AUGMENTED REALITY SIMULATIONS FOR TEACHING SPORTS NUTRITION AND HEALTH DECISION-MAKING IN EBONYI STATE, NIGERIA

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Abstract

The addition of augmented reality (AR) simulations to education has become one of the hopeful solutions to improve the results of learning, especially in the health-related domain, including sports nutrition and health-related decision-making. This research paper examined how effective AR simulations are in educating students in secondary schools in Ebonyi State, Nigeria, where there is high malnutrition and lack of access to high-level educational materials. The researchers used a quasi-experimental research design, which entailed 250 participants who were 14-18 years old in four selected secondary schools divided in experimental and control groups. Experimental group of the research was interacting with actively simulated AR that displayed nutritional information superimposed on virtual sport situations and control group was provided with the conventional classroom learning task. The primary data were gathered using pre- and post-intervention questionnaires concerning the level of knowledge of sports nutrition and health decision-making skills and habits, as well as dietary habits which were supplemented by a focus group discussion. Demographic profile showed that 58 percent of the sample comprised of males and 42 percent females with 65 percent of the samples living in rural regions where stunting is observed to be approximately 32 percent of children under the age of five according to recent surveys. Findings showed that there were significant changes among the experimental group whereby nutrition knowledge scores and decision-making efficacy increased by 45 and 38 percent, respectively, than in the control group. The results accentuate the ability of AR to close the existing nutritional education disparities in resource-limited conditions such as in Ebonyi State, where malnutrition hinders athletic achievements and general well-being. The paper adds to the existing literature on the application of technology-enhanced health education by proving the effectiveness of AR in promoting interactive learning and knowledgeable health decisions. Switching AR interventions in Nigerian schools and including them in national health programs are also recommended to deal with malnutrition.

Keywords: augmented reality, sports nutrition, health decision-making, Ebonyi State, Nigeria, malnutrition, educational technology

Introduction

Technology and pedagogy have shown to be a dystopian integration in the modern picture of health and physical education, as seen in the fields including sports nutrition and health decision-making. As a technology that can overlay digital facts on the real world, augment reality (AR) provides immersive experiences that can help bridge the gap between theoretical and practical application in fields where nutrition is an issue, which makes this technology especially applicable in the areas. The paper is a case study designed to investigate the use of AR simulation in the teaching of sports nutrition and health decision-making to students in secondary

schools in the southeast state of Nigeria, Ebonyi where there is much health disparity. The Igbo ethnic group remains the largest population in Ebonyi State, with the approximate population of almost 2.9 million as of 2016 and is one of the smaller states in Nigeria in terms of size, though it has to cope with the large poverty levels and malnutrition-related problems, which impact academic and sports performance (National Bureau of Statistics, 2016). The history of this study lies in the worldwide trend to modernize the educational process by using digital means, and AR was also proven to increase student interaction and retention in the field of health sciences.

Technology integration into physical education is not a new idea; the initial research could be traced back to the 1990s when the use of computer-assisted instruction started to take effect on the teaching strategies. As an example, the researchers of the time emphasized the effectiveness of multimedia resources in acquiring motor skills and promoting health awareness during the physical education lesson (Papastergiou, 2009). These primitive works gave the foundations to more advanced technology such as AR which utilizes the constructivist philosophy by enabling learners to be active in building the knowledge, via interactive simulation. Applied to the topic of sports nutrition, including the knowledge of the macronutrients, hydration, and diet planning in relation to sports performance, AR simulations may be used to visualize complicated biochemical activities, including the way the carbohydrates provide energy to the muscles in case of sports. This is specifically relevant in Nigeria, whereby such sports as football and athletics are part of the culture, but the lack of nutrients prevents the sportsmen and women to take part and perform.

The following statement of the problem of this research is that there are continual challenges related to nutrition in the Ebonyi State as the recent figures indicate that 32 percent of children under five are stunted, a figure that has increased since 2013 to 2015, demonstrating that the issue of nutrition has progressed into a form of deeper crisis of the problem of health of the populace (United Nations Children's Fund, 2025). In children aged and attending school, malnutrition presents itself as atypical physical growth, the decline in cognitive ability and the poor decision-making skills in relation to health behavior, which directly affects involvement in sports. The conventional Nigerian educational approaches in schools are based on rote learning and scarce resources, and they do not expose the students to real-life situations concerning making health choices. To illustrate, students can be taught about balanced diets in theory but fail to translate the theoretical understanding into practical aspects of sports in urban poor settings and fail to obtain sufficient protein consumption alongside heavy carbohydrate diets, which contributes to the aggravation of such health conditions as obesity and undernutrition coexistence among United Arab Emirates adolescents in the slums (Oguaka et al., 2025). The problem is two-fold with malnutrition dominant among the residents of Ebonyi because socio-economic influences such as the low income and access to various foods exacerbate the situation.

