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Virtual and Augmented Realities in Learning Spaces as Determinants of Students' Engagement in Test Development

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Abstract

Virtual and augmented realities are two of many technological advances in learning spaces. The present study sought to determine the contribution of the integration of virtual and augmented realities in learning spaces to students' engagement in test engagement. The correlational study sampled 269 final year Faculty of Education students from the University of Nigeria, Nsukka using multi-stage sampling. Pearson Product Moment Correlation, Coefficient of Determination and Regression Analysis were used to address the four research questions and hypothesis which guided the study. The findings of the study revealed that a significantly strong positive relationship exists independently between virtual and augmented realities with students' engagement in test development and contributes 75.69% and 53.58% respectively to students' engagement in test development. The joint integration of virtual and augmented realities in learning spaces highly relates positively to students' engagement in test development, contributing 87.24% to students' engagement in test development. The study concluded that integrating virtual and augmented realities into learning spaces enhances students' engagement and fosters better learning experiences which may impact positively on students' academic achievements in test development, reducing cases of school dropouts. Recommendations were made in line with the study's findings.

Keywords: Virtual and augmented realities, Test Development, Immersive and interactive learnings

Introduction

The influx of technology in almost all spheres of life has impacted the landscape of learning; and in particular, has mutated the twenty-first-century teaching and learning environment. No doubt, the introduction of new technologies in teaching and learning offers great flexibilities for accommodating students' diverse learning styles and educational demands. Especially with the new generation of digital native students already in the classroom (Parker, 2021), the prowl of technology in traditional education has been extolled for enhancing the reproduction of learning experiences so closely to real-life experiences, tangible enough to immerse the learner into reality, assist educators and improve educational quality (López-Belmonte, et al. 2022). However, Lampropoulos, et al. (2021) point out that learners' interests, preferences, capabilities, personality, and knowledge should be taken into account when designing technology-enhanced learning activities.

Literature reveals the invaluable contribution of the quality of the learning environment in achieving instructional objectives (Hughes & Morrison, 2020); and the influx of technology in our learning spaces appears to be of immense benefit to this end. Hughes and Morrison (2020) view learning space as a dedicated place purposefully designed by the instructor or student, in which learners interact, and engage in knowledge creation to achieve behavioural objectives and optimise learning. Learning spaces are the totality of indoor and outdoor learning environments prepared with the intent of enhancing cognitive, affective and psychomotor changes towards intended behavioural objectives. According to McDaniel (2014), whether formal or informal, technological tools could be employed to synchronise learning spaces for optimal learning experience, via adaptations to transcend physical, simulated and extended reality experiences.

Extended reality technologies are increasingly being deployed in learning spaces due to the great possibilities associated with reimaging learning spaces, and have been applauded for the rich interactive learning environments that immerse the students with intriguing experiences. Scholars like Zhou and Lam (2019) have described extended realities, in the league of other technological interventions, as the game-changers for the decade by transforming education and potentially reimagining learning in the future. According to Makransky and Petersen (2021), extended realities offer a safe haven for learning that encourages deeper comprehension, motivates students to participate in learning activities, fosters positive learning behaviours and attitudes, facilitates teaching and learning processes, improves learning outcomes, self-efficacy, and self-regulation, helps students make sense of the material by demystifying it, and helps them hone and perfect their skills by giving them a sense of immersion in accordance with instructional theory (Calvet, et al., 2021, 2019; Beck, 2019; Rupp, et al., 2019). Nunn (2021) describes three forms of Extended Reality (XR) technologies on a continuum of augmented, mixed, and virtual (AR, MR, VR). AR is closely related to the real-world environment, MR covers various ratios of syncing of VR and AR, while VR is a totally different world, perfect and computer-synthesised.

Augmented reality (AR) is one form of extended realities which employs the use of computer applications to provide interactive virtual objects to enrich the learner's physical environment in real time. AR leaves the learner's physical being outside to observe in order to learn with partial immersion in the learning environment, unlike the case of a virtual environment where the learner is fully immersed and becomes an "object" in the environment (Garzón, et al., 2019). In AR, digital data such as pictures, movies, or three-dimensional models are overlayed onto the actual physical world to improve the student's understanding of reality. Numerous technologies such as tablets, smartphones, smart glasses, and headsets can be used to enjoy augmented reality. Users can interact with both the real environment and computer-generated aspects simultaneously, thanks to augmented reality (AR). When AR is used effectively in educational settings, it may build inclusive learning environments that inspire students, encourage active learning, and provide high-quality instruction (Goff, et al., 2018).

