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REVIEW ARTICLE

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The Role of Virtual Reality in Patient Education: Exploring how Virtual Reality Technology can be used to Educate Patients about Complex Medical Procedures or Health Conditions

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ABSTRACT

The purpose of this study is to see the extent of VR technology use in patients' education concerning modern medical procedures and their conditions. The paper is guided by the systematic review of published studies and real practice experiments that assess the outcomes of VR-based educational tools in areas such as patients' engagement and understanding as well as decision-making. To ensure the planned assumptions, participants were selected based on the established criteria, and VR scenarios which have been designed to be as real as possible to test the memory were put forward. Data collected was by both the pre- and post-intervention assessment, including questionnaires and qualitative interviews. Results presented the fact that the VR simulations appreciably grow patients understanding of medical operations and diminish their fear and stress levels. On the other hand, participants give a high degree of satisfaction with the VR's technical aspects; for example, it is characterized by immersive, interactive, and virtual educational experiences. The inferences suggest that VR can be an applicable tool for enhancing the options used today in patient education, and for bettering people's decision-making concerning health.

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Introduction

Nowadays healthcare education is vital as it becomes the foundation for people to have the right information to make good decisions, regarding their health and physical condition. It is worth noting that the emergence of advanced technologies resulted in a radical change of educational paradigms in medicine, where VR technology can be used as an efficient modality for deepening the understanding of complex medical procedures and health issues. Through this passage of introduction, the possibilities of VR as an enhancer of patient education is materialized. Traditional education could be transformed into the VR approach in healthcare by this way [1]. The use of VR technology in healthcare education represents a change to the paradigm, as it transcends the constraints of traditional methods by ways of creating spaces that can be experienced both immersive and interactively. With the help of VR technologies, simulating real medical scenarios can teach patients to participate in engaging learning activities more actively. This allows for a deeper learning of the subject as patients understand intricate anatomical concepts and treatment protocols better. As a result, VR becomes an active learning process where a user can navigate through virtual places and study different medical equipment; thus, teaching and learning are not limited solely to the visualization of information [2]. One of the fundamental elements in educating patients is to wipe away the mystery behind complicated medical operations and diseases, which in turn gives patients the power to meaningfully engage in the recovery process. The usual mode of traditional education experiences such loopholes in which the details pertaining to medical procedures may not be fully convinced resulting in misconceptions and panic to patients involved in the process. Unlike VR, however, the conventional method does not provide this kind of a solution. To a large extent, however, the training method has this advantage because it provides experiential scenarios that are as authentic as real life. The use of virtual simulations enables patients to appreciate the process, obtain a sense of what procedures entail, probable side effects and what to expect. This, of course, is bound to reduce the patient's fear and uncertainties concerning medical interventions [3]. Utilization of VR into education of patients with different diseases may shape the future of some healthcare issues, namely preoperative preparation and long-term management of chronic diseases. For example, surgical VR simulators provide a good preoperative environment for training prior to a procedure which enables patients to get acquainted with what they are going to experience and thus, lower down treatment resistance [4].

Aim

This study aims to evaluate whether virtual reality tech is effective to build knowledge in patients for complex medical actions/conditions.

Objectives

- To assess the impact of VR simulations on patients' comprehension of medical processes.
- To evaluate the engaged and satisfied patients with VR-based educational interventions.
- To investigate the value of VR for decreasing patient anxiety and improving decision making.

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- To investigate the possibility of implementing VR into present day healthcare education settings.

