand Mean	2.60	0.94	High

The results in Table 4 indicate that most of the items recorded mean scores above the cut-off point of 2.50, suggesting that university lecturers in Sokoto State have some level of awareness of augmented reality applications in chemistry teaching. However, the item on exposure to augmented reality applications in science instruction recorded a mean score below the cut-off point, indicating low practical exposure. The overall grand mean of 2.60 implies that lecturers possess a moderate level of awareness of augmented reality, though such awareness is not sufficiently strong, particularly in terms of direct experience and application.

Research Question Two: What types of augmented reality applications are known to university lecturers for teaching chemistry?

Table 5: Types of Augmented Applications Known by the Respondents

Questions	Mean	SD	Decision
I am familiar with mobile-based augmented reality applications for teaching chemistry.	2.55	0.93	High
I am aware of AR applications that visualize molecular structures in 3D.	2.68	0.90	High
I know AR tools that simulate laboratory experiments.	2.40	1.01	Low
I am aware of AR applications used for interactive textbooks or learning materials.	2.47	0.98	Low
I know of any specific AR software/platform used in science education.	2.32	1.05	Low
Grand Mean	2.48	0.97	Low

The data presented in Table 5 show the mean and standard deviation scores of lecturers' responses on the types of augmented reality applications known for teaching chemistry. The mean scores range from 2.32 to 2.68, while the standard deviation values range from 0.90 to 1.05, indicating variability in responses. Specifically, the item "I am familiar with mobile-based augmented reality applications for teaching chemistry" recorded a mean of 2.55 with a standard deviation of 0.93, while "I am aware of AR applications that visualize molecular structures in 3D" had a mean of 2.68 and standard deviation of 0.90. The item "I know AR tools that simulate laboratory experiments" recorded a mean of 2.40 with a standard deviation of 1.01. Similarly, "I am aware of AR applications used for interactive textbooks or learning materials" had a mean of 2.47 and standard deviation of 0.98, while "I know of any specific AR software/platform used in science education" recorded a mean of 2.32 with a standard deviation of 1.05. The overall grand mean of 2.48 with a standard deviation of 0.97 summarizes the responses across all items.

Research Question Three: What factors influence university lecturers' awareness of augmented reality applications in chemistry teaching?

Table 6: Mean and Standard Deviation of Factors Influencing Awareness of AR

Questions	Mean	SD	Decision
My level of awareness of AR is influenced by access to technological devices.	3.05	0.88	High
Availability of internet facilities affects my awareness of AR applications.	3.12	0.85	High
Training in educational technology influences my awareness of AR.	3.20	0.82	High
Institutional support affects my awareness of AR in teaching.	2.95	0.90	High
My teaching experience influences my awareness of AR applications	2.48	0.97	Low
Grand Mean	2.96	0.88	High

The data presented in Table 6 show the mean and standard deviation scores of lecturers' responses on factors influencing their awareness of augmented reality applications in chemistry teaching. The mean scores range from 2.48 to 3.20, while the standard deviation values range from 0.82 to 0.97, indicating some variation in responses. Specifically, the item "My level of awareness of AR is influenced by access to technological devices" recorded a mean of 3.05 with a standard deviation of 0.88, while "Availability of internet facilities affects my awareness of AR applications" had a mean of 3.12 and standard

deviation of 0.85. The item "Training in educational technology influences my awareness of AR" recorded a mean of 3.20 with a standard deviation of 0.82. Furthermore, "Institutional support affects my awareness of AR in teaching" had a mean of 2.95 and standard deviation of 0.90, while "My teaching experience influences my awareness of AR applications" recorded a mean of 2.48 with a standard deviation of 0.97. The overall grand mean of 2.96 with a standard deviation of 0.88 summarizes the responses across all items.

Discussion

The findings of the study revealed that university lecturers demonstrated a moderate level of awareness of augmented reality applications in chemistry teaching. Although lecturers indicated familiarity with the concept and general benefits of augmented reality, their exposure to its practical use, particularly through workshops and direct classroom application, appeared limited. This suggests that awareness is largely theoretical rather than experiential. This finding aligns with recent studies which report that while educators are increasingly aware of emerging technologies, their practical engagement remains constrained due to limited training opportunities and institutional support (Garzón & Acevedo, 2019; Ibáñez & Delgado-Kloos, 2018). It further supports the argument that awareness alone is insufficient for effective technology integration without adequate professional development.

The study also found that lecturers' knowledge of specific augmented reality applications used in chemistry teaching was relatively low. While some respondents were aware of general applications such as those used for molecular visualization, fewer were familiar with more specialized tools like virtual laboratory simulations and interactive instructional platforms. This indicates a gap between general awareness and in-depth knowledge of available technological tools. Similar findings have been reported in recent literature, where educators demonstrated limited familiarity with specific augmented reality platforms despite acknowledging their instructional potential (Radianti et al., 2020; Akçayır & Akçayır, 2017). This gap may hinder effective adoption, as the ability to integrate technology meaningfully depends on both awareness and functional knowledge of specific applications.

Furthermore, the findings identified key factors influencing lecturers' awareness of augmented reality, including access to technological devices, internet availability, training in educational technology, and institutional support. These factors were perceived as significant in shaping lecturers'

awareness levels, highlighting the role of environmental and organizational conditions in technology adoption. This is consistent with existing studies which emphasize that successful integration of emerging technologies in education is strongly influenced by infrastructural readiness, institutional backing, and continuous professional training (Bond et al., 2020; Zawacki-Richter et al., 2019). The relatively lower influence of teaching experience suggests that familiarity with technology is not necessarily dependent on years of service but rather on exposure and access to digital resources.