On the other hand, virtual reality (VR) is the term for computer-generated virtual worlds that allow users to interact, explore, and be perceived as genuine by simulating their physical presence within them. This is made possible through the use of immersive devices such as VR headsets, that transport students to a virtual world that can be entirely fictional or a realistic recreation of the real-world place or scenario which typically provides a 360-degree view, and responds to the user's head movements to create a sense of presence and immersion (Lampropoulos, et al., 2021). Pozo-Sánchez, et al., (2022) point out that the primary features of virtual reality (VR) are its capacity to actively involve people, its sensation of presence, and its immersion and immediacy. VR provides a highly immersive and interactive experience, allowing learners to feel like they are part of the virtual world. VR can remove the great risks associated with certain learning environments such as flight simulators, medical procedures and hazardous environments, and remotely offer students the opportunity to engage in virtual tour of dangerous destinations which could otherwise be too expensive to afford.

Studies have shown that students' engagement in learning spaces is a crucial index to academic success. According to Evans and Zhu (2023) students' engagement in learning spaces is an essential component which defines the extent to which students pursue learning objectives and overcome learning tasks. Perhaps to say, that students gravitate closely to mastery when they engage meaningfully with learning contents. Luo and Gan (2022) point out that students have to be engaged with more attention drawn to those learning activities that promote self-regulatory skills within, as well as beyond the learning specifics. Trowler, et al., (2021) define students' engagement as taking part in instructionally beneficial activities, both within and outside the classroom, that provide a variety of quantifiable results. However, Bloom (1956) identifies students' engagement in three dimensions, viz: (1) Behavioural Engagement, that is, the behavioural norm associated with the learning experiences; (2) Emotional Engagement, that is, feelings associated with the learning experiences; and (3) Cognitive Engagement, that is, intellectual abilities associated with the learning experiences. Therefore, students' engagement extends beyond the immediate learning context and involves all of students' relationship with the academic (courses and learning materials) and social (teachers, friends, peers, others and environment around) learning spaces.

To determine the extent of achievement of desired learning objectives, test is one of the commonly used assessment tools in education. Linn (2008) as cited in Adom, Adu and Dake (2020) believes that beyond being considered as an instrument, a test is often designed to measure ability, skill or the quality of knowledge, and is used for assessing the effectiveness of instruction against a standard, and for gathering relevant information upon which decisions are based. The development of tests follow a sequence of stepwise procedures summarised in four broad categorisations by Quansah and Amoako (2018). The first stage is the planning stage which involves initial preparations in which decisions are taken as to test form, type and purpose, as well as the specification of item format; the item construction stage involves crafting valid items in line with a purpose that covers the content scope with a well-defined pattern; review stage is where items are evaluated to minimise errors and ambiguity and to determine reliability and validity in line with the purpose of the test; and assembling stage, which is the final stage of coupling and arranging items of the test, as well as establishing norms. The stepwise procedure involved in test development requires mastery, which studies show to have been a function of students' engagement and could be enhanced through the platform of virtual and augmented realities.

A plethora of studies in literature have demonstrated huge contributions of virtual and augmented realities in enhancing students' engagement in some areas of studies. Bodzin, et al., (2021); Guan, et al., (2021); Garduno, et al., (2021); Dubovi (2022); Bennett and Saunders (2023), among others found a positive impact on students' engagement due to exposure to virtual reality. On the other hand, Herpich, et al., (2018); Dakeev, et al., (2020); Suryaman, et al., (2020);

Kaur, et al., (2020); Liu, et al., (2021); tom-Dieck, et al., (2023), among others showed that augmented reality (AR) applications enhance students' engagement in learning spaces. Technology has come to stay in the world today and its relevance within the learning spaces has become very vital. Although empirical evidence in various fields like medicine has demonstrated the effectiveness of this evolving technology in our learning spaces, however, the present study became necessary to determine the contribution of AR and VR on students' engagement in test development learning spaces.

Research Questions

The following research questions guided the study:

1. What is the contribution due to the integration of virtual reality in learning spaces on students' engagement in test development?
2. What is the contribution due to the integration of augmented reality in learning spaces on students' engagement in test development?
3. What is the joint contribution due to the integration of virtual and augmented realities in learning spaces on students' engagement in test development?
4. What regression model can be used to predict students' engagement in test development due to the integration of virtual and augmented realities in learning spaces?

Hypothesis

The research hypothesis that guided the study states that:

1. The joint contribution due to the integration of virtual and augmented realities in learning spaces on students' engagement in test development is not significant.

