

THE IMPACT OF AUGMENTED REALITY (AR) AND VIRTUAL REALITY (VR) ON USER ENGAGEMENT IN DIGITAL LIBRARIES IN SOUTH SOUTH, NIGERIA

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ABSTRACT

The study investigated the impact of augmented reality and virtual reality on user engagement in digital libraries in Universities in South- South Nigeria. The study adopted descriptive survey design. The study population consistent of all the 568 library staff in the university in the south – south, Nigeria. A random sample procedure was used to select two universities namely: University of Port Harcourt and University of Calabar respectively while a sample of 158 study participants were selected randomly from the two universities (i.e Uniport =82 Unical 76). The instrument used for data collection was a self constructed questionnaire titled: Impact Of Augmented Reality And Virtual Reality on User Engagement in Digital Libraries (IARVRUE). The instrument was validated by experts drawn from the department, while a reliability coefficient index of 0.81 was obtained using test-retest method. The research questions were answered with mean and standard deviation while the hypotheses were tested using t. Test at 0.05 level of significance. Major findings of the study revealed that augmented reality and virtual reality impacted on the level of user engagement in digital libraries by enhancing information literacy and making learning and research more attractive. The study recommends among others that library staff should be encouraged to attend workshops to keep them abreast with new innovations in the industry.

INTRODUCTION

The integration of Augmented Reality (AR) and Virtual Reality (VR) technologies has revolutionized user engagement across various sectors, including education and information services. In the context of digital libraries, AR and VR offer immersive experiences that can transform traditional methods of information access and learning. This transformation is particularly significant in regions like South-South Nigeria, where digital libraries play a crucial role in educational development and information dissemination.

AR enhances the real-world environment by overlaying digital information, allowing users to interact with both physical and virtual elements seamlessly. For instance, libraries can utilize AR to create interactive displays that provide additional information and multimedia content related to their collections. This technology has been employed to offer interactive tours, virtual maps, educational games, and even virtual assistants, thereby enriching the user experience and making information more accessible (IFLA, 2023).

Similarly, VR creates entirely virtual environments, enabling users to explore simulated settings that can be both educational and engaging. In library services, VR has been used to develop immersive learning experiences, such as virtual tours of historical sites or interactive exhibits, allowing users to engage with content in a more profound manner. These applications have the potential to enhance information literacy, library orientation, and user education services (Pacific University Libraries, 2024).

In Nigeria, studies have indicated a growing interest in adopting AR and VR technologies within library services. Research conducted in Lagos State revealed that library users have a positive attitude towards the implementation of AR and VR, recognizing their potential to enhance library usage and user engagement (Adeyemi et al., 2023). Similarly, a study focusing on university libraries in Delta and Edo States highlighted librarians' willingness to implement VR technologies,

acknowledging their potential to revolutionize library services and improve user experiences (Ogbomo, 2022).

Despite the recognized potential, the adoption of AR and VR in digital libraries within South-South Nigeria faces challenges, including limited awareness of suitable technologies to adopt, financial constraints, and the need for training among library staff (Ogbomo, 2022). Addressing these challenges is essential to fully harness the benefits of AR and VR in enhancing user engagement in digital libraries.

This study aims to explore the impact of AR and VR on user engagement in digital libraries in South-South Nigeria, examining both the opportunities these technologies present and the challenges that need to be addressed to facilitate their effective implementation.

Statement of the Problem

Digital libraries in South-South Nigeria play a critical role in providing access to academic resources, research materials, and information services. However, user engagement in these libraries remains a significant challenge due to traditional library systems that may not fully capture the interest and participation of modern users, particularly in an era where digital and immersive technologies are becoming mainstream.

Augmented Reality (AR) and Virtual Reality (VR) have emerged as innovative tools capable of transforming library services by enhancing interactivity, engagement, and accessibility. These technologies offer users immersive experiences, making learning and research more interactive and appealing. Despite the growing adoption of AR and VR in global library systems, their integration in digital libraries across South-South Nigeria remains limited. There is a lack of empirical studies evaluating their effectiveness in improving user engagement, and many institutions may not have the necessary infrastructure, technical expertise, or funding to support these advancements.

Additionally, many library users in the region may be unaware of the potential benefits of AR and VR, leading to underutilization of available digital resources. There is also a gap in training librarians to effectively implement these technologies and educate users on how to maximize their use.