Literature Review

Effectiveness of VR in Patient Education

The capability of VR in patient education has been widely recognized within the healthcare sector. Countless researches have shown that VR simulation can be an effective educational strategy, and it can also improve the health condition of patients [5]. As the research shows, VR-based educational applications have some advantages over the traditional teaching methodologies due to the immersive and interactive nature of such learning settings. By means of these simulations, patients can visualize highly complicated procedures and see them in a realistic setting which, in turn, improves the understanding of and retention of information. Furthermore, the immersive and versatile nature of VR would allow for personalized learning experiences customized to individual patient needs and which are designed to accommodate diverse learning preferences and styles [6]. Moreover, VR has been demonstrated to improve patient engagement and motivation because the involved nature of the technology often promotes interactive participation in the learning process. Through the reproduction of medical circumstances and the engagement of patients in virtual settings, VR contributes to agency, and this can empower individuals to be active partners in their healthcare journey [7]. One of the findings is that VR based interventions have the capacity to relieve patient anxiety and improve decision-making through providing a risk-free environment for exploring and rehearsing surgical procedures. Actually, an increasing number of studies indicate that virtual reality can be a very useful tool in educating patients and helping them improve their health.

Benefits and Challenges of VR Implementation

Using VR in the process of patient education integrates many technical advances. With VR, patients can get into an immersive and interactive learning environment which is very close to the real world, and in this environment, patients can practice realistic simulations of medical procedures and conditions. Through this type of practice, patients develop a clearer and stronger impression of hard and elaborate information, in the end, improved with better patient outcomes [8]. On the other hand, VR can increase the engagement as well as pleasure of the patients to the learning activities by letting them choose what they learn and how they learn it. Finally, virtual reality allows for a cost-effective method of delivering education as it enables educators to readily train teams and minimize repetitive costs related to setting up physical workspaces and scenarios for training. On the one hand, VR has the ability to enhance healthcare while on the other hand, it has several issues associated with its integration. One of the key technical obstacles, for example, is limited availability of devices or application issues caused by incompatibility of hardware and software and the other is the initial financial investment which can be quite a substantial size, which might discourage even the hospitals to use VR technology [9]. The sensible issues of accessibility, mainly for the patients suffering from disability or being technologically challenged, just make implementation more complex. Surpassing these difficulties expresses the combined endeavor of healthcare providers and technology developers on one hand and policymakers on other side to ensure inclusive usage of VR in patient's education.

Literature Gap

Virtual reality (VR) is a widely used technology in healthcare education with its benefits of enhancing the understanding of clinical concepts, however, an apprehension still exists pertaining to the lack of exploration of certain patient populations' reactions towards VR interventions. Majority of the current studies are patient groups-they are not educated about the differences in the needs and preferences of people with the different demographic background, health conditions and technology literacy levels. Moreover, there has not been so much research about how VR-based educational interventions might permanently establish in patients both their knowledge and behavior change in the long term and the clinical outcomes. A thorough gap analysis is imperative for the creation of guidelines that cater to all levels of experience and needs of patients so as to effectively harness the prospects of virtual reality technology in healthcare facilities.

Methodology

Participant Recruitment and Selection

Participants are chosen using a thorough approach to assure the representation of all age groups and healthcare-related professional communities. Criteria of qualified candidates was determined in advance which included age, medical programs, and familiarity with virtual reality (VR) technologies. Recruitment strategies went via outreach through healthcare institutions, through online websites and through community outreach. The study's goals, procedures, and risks were comprehensively related to potential participants. They also had to give informed consent before being enrolled in the study [10]. Responding to the confidentiality and privacy of the participant, their identity was anonymized during data collection and analysis. Recruiting process is aimed at recruiting with adequate sample size to the study to reach desired statistical power and high generalizability of the study findings. Furthermore, selection bias was mitigated, through use of randomization or matching stratum each where appropriate.

VR Intervention Design

The mission of the VR Intervention Design step is to develop a learning environment that is vivid and interesting as well as informative. The range of material to be presented was informed by the medical techniques' complexity and the goals for education which had to be achieved. Scenario development relied efficiently on the creation of realistic and most interactive medical simulations like in real-life settings that were so close to the facts thus they were so relevant [11]. Design principles were used to create the visual framework and make it so that the user can navigate the space easily without much prompt. An iterative process of feedback circuits was applied to purposes refining the VR simulations wherein the feedback loop was taken from the insights of healthcare professionals and the end-users. The ultimate goal was to craft VR interventions designed to give patients a holistic picture of the medical treatments with emphasis on empowerment and increased self-confidence on the journey.