Methods

Correlational research design was adopted for this study since the study sought to determine the contribution of virtual and augmented realities in learning spaces to students' engagement in test development (Nworgu, 2015). The study was carried out at the University of Nigeria, Nsukka. 814 final-year students in the Faculty of Education, University of Nigeria, Nsukka formed the population of the study. The choice of final year students is because they have been taught Research Methodology and Measurement and Evaluation courses where they were exposed to item writing and instrumentation, with emphasis on test development in preparation for their research work. The Faculty of Education is composed of seven departments including departments of Adult Education, Arts Education, Educational Foundations, Human Kinetics and Health Education, Library and Information Science, Science Education and Social Science Education consisting of 114, 90, 155, 98, 81, 147 and 130 final year students respectively.

The sample size for the study was 269 final-year Faculty of Education students from the University of Nigeria, Nsukka using Taro Yamane's formula. A multistage sampling procedure was adopted to recruit the 269 subjects who participated in the study. First, the researchers randomly sampled four departments using a simple random sampling procedure. Then, disproportionate stratified sampling procedure was applied to determine the proportion of students sampled from each stratum (department) since the population differ between departments in order to ensure that each stratum was adequately represented in the sample. A simple random sampling technique was further applied in each stratum to select 62, 84, 44 and 79 students from Adult Education, Educational Foundations, Library and Information Science, and Science Education departments respectively. Finally, by a dip of luck, students were randomly assigned to either virtual reality or augmented reality test development experience.

The instruments for data collection were a structured four-point Likert scale questionnaire titled "Extended Reality Questionnaire" (ERQ) and “Students’ Engagement in Test Development Scale” (SETDS) developed by the researchers. The ERQ consists of two clusters (A for Virtual Reality and B for Augmented Reality), designed to elicit participants' responses towards answering the research questions in the study. The items of the instruments (ERQ and SETDS) were validated in line with the purpose of the study by three experts, in the Department of Psychology, Measurement and Evaluation unit, Science Education, and Department of Computer Science, all of the University of Nigeria, Nsukka. Their suggestions and recommendations were adhered to. Upon trial testing, ERQ returned a total Cronbach Alpha reliability index to be 0.85 while Cluster A had an internal consistency of 0.86 and Cluster B had an internal consistency of 0.83; the SETDS had a Cronbach alpha reliability index of 0.82

The instruments, ERQ and SETDS were distributed by the researchers to final year Measurement and Evaluation course lecturers in the sampled departments who served as research assistants for distribution to sampled students in their respective departments after obtaining permission from their departmental heads, and were collected on the spot, after filling, for analysis. Data was analysed using SPSS v.25, and research questions 1, 2 and 3 were answered using Pearson Product Moment Correlation and Coefficient of Determination while research question 4 and the research hypothesis were investigated using regression. A criterion adopted for interpreting the result according to Schober and Boer (2018) considered absolute values of correlation coefficient below 0.1 as negligible, 0.1-0.39 as weak, 0.40-0.69 as moderate, 0.70-0.89 as strong while 0.90-1.00 as high relationships.

Results

Table 1: Contribution due to the integration of virtual reality in learning spaces on students' engagement in test development.

	r	**r^2**
VR*SETD	0.870	0.7569

Key: r = Pearson's Correlation coefficient; r^2 = Coefficient of Determination

Result in Table 1 shows that there is a strong positive relationship between students’ exposure to virtual reality and their engagement in test development (r = 0.870). With a coefficient of determination of 0.7569, it implies that exposure to virtual reality contributes about 75.69% to students’ engagement in test development.

Table 2: ANOVA of the integration of augmented and virtual realities in learning spaces on students’ engagement in test development.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2049.886	2	1024.943	289.839	.000[b]
	Residual	463.249	131	3.536		
	Total	2513.134	133			

a. Dependent Variable: SETDS
b. Predictors: (Constant), VRQ, ARQ

From Table 2 shown above, the F-ratio of 289.839 with an associated or exact probability value of 0.000 was obtained with respect to the joint contribution observed due to the integration of virtual and augmented realities in learning spaces on students' engagement in test development is not significant. The associated or exact probability value of 0.000 when compared with 0.05 set as the level of significance for testing the hypothesis was found to be significant because 0.00 is less than 0.05. Therefore, the null hypothesis one which stated that the joint contribution due to the integration of virtual and augmented realities in learning spaces on students' engagement in test development is not significant was rejected. Hence, it is inferred that, the joint contribution due to the integration of virtual and augmented realities in learning spaces significantly contributes to students' engagement in test development.