Given these challenges, this study seeks to explore the impact of AR and VR on user engagement in digital libraries in South-South Nigeria and provide recommendations on how digital libraries can leverage these technologies to enhance learning experiences and overall user satisfaction.

Purpose of the Study

This main aim of this study was to explore how Augmented Reality (AR) and Virtual Reality (VR) influence user engagement in digital libraries across South-South Nigeria. The study sought to assess whether these technologies make digital libraries more interactive, accessible, and appealing to users.

Specifically, the objectives of the study include:

1. To find out how Augmented Reality (AR) and Virtual Reality (VR) influence user engagement in digital libraries in South South Nigeria.
2. To find out whether users of Augmented Reality (AR) and Virtual Reality (VR) experience higher engagement and satisfaction compared to traditional digital libraries

Research Questions

The following research questions guided the study:

1. How does the use of AR and VR impact the level of engagement of users in digital libraries in South-South Nigeria?
2. What is the difference in user experience between traditional digital libraries and those enhanced with AR and VR?

Hypotheses

The following hypotheses guided the study:

H₀₁ there is no significant difference between the mean scores of Uniport library staff and Unical Library staff on the impact of augmented reality and virtual reality on the level of engagement of the users in digital libraries in the Universities in South-South, Nigeria

H₀₂ there is no significant difference in the mean scores of Uniport library staff and Unical library staff on the differences between traditional digital library and those enhanced by augmented reality and virtual reality in the Universities in the south-south, Nigeria

Conceptual Review

Concept of The impact of Augmented Reality (AR) and Virtual Reality (VR) on user Engagement in Digital Libraries in South South, Nigeria

Augmented Reality (AR) and Virtual Reality (VR) technologies have been recognized for their potential to enhance user engagement in digital libraries by offering immersive and interactive experiences. In the context of South-South Nigeria, encompassing states like Delta and Edo, studies have explored the readiness and perceptions of implementing these technologies in university libraries.

A study by Ogbomo (2022) Investigated the potential adoption of virtual reality services in university libraries within Delta and Edo States. The research revealed a high willingness among librarians to implement VR technologies, acknowledging their applicability in services such as information literacy, library orientation, and user education. However, the study also highlighted a gap in awareness regarding specific VR technologies suitable for adoption, suggesting a need for targeted training and funding to facilitate effective implementation. Similarly, a study by Adeyemi et al. (2023) examined the influence of VR and AR on users' intentions to utilize public libraries in Lagos State. The findings indicated a positive attitude among users towards these technologies, with subjective norms significantly influencing their intention to use VR and AR in library settings. The study also emphasized the necessity of librarians' cooperation in the successful adoption of these technologies, underscoring the importance of staff readiness alongside user enthusiasm. While these studies provide valuable insights, there is a paucity of specific research focusing exclusively on the impact of AR and VR on user engagement in digital libraries within the South-South region of Nigeria. The existing literature suggests a general openness to adopting immersive technologies among both librarians and users, but also points to challenges such as lack of awareness about specific technologies, funding constraints, and the need for specialized training.

Theoretical Review

The Technology Acceptance Model (TAM), developed by Fred Davis in 1986 and published in 1989, is a widely recognized framework for understanding user acceptance of technology. TAM posits that two primary factors influence an individual's decision to use a technology:

Perceived Usefulness (PU): The degree to which a person believes that using a particular system would enhance their job performance.

Perceived Ease of Use (PEOU): The degree to which a person believes that using a particular system would be free from effort.

In the context of digital libraries, these constructs can be applied to assess how users perceive and engage with Augmented Reality (AR) and Virtual Reality (VR) technologies. For instance, if users find AR and VR applications in digital libraries useful and easy to use, they are more likely to adopt and engage with these technologies.

The TAM has undergone several extensions to incorporate additional factors influencing technology acceptance:

TAM2: Introduced by Venkatesh and Davis in 2000, this extension includes social influence processes and cognitive instrumental processes as determinants of perceived usefulness and usage intentions.

Unified Theory of Acceptance and Use of Technology (UTAUT): Proposed by Venkatesh, Morris, Davis, and Davis in 2003, UTAUT integrates elements from various models, including TAM, to explain user intentions and subsequent usage behavior.

Applying these models to the study of AR and VR in digital libraries, particularly in regions like South-South Nigeria, can provide valuable insights into user engagement. Understanding factors such as social influence, facilitating conditions, and individual differences can help in designing and implementing AR and VR applications that meet user needs and encourage adoption.

