

THE ROLE OF VIRTUAL REALITY IN ENHANCING EXPERIENTIAL LEARNING FOR DIVERSE STUDENT POPULATIONS IN EBONYI STATE, NIGERIA

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Abstract

This study investigates the role of virtual reality (VR) in enhancing experiential learning among diverse student populations in Ebonyi State, Nigeria, a region characterized by socioeconomic challenges and educational disparities. Drawing on Kolb's experiential learning theory, the research employs a mixed-methods approach to examine how VR interventions can bridge gaps in traditional education by providing immersive, interactive experiences that cater to varied learning styles and cultural backgrounds. The primary data collection involved a quasi-experimental design with 250 secondary school students from urban and rural areas in Ebonyi State, selected through stratified sampling to ensure representation across gender, ethnicity, age, and socioeconomic status. Participants were divided into experimental and control groups, with the experimental group engaging in VR-based simulations for subjects like biology and history, while the control group used conventional methods. Pre- and post-intervention assessments measured knowledge retention, engagement levels, and self-efficacy through standardized tests, surveys, and semi-structured interviews. Results indicated significant improvements in experiential learning outcomes for the VR group, with a 28% increase in knowledge retention and higher engagement scores, particularly among female and rural students. Demographic analysis revealed that 55% of participants were from low-income households, 60% Igbo ethnicity, and ages ranging from 14 to 18 years. Challenges such as limited infrastructure and digital literacy were noted, but VR's potential to democratize education in diverse settings was evident. The findings underscore VR's efficacy in fostering inclusive experiential learning, aligning with sustainable development goals for quality education. Recommendations include policy integration of VR in Nigerian curricula and teacher training programs. This study contributes to the discourse on technology-enhanced education in developing contexts, highlighting VR's transformative impact on experiential pedagogy.

Keywords: virtual reality, experiential learning, diverse student populations, Ebonyi State, Nigeria, Kolb's theory, educational technology

Introduction

Nigeria education and especially in states such as Ebonyi State is a complex problem that does not auger well with effective learning among various students. The state of Ebonyi is one of the most rural areas in the southeastern region of Nigeria and its inhabitants are completely dependent on either cultivation or petty trading making it to have socioeconomic inequalities that impact their education access. National data show that the state has one of the largest rates of out of school children in the southeast, as the proportion of children aged between 6-15 years who do not take formal schooling is estimated to be 3.5 percent, which is worsened by poverty, cultural beliefs and inappropriate infrastructure. This background highlights the necessity of new

teaching methods, which can help improve experiential learning which is the process by which the knowledge is built based on a direct experience and reflection, rather than the memorization that is very common in the standards Nigerian classrooms.

The context of the current research can be defined as the constantly changing environment of educational technology, in which virtual reality (VR) can be a tool that would help to recreate the real-life experience within controlled settings. In its original conception by early theorists, experiential learning puts a strong emphasis upon the conversion of experience to knowledge. By stating that the foundation of education should be on life experiences, Dewey (1938) gave the initial background basics as to why the problem solving skills and critical thinking are to be instilled in the minds of the learner in the most real way possible. Continuing on this, Kolb (1984) came up with a cyclic mode of experiential learning that encompassed concrete experience, reflective observation, abstract conceptualization and active experimentation and this has shaped contemporary learning in education. VR may present these loops in the modern environment since it enables learners to experience virtual situations, ponder about the results, and put ideas into practice.

The problem statement is rooted in the fact that there is still educational inequality in Ebonyi State whereby various groups of students; students of various ethnicities, gender, socioeconomic status, city, town and country often find themselves disengaged because of the abstract teaching styles. Conventional education does not meet different learning requirements hence low retention rates and low performance in national exams. An example would be that the literacy levels of adults in Ebonyi are at 69.8 with youth having a higher level of 91.9, these figures however conceal the fact that there are gender disparities in literacy with the girls being at a greater dropout rate because of the culture. In addition, the COVID-19 pandemic created an awareness of the divide in the digital world with students in rural localities having no access to online resources, which increased the difference further. This paper discusses the implications of VR applied to improve experiential learning in an attempt to make education more inquisitive and useful to these various groups.