Table 3: Contribution due to the integration of augmented reality in learning spaces on students' engagement in test development.

	r	**r^2**
AR* SETD	0.732	0.5358

Key: r = Pearson's Correlation Coefficient; r^2 = Coefficient of Determination

The result in Table 3 shows a strong positive relationship between students' exposure to augmented reality and their engagement in test development (r = 0.732). With a coefficient of determination of 0.5358, it implies that exposure to virtual reality contributes about 53.58% to students' engagement in test development.

Table 4: Joint contribution due to the integration of virtual and augmented realities in learning spaces on students' engagement in test development.

	r	**r^2**
ER*SETD	0.934	0.8724

Key: r = Pearson's Correlation coefficient; r^2 = Coefficient of Determination

The result in Table 4 shows a high positive relationship between students' exposure to virtual and augmented realities and their engagement in test development (r = 0.934). With a coefficient of determination of 0.8724, it implies that exposure to virtual reality and augmented realities jointly contributes about 87.24% to students' engagement in test development.

Table 5: The regression model for the prediction of students' engagement in test development due to the integration of virtual and augmented realities in learning spaces.

		Unstandardised Coefficients		Standardised Coefficients		
Model		B	Std. Error	Beta	t	Sig.
	(Constant)	2.225	1.145		1.943	.054
	AR	.253	.039	.309	6.447	.000
	VR	.657	.047	.677	14.120	.000

a. Dependent Variable: SETD

The result in table 5 shows that the coefficients of augmented reality, virtual reality and intercept are 0.253, 0.657 and 2.225 respectively. This implies that the regression model for predicting students' engagement in test development is SETD = 2.225 + 0.253AR + 0.657VR.

Discussion

The findings of this study show that both virtual and augmented realities individually strongly contributes to students' engagement in test development, and contribute highly significantly to students' engagement in test development when jointly integrated into the learning space. This result may have been so due to the mixed reality effect provided by the integration of both interventions in learning spaces. Suffice to say that, the new learning experience offered by the blend immersed and encouraged students to actively interact in the digital test development processes which may have translated to the observed high contribution to students' engagement in test development. The findings of the study fall in line with the findings of previous studies, including those of Herpich, et al., (2018); Dakeev, et al., (2020); and Liu, et al., (2021) who identified that virtual and augmented realities respectively influence students' learning characteristics; and Suryaman, et al., (2020); Kaur, et al., (2020); and tom-Dieck, et al., (2023) that the integration of augmented reality in learning spaces improves students' engagement.

The findings of the study resounds the importance of integrating VR and AR technologies in learning spaces, not only to enhance students' engagement, but to also improve academic achievement, reduce dropout rates and increase technological literacy. The findings of this study may have turned out so because technology is globally invoked and twenty-first-century students are already technology natives, which makes students in test development familiar with the use of VR and AR technology devices. Otherwise, the result of this study may have been different if the students were not familiar with technology. The evidence from the study agrees with the findings of Bodzin, et al., (2021); Guan, et al., (2021); Garduno, et al., (2021); Dubovi (2022); Bennett and Saunders (2023) that the integration of virtual reality in learning spaces improves students' engagement.

Conclusion and Recommendations

Students' engagement in learning spaces has been considered over time as a functional component of students' academic outcomes, especially in test development. Test development employs a sequence of iterative activities to design tests for a specific purpose. Immense technologies such as VR and AR have shown to be effective for such reiterative procedures. Furthermore, the evidence from this study showed that the integration of virtual and augmented realities into learning spaces contributes significantly to enhancing students' engagement and fostering better learning experiences which may impact positively on students' academic achievement in test development and reduce cases of school dropouts. In view of the foregoing, it has become necessary for the integration of immersive technology such as virtual and augmented realities into learning spaces. However, the novelty of immersive technology in Nigeria educational system has prompted this study. Following the findings from the study, the following recommendations have been made:

1. School administrators should consider integrating VR and AR in learning spaces since they have been shown to highly influence students' engagement and reduce incidences of school dropouts through the fun learning they create.
2. Government and other agencies should provide special training for teachers in test development courses to encourage them to accept and integrate VR and AR in pedagogy, and in the operational use of associated tools.
3. Due to the cost of technological devices, the government should support schools to provide VR and AR devices in learning spaces for effective use.

4. Educational policies should strengthen the integration of virtual and augmented realities in learning spaces, and strengthen their use as alternative to field trips in order to reduce cost and avoid the risks associated with hazardous practical learning environments.
5. Parents should provide moral and rational support to encourage teachers to effectively use virtual and augmented realities in learning spaces.

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