Empirical Review

Empirical studies on the impact of Augmented Reality (AR) and Virtual Reality (VR) on user engagement in digital libraries within South-South Nigeria are limited. However, relevant research from nearby regions provides valuable insights. A study by Ogbomo (2022) investigated the potential for implementing VR services in university libraries in Delta and Edo States, Nigeria. The research revealed a high willingness among librarians to adopt VR technologies for services such as information literacy, library orientation, and user education. However, there was a notable lack of awareness regarding specific VR technologies suitable for adoption. The study recommended allocating funds for VR technology acquisition and organizing training sessions for librarians to enhance their readiness for implementation. In Lagos State, Adeyemi et al. (2023) examined how VR and AR could predict users' intentions to utilize public libraries. The findings indicated that library users had a positive attitude toward VR and AR, suggesting that the introduction of these technologies could enhance user engagement and intention to use library services. The study also highlighted the necessity for librarian cooperation and adequate funding to support the adoption of these technologies. These studies suggest that while direct empirical research on AR and VR's impact on user engagement in digital libraries within South-South Nigeria is scarce, there is a positive perception and willingness among both librarians and users in nearby regions to adopt these technologies. Implementing AR and VR could potentially enhance user engagement in digital libraries, provided there is sufficient awareness, funding, and training for effective adoption.

METHODOLOGY

Research design: the research design adopted in this study was descriptive survey design

Population of the study: the population of the study consisted of all library staff in the Universities in the South- south; Nigeria. As at the time of this study, the total population was 568.

Sample And Sampling Procedure: A simple random technique was used to select two Universities in the South –South Region, they are University of Port Harcourt and University of Calabar, in the same vein, a total of 158 study participants were selected as respondents, consisting of 82 for Uniport and 76 for uncial respectively.

Instrument For Data Collection: The instrument for data collection was a self constructed questionnaire titled impact of Augmented reality and virtual reality on user engagement in digital libraries (IARVRUE). The instrument has two parts; the first part handled demographic variables while the second part addressed the questionnaire items. The response options adopted are, Strongly Agree, Agree, Disagree And Strongly, disagree

Validity Of The Instrument: The validity of the instrument was carried out by experts who ensured that the instrument measured what it supposed to measure.

Reliability Of The Instrument: A reliability coefficient index of 0.81 was obtained using test- retest method.

Method Of Data Analysis: the data collected from research questions were analyzed using mean and standard deviation while the hypotheses were tested using t-test at 0.05 level of significance

RESULTS

Research question I: How does the use of augmented reality (AR) and virtual reality (VR) impact on the level of engagement of user in digital libraries in Universities in South- South, Nigeria.

Table 1 mean and standard deviation scores on how augmented reality (AR) and virtual reality (VR) impact on the level of engagement of user in digital libraries.

S/N	Items	Uniport X	SD	Unical X	SD	Remarks
1	Augmented reality and virtual reality enhances user engagement in digital libraries.	2.926	1.710	2.934	1.712	Agreed
2	Virtual reality enhances information literacy	2.951	1.717	2.881	1.697	Agreed
3	These technologies makes learning and research more interactive and appealing	3.024	1.738	3.157	1.776	Agreed
4	Augmented reality improves traditional digital learning	2.987	1.728	2.894	1.701	Agreed
	Aggregate x & SD	2.972	1.723	2.966	1.722	

Table I data analysis revealed that items 1-4 had all the mean score above the criterion mean of 2.5, indicating that augmented Reality and Virtual Reality Impacts on the level of Engagement of Users in Digital Library, by enhancing information literacy, making learning and research interactive and appealing and improving traditional digital learning

Research question 2: what is the difference between traditional digital libraries and those enhanced by augmented reality and virtual reality in universities in the South South Nigeria?

Table 2: Mean and Standard Deviation, Scores on The Difference Between Traditional Digital Libraries And Ar And Vr.