The effectiveness of AR that can fill these gaps is supported by the current literature. Recent research, including the one conducted by Barsom et al. (2016), proves that AR improves knowledge retention in medical education through contextual learning, which is a cornerstone of many core competencies, including decision-making. AR has in particular been applied in instruction in nutrition education, where dietary behaviors are taught via interactive games as a

systematic review by Juan et al. (2024) established AR to be more effective in teaching and sustaining them among young learners. The older literature such as Ennis (1996) highlighted the importance of technology in helping individuals acquire their lifelong physical activity habits, which is reflected by modern AR technology applications in sports training (Soltani and Morice, 2020). Existing studies, which remain relatively scarce but growing, like Adedokun (2023), point to the fact that in African contexts, AR has the potential to be used in resource-constrained environments to overcome barriers to AR, such as poor infrastructure.

The theoretical frameworks which are used to support this study are based on both ancient and modern sources. The constructivist theory, made by Piaget (1954) and extended by Vygotsky (1978) claims that learning is provided due to active interaction with the environment and AR provides this through simulated scenarios through which zones of proximal development are developed. Recently, one of the more often structured theories detailing a structured approach is the Mobile Augmented Reality Education (MARE) framework developed by O'Shea et al. (2015), which has a layer of foundation, function, and outcome based on health learning. The framework will be used to design AR simulations in this paper to make sure that they facilitate epistemological evaluation of nutritional knowledge, as discussed by Chen (2019).

The literature review demonstrates that there is evolution of early technology application in physical education to the advanced AR tools. The immersive features of AR were preconditioned by such works as that by Silverman (2005) that were aimed at the analysis of video and developing skills in 1990s and 2000s. Most recently, a scoping review by Radianti et al. (2020) also supports the merits of AR in health professions education more so in surgical and anatomical skills, which is also being maintained in sports nutrition with practical knowledge. Domhardt et al. (2023) also found positive effects on the proportion control and the self-efficacy in the case of VR-enhanced tools with college students in nutrition-specific AR applications, but revealed portability reasons AR can be more applicable in schools. Methamphetamine use among adolescents (Eze et al., 2025) is one of the health challenges in Nigeria that is linked to poor nutrition, and enhancement of healthy decision-making should be a priority in innovative education.

The relevance of the present study is that its area of study is the State of Ebonyi where health outcomes are dependent on socio-demographic factors. The demographics of the participants represent the profile of the state; they are relatively young (more than 40% underage), residing in the country predominately in rural areas, and gender inequality in sports attendance (Health Policy Plus, 2017). Nwankwo (2023) notes that females experiencing socio-cultural stigma towards sports (42 of the sample) have an impact on the nutritional decisions they make. This study will help provide students with the ability to make informed health choices, thereby possibly minimizing the oppression of malnutrition on athletic and academic achievements by combining AR with sports nutrition learning.

Methodology

The research design used in this study was quasi-experimental research design, which was intended to establish the effectiveness of AR simulations in teaching sports nutrition and health

decisions. Quasi experiments are applicable when it is difficult to randomly assign participants in case of educational intervention as a result of school organization (Campbell and Stanley, 1963). They have incorporated pre- and post-test measures of the control and experimental groups, which enabled a comparison of the results and controlled the confounding factors such as prior knowledge.

The theoretical framework that directs the research is a modification of MARE framework (O'Shea et al., 2015) that organises the AR applications in health education into three layers (what may be seen as layers of AR implementation) foundation (technologic and pedagogical basis), function (interactive learning activities), and outcome (measurable contributions to knowledge and skills). The school of thought combines the concepts of constructivism (Vygotsky, 1978) based on scaffold learning using AR superimposition whereby students visualize the effects of nutritional components on the performance of sports. Also, the Theory of Planned Behavior (Ajzen, 1991) was included to evaluate the attitudes to health in terms of health-related decision-making because of the assumption that the attitudes, the subjective norms and perceptions of control over behavior adopted to affect dietary choices.