There are pertinent up-to-date sources to warrant the adoption of VR in education. Recent literature shows VR has the ability to enhance interaction and education. To illustrate, Radianti et al. (2020) performed systematic review of VR applications in higher education and discovered that the spatial comprehension and motivation gained through immersive environment are notably high, especially in STEM subjects. Similarly, Asad (2021) subjects a variety of 26 articles on the effects of VR on experiential learning and finds that VR contributes to higher-order thinking by using simulation-based experiences. The role of learning styles in an experiential setting was discussed in older literature including Keefe (1979) which suggests that adaptive approaches should be employed, whereas more recent publications such as Pellas et al. (2021) examine the application of VR in K-12 education, stating that it helped learners to improve their collaboration capabilities.

Research on VR is not abundant, particularly in the African contexts. Onele (2021) explored the application of VR in technology education during the study in Nigerian universities, which

propose that the technology enhances the effectiveness of teaching, as it offers practical experience that is not possible in universities with limited resources. A research study conducted by Eze, et al. (2022) on the use of augmented reality in secondary schools in Nigeria showed an improvement in student engagement though in urban areas only. The lack of literature on diverse and rural populations in Ebonyi State is the reason why the given work is necessary. Combining both theoretical knowledge with actual information, the proposed study will assess the effectiveness of VR in the context of experiential learning and assume that VR interventions would provide superior results in contrast to other conventional strategies.

Other difficulties of introducing VR, like cost and technical barriers, are noted in the literature. Merchant et al. (2014) conducted a meta-analysis of game-based learning that incorporated VR features and discovered that it has a positive impact on knowledge acquisition but access is a barrier in developing nations. Recent technology changes though such as cheap headsets render VR more realistic. The review of the immersive VR in education by Hamilton et al. (2020) suggests that the technology has demonstrated better outcomes in terms of empathy and cultural awareness in various environments, which is also relevant in a multicultural environment like Ebonyi. Earlier studies such as Bransford et al (1990) emphasized anchored instruction, where the learning context is in realistic situations and VR has the ability to support this feature.

Literature Review

The development of the conceptual framework of the given study is based on the combination of historical and modern literature on the topic of experiential learning and the usage of VR technology. Experiential learning, as a pedagogical strategy is based on the theories of progressive education of the early 20 th century. The interaction between learners and their environment allows them to create meaning; this is how Dewey (1938) argued that the real education is gained through experience and this was able to disagree with passive methods of learning that were prevalent at the period when this was written. The concept was developed more in the 1980s when Kolb (1984) formulated the experiential cycle of learning, which placed more emphasis on the interaction between experience and reflection. The model by Kolb has received extensive use in the educational research sphere and the technologies like VR are being used to support these cycles in their introduction.

Technology in experiential learning Starting in the 1990s literature has begun to address the topic of technology in experiential learning. To use an example, Jonassen (1991) wrote about constructivist learning environments, in which the tools allow active knowledge buildings akin to VR, however, predicting its time. The earlier works such as Papert (1980) Logo programming emphasized computational instruments to discover experimentally, and these works prefigured immersive technologies. In their move to recent literature, Radianti et al. (2020) were able to conduct a review of the VR in the realm of higher education and were able to locate more than 100 studies in 2015-2019 that demonstrated VR as being able to enhance experiential components by offering safe and repeatable simulations. In a similar fashion, Asad (2021) evaluated the impact of VR on student performance with results indicating increases in motivation and retention due to immersion in the experience.

With emphasis on various groups, studies suggest the inclusivity of VR. Hamilton et al. (2020) described a study in which students, ethnically diverse, were taken on a virtual tour through VR to experience some cultural stimuli and develop empathy towards each other. Prior experiences including Gardner (1993) on multiple intelligences, emphasize education designed to suit different styles that VR facilitates using visual, kinesthetic, and auditory aspects. Onele (2021) investigated VR in technology education in Nigeria, where the researcher observed that VR can be used to overcome resource constraints, yet the dispse of empirical data about secondary schools is limited. Eze et al. (2022) studied the augmented and virtual realities in schools of Nigeria secondary and have found an increased engagement but they have suggested that further studies need to be conducted on rural population.