S/N	Items	Uniport X	SD	Unical X	SD	Remarks
5	Traditional digital libraries focuses on delivering content through screens while AR and UR creates interactive and immersive experiences.	3.000	1.732	3.3013	1.735	Agreed
6	AR and VR provides digital information while traditional digital, libraries, provides immediate access to information	2.953	1.718	2.921	1.709	Agreed
7	Traditional digital libraries foster direct information and immediate feedback while AR and VR uses computer based perceptual information	2.902	1.703	2.881	1.697	Agreed

8.	AR and UR can control their presence in their in the real world while traditional digital libraries creates contents through screens	3.121	1.766	2.996	1.730	Agreed
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Analysis of data on table 2 showed that item 5-8 had all the mean scores above the criterion mean of 2.5, meaning that the differences between traditional digital libraries and augmented Reality, and virtual Reality are that, traditional digital libraries focuses on delivering content through screens while AR and VR provides digital information

HYPOTHESES

H₀₁ there is no significant difference between the mean scores of Uniport library staff and Unical Library staff on the impact of augmented reality and virtual reality on the level of engagement of the users in digital libraries in the Universities in South-South, Nigeria

Table 3: t-test of differences between Uniport and Unical on the impact of AR and VR on the level of engagement of users in the digital libraries.

Variables	N	\bar{X}	SD	DF	t-cal	t-tab	Decisions
Uniport	82	2.972	1.723				
				156	0.22	1.96	Not sig
Unical	76	2.966	1.722				

Data analysis on table 3 showed that t-calculated value of 0.22 is less than the t-tab value of 1.96 at 156 degrees of freedom. Hence, the null hypothesis was accepted, meaning there is no significant difference between the mean scores of Uniport library staff and Unical library staff on the impact of augmented reality and virtual reality on the level of engagement of users in digital library in the universities in the South-South Nigeria

H₀₂ there is no significant difference in the mean scores of Uniport library staff and Unical library staff on the differences between traditional digital library and those enhanced by augmented reality and virtual reality in the Universities in the south-south, Nigeria

Table 4: t-test of differences between Uniport and Unical library staff on the differences between traditional digital library and those enhanced by AR and VR.

Variables	N	\bar{X}	SD	DF	t-cal	t-tab	Decisions
Uniport	82	2.994	1.730				
				156	0.15	1.96	Not sig
Unical	76	2.952	1.718				

TABLE 4 data analysis revealed that t calculated value of 0.15 is less than the t-table value of 1.96 at 156 degrees of freedom and 0.05 significant level. Hence the null hypothesis was accepted, indicating that there is no significant difference in the mean scores of Uniport and Unical library staff on the difference between traditional digital library and those enhanced by augmented reality and virtual reality in the universities in the south-south, Nigeria

DISCUSSION OF RESULTS

The findings on research question one and hypothesis one indicating that augmented reality and virtual reality impacted on the level of engagement of users in digital libraries by enhancing information literacy, making learning and research interactive and appealing and improving traditional digital learning. These findings are in agreement with Adeyemi et-al (2023) who posited that implementing augmented reality and virtual reality could potentially enhance user engagement in digital learning. Research question two and hypothesis two findings revealed that the differences

between traditional digital libraries and augmented reality and virtual reality is that traditional digital libraries focuses on delivering content through screens while augmented reality and virtual reality creates Interactive and immersive experiences this findings is in agreement with Ogboma (2022) who emphasized that while traditional digital libraries provides immediate access to instructors through direct virtual reality it enhances the real world with computer aided perceptual information.

CONCLUSION

Augmented reality and virtual reality have emerged as innovative tools capable of transforming library service by enhancing interactivity engagement and accessibility. This study which explores the impact of augmented reality and virtual reality on user engagement in digital libraries could be concluded that augmented reality and virtual reality impacted on level of engagement of users on digital libraries by enhancing information literacy and making learning and research more interactive.

RECOMMENDATIONS

The study recommends as follows

1. Management of tertiary institutions libraries should carry out innovative practices to reposition their library services to meet global standards
2. Augmented and virtual reality should be integrated in our library services to enhance information sharing among students
3. Library staff should regularly attend workshops to keep them abreast with new innovations.

REFERENCES

- Adeyemi, I.O., Sulaiman, K.A., Abdulsalam, Z.M., &Issa, A.O. (2023). Virtual and augmented reality as predictors of users' intention to use Lagos State Public Library, Lagos State, Nigeria. *The Electronic Library*, 41(5), 682-699.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340.
- IFLA. (2023, June 5). Augmented Reality in Libraries. *International Federation of Library Associations and Institutions*.
- Ogbomo, E.F. (2022). Virtual reality library services: A global vision for university libraries in Delta and Edo states, Nigeria. *Regional Journal of Information and Knowledge Management*, 7(1), 1-13.
- Pacific University Libraries. (2024, February 16). Augmented Reality and Virtual Reality in Libraries. *Pacific University Libraries*.
- Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, 46(2), 186-204.
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425-478.