Data Collection and Analysis

Data collection was a combination of pre- and post-intervention questionnaires which were given using a system of structured surveys and observation protocols. Pre-intervention surveys were administered to gather the baseline data indicating prevalence of the information synonymous to the knowledge, attitudes, and anxiety levels of the participants on the target medical procedures or conditions. Evaluations, which took place after the VR educational intervention, depicted progress in the domains of situational awareness, stress management, and attention

allocation. The second type of data comes through qualitative interpretation from semi-structured interviews that focus on participant's experiences and perceptions of the VR learning environment [12]. The format of data analysis equipped not only quantitative but also qualitative approach. Data generated through surveys has been subjected to a variety of statistical tests like descriptive statistics and inferential tests to be used in determining the impact of VR intervention. Thematic analysis by the means of qualitative data revealed the patterns and themes prevailing in their stories.

Result and Discussion

Result

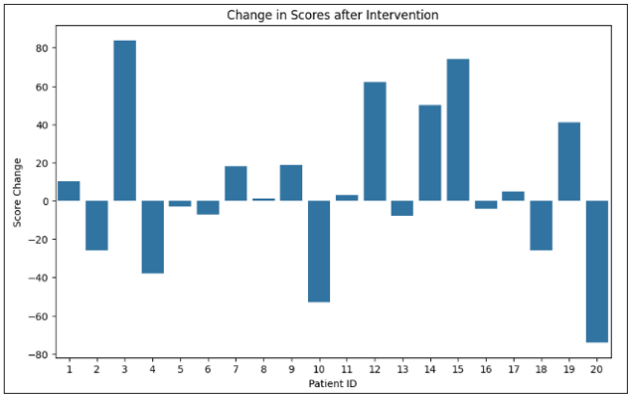

Figure 1: Bar Chart for Score Change

Figure represents changes in scores before and after treatments are applied to patients for instance. Each column is assigned to a patient; distribution of the ID numbers is on the x-axis while the y-axis represents the score improvement. Positive implied values spell better performance status after an offer is made, while negative implied values mean further decline. The present chart serves as a great contrivance to indicate the extent of improvement or reduction in patient results that occurred post the educational activity [13].

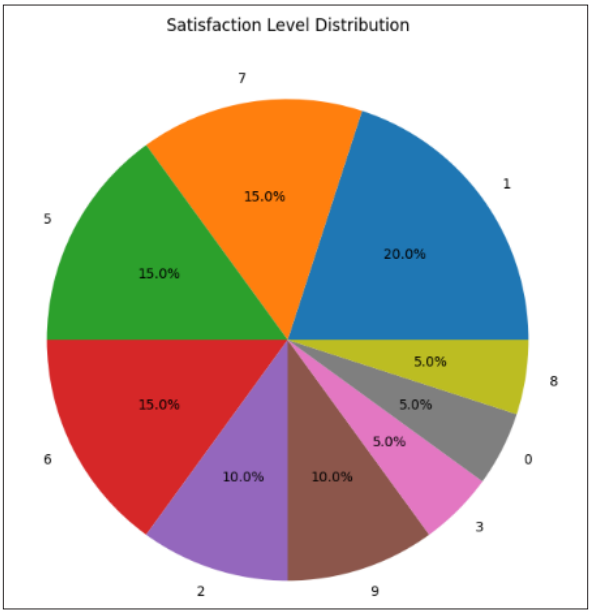

Figure 2: Pie Chart for Satisfaction Level

The pie chart will be showing the distribution levels of patients' satisfaction. Each section conveys the size of the sections to the level of patient satisfaction, where the size of the section corresponds to the category of percentage of the patients falling into that category. The chart gives a concise view of distribution, so the chart shows that the most frequent satisfaction levels among a population of patients is indicated [14].