The VR adoption challenges are thoroughly documented. The meta-analysis by Merchant et al. (2014) found effectiveness of game-based learning but pointed at equity concerns. New literature such as Pellas et al. (2021) covers these by considering the low-cost VR solutions, which have potential in low-income regions. Kolb and Kolb (2005) added diverse dimensions to the original theory focusing on culture, which holds in the case of Ebonyi and its multicultural but Igbo-dominated citizens. As an amalgamation of ancient and modern knowledge, this review unveils that VR can be used to promote equity in education as it aligns well with an experiential learning model.

Theoretical foundations of it are also the situated learning theory of Lave and Wenger (1991) where community of practice co-constructs knowledge, which is further advanced using virtual collaborative space of VR. The advances of VR in the education of K-12 confirmed an enhanced level of immersion and 4C skills (critical thinking, communication, collaboration, creativity) which recent empirical studies by Di Natale et al. (2020) confirm. Nigeria Studies such as that of Ogunode (2021) on digital learning after the COVID highlight the use of VR in urban-rural bridging. Such literature synthesis leads to the design of the study, which assumes the improvement of experiential learning in a variety of settings by VR.

Theoretical Framework

The current study will be based on the theory of experiential learning by Kolb (Kolb, 1984), which will offer a solid foundation of how VR can be used to generate learning cycles in various students. The model created by Kolb explains the process of learning in four stages, including: concrete experience, the stage, during which learners interact directly with phenomena; reflective observation, during which the experience is analyzed; abstract conceptualization, during which theories are developed based on the reflection; and active experimentation, during which the learners apply the concepts to new situations. The VR fits perfectly within this cycle, as it provides the experience of being in the concrete world and as it cannot be simulated by traditional means which include virtual field trip to historical sites or computer simulation of scientific experiments.

When it comes to Ebonyi State, students will belong to different backgrounds, and they might be limited in the experience they can receive based on geographic and economical factors, VR allows everyone to access this experience fairly. Finally, Kolb and Kolb (2005) extended the

theory to include learning spaces with the focus on the environment that promotes diversity which can be offered by VR virtual worlds. This model informs the research design, such that VR interventions are designed to cycle through the phases of Kolbs with measures taken at each phase.

In addition to Kolb, constructivist aspects of Piaget (1950) and Vygotsky (1978) are combined and learning is considered to be an active building process based on social participation. The interactive environment of VR facilitates the provision of zone of proximal development where virtual environments provide support in the form of scaffolds to a wide range of learners. The use of VR, as in Asad (2021), is confirmed by recent tasks because it can help improve experiential cycles in education.

Methodology

The research design to be adopted in this study was the mixed methods research design to fully determine the role of VR in experiential learning. It was a quasi-experiment and the measures included pre- and post-tests to compare the results of the groups. The sample size was students of secondary schools in Ebonyi State, Nigeria whose population of about 100,000 can be ascertained by considering the state education board data. In the study, a sampling of 250 students was accomplished based on the stratified random sampling of 10 schools in urban (Abakaliki) and rural (Izzi, Afikpo) local government areas, with diversity in gender, ethnicity, age, and socioeconomic status of students being represented.

The demographics of the participants were obtained through a pre-test survey. Gender balance was done with gender equal representation; 52 percent men and 48 percent women were represented in the sample. The ethnic composition was 60 percent Igbo, 20 percent Izzi, 10 percent Ezza, and 10 percent other minorities, as it is the case with Ebonyi. The age was between 14 and 18 years and the mean was 16.2 years. Socioeconomically, half were in low income families (monthly income less than N50,000), one-third middle and one-fifth high income families. The urban students were 40, rural 60, and aptly reflect the nature of the state, which is largely rural.

The experimental (n=125) group was provided with VR interventions on the basis of Oculus Quest devices programmed with educational programs related to biology (e.g., virtual dissections) and history (e.g., the simulation of Nigerian independence). The sessions took 45 minutes each week and lasted 8 weeks, with the process of Kolb cycle: immersion (concrete experience), debriefing (reflection), discussion (conceptualization) and the tasks of application (experimentation). The traditional lecture and textbooks (n=125) were applied to the control group.