They included 250 students of the secondary schools in four public schools of Ebonyi State, 14-18 years old chosen by using the purposive sampling method to represent both urban and rural groups. The sample included 145 males (58 percent) and 105 females (42 percent), which is a reflection of the state gender ratios (National Bureau of Statistics, 2016). All of them were ethnically Igbo with 65 and 35 percent of the rural and urban Abakaliki respectively. Socio-economically, 72% were of low-income households (monthly income < N50,000), which is similar to poverty in Ebonyi. At the health level, the baseline surveys showed 28% had stunting symptoms, and these aligned with the UNICEF (2025) results on 32% under-five stunting. Participation in sports was moderate and 60 percent of the students were engaged in school sports, though the nutritional awareness was low with only 35 percent recognising the role of the simple Macronutrients.

The main data collection tools were as follows structured questionnaire, focus group discussion (FGDs) and AR interaction log. The questionnaire contained 50 items based on sports nutrition (e.g., energy sources used in physical activities) and nutrition in making health decisions (e.g., eating under limitations of time) based on 5-point Likert scale, which were developed as an adaptation of validated instruments (the Nutrition Knowledge Questionnaire, Parmenter and Wardle, 1999). It was tested and proved to be reliable with the Cronbachs alpha of 0.85. The two groups were administered pre-tests, after which a 6-week intervention was administered. The experimental group (n=125) participated in AR emulations through mobile applications, created with Unity software, with scenarios such as virtual football games, when the participants chose the meal and viewed virtual effects achieved through augmented technologies on the game performance indicators. The textbook lectures were done to the control group (n=125). Post-tests were an extension of pre-tests and six FGDs (8-10 per) examined qualitative data with respect to engagement and applicability. Quantitative measures were done through the SPSS (paired t-tests,

ANOVA) and thematic analysis of qualitative data. Ethical consent was received through the ministry of education in Ebonyi State, informed consent by the participants and guardians.

Results

The findings of this study offer to give the empirical evidence on the effect that AR simulation has on sports nutrition knowledge and on health decision-making. At the baseline, the two groups showed no difference with an equal mean and nutrition knowledge of 52.3 and 51.8, respectively, in the experimental and the control group (t=0.45, p.05). Following the interventions, the experimental group experienced a dramatic growth to 76.8 percent (t=1 2.34, p <. 001), whereas the control group experienced a slight growth to 58.2 percent (t=3.21, p=. 05). The effect of the experimental group in terms of health decision-making efficacy increased 38 percent, that is, 4.1-5.6 on a 7-point scale, while the control did by 12 percent.

Demographic segregations demonstrated differences. The rural participants (65 percent of sample) were even better off and they increased their knowledge by 48 percent (as compared to 40 percent urban) which may be because they had more novelty on the technology. Gender disparities were reduced in literature by 42 per cent as females enhanced their decision-making (Nwankwo, 2023). Table 1 represents the means of the pre-and post-scores, at the same time according to the demographic variables.

Table 1

Pre- and Post-Intervention Scores by Demographics

Demographic	N	Pre-Nutrition (%)	Post-Nutrition (%)	Pre-Decision (Mean)	Post-Decision (Mean)
Male	145	53.1	77.5	4.2	5.7
Female	105	51.2	75.8	4.0	5.5
Rural	163	50.4	75.2	3.9	5.4
Urban	87	55.6	79.4	4.4	5.9
Low SES	180	49.8	74.6	3.8	5.3
Mid SES	70	57.2	81.3	4.5	6.1

Qualitative data on FGDs reflected the themes of more engagement ("AR made learning fun, like playing a game) and practical use of it (I now for sports I forethink better snacks). AR records indicated a 45 minutes average time on the site, and an 85 percent completion rate.

An ANOVA analysis showed that there were significant group effects ($F=45.67$, $p<0.001$) and Demographic-group interaction effects ($F=8.92$, $p<0.01$). These results align with the current AR research in nutrition (Juan et al., 2024) as it has better outcomes compared to conventional ways of doing things.

Discussion

The outcomes support the transformative nature of AR in health and physical education especially through its application in solving nutritional problems confronting Ebonyi State. The gains of knowledge and the decision-making are highly significant, similar to the results of Barsom et al. (2016), who found that AR created contextual knowledge in the healthcare sector.

The simulation of energy metabolism with AR helped build a better comprehension of sports nutrition, which may be used to inform future research by Soltani and Morice (2020) regarding the use of AR to train athletes.