Conclusion

This study examined the awareness of augmented reality applications in chemistry teaching among university lecturers in Sokoto State. The findings revealed that lecturers possess a moderate level of awareness of augmented reality, indicating that while they are generally familiar with the concept and its educational relevance, their practical exposure and in-depth knowledge remain limited. The study also showed that lecturers have relatively low familiarity with specific augmented reality tools and applications used in chemistry instruction, suggesting a gap between general awareness and practical competence. Furthermore, factors such as access to technological devices, internet availability, training in educational technology, and institutional support were identified as key influences on lecturers' awareness of augmented reality. Based on these findings, it can be concluded that although awareness of augmented reality exists among university lecturers, it is not sufficiently developed to support effective pedagogical integration in chemistry teaching.

Recommendations

Based on the findings of this study, the following recommendations are made:

I. Universities should organize regular training and workshops on augmented reality applications to enhance lecturers' practical knowledge and skills in integrating the technology into chemistry teaching.

II. Government and educational stakeholders should improve technological infrastructure, including access to digital devices and

reliable internet facilities, to support the adoption of augmented reality in higher education.

III. Institutional support should be strengthened by providing policies and incentives that encourage the use of innovative teaching technologies such as augmented reality.

IV. Lecturers should be encouraged to engage in continuous professional development through conferences, seminars, and self-directed learning to improve their awareness and use of emerging technologies in teaching.

Reference

Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review.*

Bond, M., Bedenlier, S., Marín, V. I., & Händel, M. (2020). Emergency remote teaching in higher education: Mapping the first global online semester. *International Journal of Educational Technology in Higher Education.*

Garzón, J., & Acevedo, J. (2019). Meta-analysis of the impact of augmented reality on students' learning outcomes. *Educational Research Review.*

Ibáñez, M. B., & Delgado-Kloos, C. (2018). Augmented reality for STEM learning: A systematic review. *Computers & Education.*

Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers & Education.*

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education. *International Journal of Educational Technology in Higher Education.*

Abanikannda, M. A., & Anu, A. G. (2024). Perceived influence of augmented reality on students' learning of chemistry concepts. *Journal of Chemical Education Research*.

Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review*.

Aliyu, F. (2020). A preliminary study for designing and developing augmented reality-based module for teaching chemical bonding in Nigerian secondary schools. *Journal of Science Education and Technology*.

Aliyu, Z., et al. (2025). Effect of augmented reality on students' academic performance and interest in STEM subjects in Kaduna State. *Gusau Journal of Humanities and Social Sciences*.

Ateş, H., & Garzón, J. (2023). Teachers' acceptance of augmented reality in education: A meta-analysis. *Computers & Education*.

Bond, M., Bedenlier, S., Marín, V. I., & Händel, M. (2020). Emergency remote teaching in higher education: Mapping the first global online semester. *International Journal of Educational Technology in Higher Education*.

Chang, K. E., et al. (2022). The effects of augmented reality on science learning: A review. *Educational Technology & Society*.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*.

Duc, D. H., et al. (2025). Challenges in integrating augmented reality in higher education. *Educational Technology Research and Development*.

Garzón, J., & Acevedo, J. (2019). Meta-analysis of the impact of augmented reality on students' learning outcomes. *Educational Research Review*.

Ibáñez, M. B., & Delgado-Kloos, C. (2018). Augmented reality for STEM learning: A systematic review. *Computers & Education*.

Lidiastuti, A., et al. (2024). Augmented reality in science education: Enhancing students' conceptual understanding. *Journal of Science Education*.

Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education. *Computers & Education*.

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education. *International Journal of Educational Technology in Higher Education*.

AWARENESS OF AUGMENTED REALITY IN CHEMISTRY TEACHING QUESTIONNAIRE (AARCTQ)

Dear respondent, I am conducting a research on Awareness of Augmented Reality Applications in Chemistry Teaching among University Lecturers in Sokoto State: Implications for Pedagogical Integration, please kindly help by responding to the following questions accordingly. Thank you

Section A: Demographic Information

1. Gender:
   Male Female

2. Academic Qualification:
   B.Sc M.Sc Ph.D

3. Years of Teaching Experience

1-5 years ( ) 6-10 Years ( ) More than 10 Years

Section B: Level of Awareness of Augmented Reality Applications

Instruction: Indicate your level of agreement using: SA = Strongly Agree, A = Agree, D = Disagree, SD = Strongly Disagree

S/N	Questions	SA	A	D	SD
1	I am aware of augmented reality technology in education.				
2	I am familiar with the use of augmented reality in teaching chemistry.				
3	I have seen augmented reality applications used in science instruction.				
4	I understand how augmented reality can enhance visualization of chemical concepts.				
5	I am aware of the benefits of augmented reality in teaching abstract chemistry topics.				

Types of Augmented Reality Applications Known

S/N	Questions	SA	A	D	SD
1	I am familiar with mobile-based augmented reality				

	applications for teaching chemistry.				
2	I am aware of AR applications that visualize molecular structures in 3D.				
3	I know AR tools that simulate laboratory experiments.				
4	I am aware of AR applications used for interactive textbooks or learning materials.				
5	I know of any specific AR software/platform used in science education.				

Factors Influencing Awareness of Augmented Reality

S/N	Questions	SA	A	D	SD
1	My level of awareness of AR is influenced by access to technological devices.				
2	Availability of internet facilities affects my awareness of AR applications.				
3	Training in educational technology influences my awareness of AR.				
4	Institutional support affects my awareness of AR in teaching.				
5	My teaching experience influences my awareness of AR applications				