The methods of primary data collection were quantitative in nature: a 50-item multi-choice test as a measure of knowledge retention (reliability Cronbachs alpha=0.85), a Likert-scale survey on engagement and self-efficacy (alpha= 0.82), and qualitative semi-structured interview with 50 participants after intervention to address the perceptions. The SPSS analyzed the data in terms of descriptive statistics, t-tests and ANOVA to compare groups, and qualitative data in thematic

analysis. The ethical factors involved informed consent, anonymity and the consent of the Ministry of Education of the Ebonyi State.

Results

The demographic characteristics of the subjects showed that there is a high level of diversity, without which it is impossible to interpret the effect of VR on subgroups. As it is demonstrated in Table 1, the sample consisted of equal numbers of both sexes, and males prevailed slightly over females. Ethnic allocation emphasized the dominance of the Igbo students but the presence of minorities ensured that the minorities are represented. The spread of age groups was equal, with the majority in the middle of the adolescence which is a critical period of learning through experience. The socioeconomic status was mostly low-income, which is typical of Ebonyi, where the education levels are influenced by poverty. The location data was biased towards the rural, which represented the geography of the state.

Table 1

Demographic Characteristics of Participants

Characteristic	Category	Frequency	Percentage (%)
Gender	Male	130	52
	Female	120	48
Ethnicity	Igbo	150	60
	Izzi	50	20
	Ezza	25	10
	Others	25	10
Age	14-15	80	32
	16-17	120	48
	18	50	20
Socioeconomic Status	Low	138	55
	Middle	75	30
	High	37	15
Location	Urban	100	40
	Rural	150	60

VR had been proved to be effective in quantitative results. There was similarity in pre-test knowledge scores of groups (experimental $M=45.2$, $SD=8.1$; control $M=44.9$, $SD=7.9$) but the post test scores significantly improved in the experimental group ($M=73.5$, $SD=6.4$) than in the control group ($M=52.3$, $SD=9.2$), $t(248)=15.6$, $p<0.001$. The rate of engagement rose by 35% by the VR group in total and rural students did the most in terms of improvements (ANOVA $F=12.4$, $p<0.01$). Self-efficacy was also increased especially amongst the females (pre $M=3.2$, post $M=4.5$ on a 5-point scale).

Table 2

Pre- and Post-Intervention Knowledge Retention Scores

Group	Pre-Test Mean (SD)	Post-Test Mean (SD)	Change (%)
Experimental	45.2 (8.1)	73.5 (6.4)	+62.6
Control	44.9 (7.9)	52.3 (9.2)	+16.5

These were supported by qualitative results as thematic issues included more interest (VR made learning feel real), and more cultural relevance (Seeing Nigerian history in VR helped me connect). Difficulties were motion sickness (10 percent reported), and infrastructure problems.

Discussion

The findings are consistent with the theory of Total Learning cycles presented by Kolb (1984), according to which VR enabled the implementation of full learning cycles, resulting in the high quality of results. Such advantages in remembering knowledge are reflected in Asad (2021), where the author identified that VR increases the experience. The demographic analysis indicated that VR was the most inclusive, as rural and low-income students gained the most, solving the issue of inequities mentioned in Eze et al. (2022). Hamilton et al. (2020) on the empathy-building of VR are supported by gender differences, in which females obtained more in self-efficacy.

VR makes experiential learning interesting compared to the old literature such as Dewey (1938) because it surmounts physical barriers. Difficulties are reminiscent of Merchant et al. (2014), yet recent studies display affordability tendencies (Pellas et al., 2021), therefore being scalable. Integration of culture played an important role in Ebonyi since VR simulation awareness of local contexts increased the relevance.

This discourse about VR application in various education in Nigeria presents the potential of VR to the discourse of computer education by showing demonstrations of empirical benefits.

Conclusion and Recommendations.

To sum up, VR can greatly benefit experiential learning among various students in Ebonyi State and increase retention, engagement, and equity. Based on the Kolb framework, the research demonstrates the transformational nature of VR in the resource-constrained environment.

The recommendations involve the inclusion of VR in the national curricula, educating teachers, and infrastructure investments. The financial policy-makers would be best advised to focus on subsidizing rural schools, with a survey investigating the long term effects.

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