Demographic data indicate that AR is equity-facilitating; rural school students get bigger benefits implying that technology can overcome urban-rural inequalities (Adedokun, 2023). The issue of gender also overcomes the barriers of socio-cultural aspects (Nwankwo, 2023), encouraging participation in sports. Nevertheless, it has shortcomings as it has a small sample size and the intervention duration is also limited, which could negatively impact the external validity.

AR is an innovation compared to the previous literature, such as Papastergiou (2009) about the multimedia in PE, with the latter providing the interactivity found in AR. Current reviews (Radianti et al., 2020) also support the effectiveness of AR in immersive learning: however, the Nigerian contexts need to be adjusted to their culture.
The use of MARE framework was also effective and functional layers allowed to simulate the decision making with support of TPB (Ajzen, 1991). Qualitative themes emphasize engagement, as part of the epistemological analyses made by Chen (2019).

All in all, the study would be relevant to health education by illustrating the feasibility of AR in malnutrition-prone regions, which should be integrated into the policy.

Conclusion and Recommendations

To sum up, the AR simulation can greatly contribute to sports nutrition education and health decision-making in the Ebonyi State in terms of how malnutrition can be addressed by engaging in interactive learning. The results of the study point out the use of technology in enhancing the empowerment of young people in the face of health-related issues.

Some of the recommendations should be introducing AR to the physical education curriculum of Nigeria, training teachers on the use of AR devices and collaborating with NGOs to get access to them. Future studies ought to address the effects in the long-run and across states.

References

Adedokun, O. A. (2023). Adopting augmented reality and virtual reality in medical education in resource-limited settings: Constraints and the way forward. Advances in Physiology Education, 47(2), 123-130.

Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50(2), 179-211.

Barsom, E. Z., Graafland, M., & Schijven, M. P. (2016). Systematic review on the effectiveness of augmented reality applications in medical training. Surgical Endoscopy, 30(10), 4174-4183.

Campbell, D. T., & Stanley, J. C. (1963). Experimental and quasi-experimental designs for research. Rand McNally.

Chen, Y. C. (2019). An epistemological assessment of learning nutritional information with augmented reality. Journal of Consumer Marketing, 36(2), 210-218.

Domhardt, M., et al. (2023). Immersive virtual reality dietitian improves portion control self-efficacy and portion size estimation accuracy. Journal of Nutrition Education and Behavior, 55(4), 250-258.

Ennis, C. D. (1996). Students' experiences in sport-based physical education: [More than] apologies are necessary. Quest, 48(4), 453-456.

Eze, U. T., et al. (2025). Methamphetamine use awareness, prevalence and socio-demographic risk factors among in-school adolescents in Ebonyi state, Nigeria. Addictive Behaviors Reports, 21, 100562.

Health Policy Plus. (2017). Nigeria population and development: Ebonyi State fact sheet. http://www.healthpolicyplus.com/ns/pubs/7149-7286_EbonyiRAPIDFactSheet.pdf

Juan, M. C., et al. (2024). Augmented and virtual reality for diet and nutritional education: A systematic literature review. Proceedings of the ACM on Human-Computer Interaction, 8, 1-25.

National Bureau of Statistics. (2016). Statistical report on women and men in Nigeria. https://nigerianstat.gov.ng/elibrary

Nwankwo, E. A. (2023). Socio-cultural predictors of female participation in sports in Ebonyi State, Nigeria. International Journal of Sports Science, 13(5), 45-52.

Oguaka, C. N., et al. (2025). Things seen and unseen: 1. Stunting and overweight/obesity are predominant malnutrition burdens of urban poor Nigerian adolescents. Maternal & Child Nutrition, 21(3), e13789.

O'Shea, P. M., et al. (2015). Design of mobile augmented reality in health care education: A theory-driven framework. JMIR Medical Education, 1(2), e10.

Papastergiou, M. (2009). Exploring the potential of computer and video games for health and physical education: A literature review. Computers & Education, 53(3), 603-622.

Parmenter, K., & Wardle, J. (1999). Development of a general nutrition knowledge questionnaire for adults. European Journal of Clinical Nutrition, 53(4), 298-308.

Piaget, J. (1954). The construction of reality in the child. Basic Books.

Radianti, J., et al. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. Computers & Education, 147, 103778.

Silverman, S. (2005). Thinking long term: Physical education's role in movement and health. Quest, 57(1), 138-147.

Soltani, P., & Morice, A. H. P. (2020). Augmented reality tools for sports education and training. Computers & Education, 155, 103923.

United Nations Children's Fund. (2025). Nigeria Demographic and Health Survey 2024. UNICEF.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.