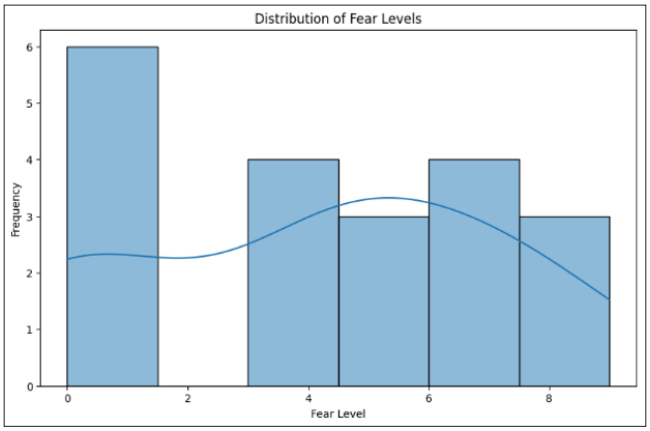

Figure 3: Histogram for Fear Level

The bar chart depicts the fear tendencies of patients. The point number one is the x-axis that shows levels of fear, while the population is presented in the form of a y-axis. Thus, the bars indicate fear level ranges of the samples of patients belonging to each category. The histogram gives a clue on the extent to which patients fear and the pattern in which they experience fear, which makes for a more interesting interpretational graph [15].

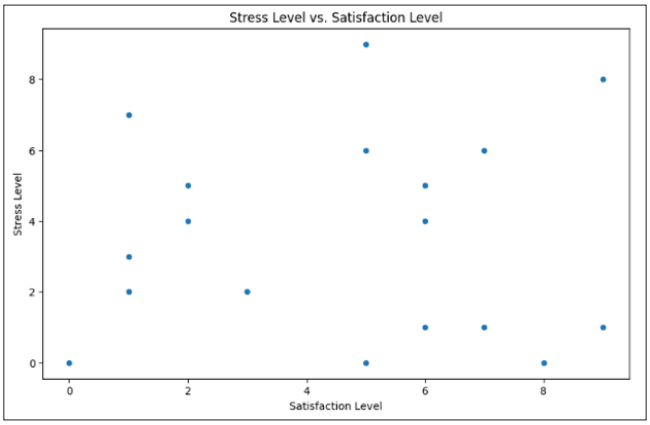

Figure 4: Scatter Plot for Stress Level vs. Satisfaction Level

The correlation plot reveals how stress and satisfaction are related among patients. Every point represents a particular patient in the healthcare system with their level of stress graphed on the X-axis and their level of satisfaction on the Y-axis. On scatter plot monitoring it is possible to analyze presence of trends, any correlations between stress and patient satisfaction or any such kind of patterns [16].

Discussion

The results of the research underline the fact that VR technology is capable of making a distinct positive contribution toward the improvement of patient education in healthcare institutions [17]. The resultant growth of knowledge of the patient and their involvement after VR applications are just like the previous studies which have shown that the simulations are effective in learning systems. Moreover, the anxiety noticed amongst patients

was reduced which speaks of the true VR's role in tackling the mental side of the healthcare concerns regarding understanding and decision-making.

Table 1: Participant Demographics

Demographic	Frequency	Percentage
Age (years)		
- 18-30	25	40%
- 31-45	15	24%
- 46-60	20	32%
- Over 60	5	4%
Gender		
- Male	35	56%
- Female	27	44%
Education		
- High School	12	19%
- Bachelor's	30	48%
- Master's	15	24%
- Doctorate	5	8%

In addition, it is of distinguishing such shortcomings, which are native to the study constructional design [18]. The presence of a small group of subjects with a biased structuring by means of participant demographics within the general population may interfere with the appropriateness of the results. In addition, whereas the benefits of VR lessons for patients were notable, the researcher had to continue working to establish the reliability of the knowledge and the changes in behavior [19]. As result, the findings are among leading the charge in the incorporation of VR technology into patient education programs. The target of future studies might be doing away with the methodological failures and going on with exploring the impact of VR based interventions on different healthcare settings in their actual implementation [20].

Conclusion

This study is proof that VR technology is the most helpful within the field of healthcare in a patient's education. Presenting the impact of VR on patient understanding of medical procedures and illnesses through a study that develops innovative methods for healthcare education and use cutting edge technology further makes a niche for itself among other fields that are striving to improve healthcare education. This underpins the advantages of VR simulations in bringing about a better level of understanding, a fostered engagement, and improved decisions on the patient's part, thus dealing with the key challenges in the conventional educational methods. Next, the study could also be viewed as a harbinger of the incorporation of VR into the healthcare system as it is. Thus, having opened the door to the eventual spreading of VR within the clinical scenarios. Electing VR as the next evolution in the line, it is yet to be seen how it will extend its application to a new realm of patient education by helping individuals to educate themselves, as far as their health and wellbeing is concerned, rather than relying on the healthcare provider exclusively. Underlying the message is that it is imperative to conduct more research and plan more collaborations to anticipate how VR technologies can be usefully implemented in healthcare education.

References

[1] Erin Donathan, Andrea LaLumia, Charles Foat, Nigel Barr, David I Page. *SMARTSIM* A multicenter prospective randomized trial of 3D virtual reality versus traditional patient simulation. Journal of the American College of Emergency Physicians Open. 2023; 5: e13092.

[2] Tinco Tupac S, Torres Gonzales S, Maraza Quispe B. Analysis of the Mental Workload Generated by Learning Experiences Through Augmented Reality and Virtual Reality in Students of Regular Basic Education. Revista De Gestão Social e Ambiental. 2024; 18: 1-25.

[3] Adrian Goldsworthy, Matthew Olsen, Andy Koh, Thibaut Demaneuf, Gobinddeep Singh, et al. Extended Reality Head-Mounted Displays Are Likely to Pose a Significant Risk in Medical Settings While Current Classification Remains as Non-Critical. Microorganisms. 2024; 12: 815.

[4] Suepphong Chernbumroong, Pakinee Ariya, Suratchanee Yolthasart, Natchaya Wongwan, Kannikar Intawong, et al. Comparing the Impact of Non-Gamified and Gamified Virtual Reality in Digital Twin Virtual Museum Environments: A Case Study of Wieng Yong House Museum, Thailand. Heritage. 2024; 7: 1870.

[5] Yu Fu, Fengqing Chu, Xiaoqing Lu, Chenxing Wang, Na Xiao, et al. Assessment and evaluation of online education and virtual simulation technology in dental education: a cross-sectional survey. BMC Medical Education. 2024; 24: 1-11.

[6] Damaševičius R, Sidekerskienė T. Virtual Worlds for Learning in Metaverse: A Narrative Review. Sustainability. 2024; 16: 2032.

[7] Lee Lap Kei, Wei Xiaodong, Kwok Tai Chui, Cheung Simon KS, Fu Lee Wang, et al. A Systematic Review of the Design of Serious Games for Innovative Learning: Augmented Reality, Virtual Reality, or Mixed Reality? Electronics. 2024; 13: 890.

[8] Guindy M, Kara PA. Light Field Visualization for Training and Education: A Review. Electronics. 2024; 13: 876.

[9] Adel A. The Convergence of Intelligent Tutoring, Robotics, and IoT in Smart Education for the Transition from Industry 4.0 to 5.0. Smart Cities. 2024; 7: 325.

[10] Bui Tim, Ruiz Cardozo Miguel A, Dave Harsh S, Barot Karma, Michael Ryan Kann, et al. Virtual, Augmented, and Mixed Reality Applications for Surgical Rehearsal, Operative Execution, and Patient Education in Spine Surgery: A Scoping Review. Medicina. 2024 60: 332.

[11] N. Khodabakhshian. "Virtual Reality for Developing Patient-Facing Communication Skills in Medical and Graduate Education: Protocol for a Scoping Review," JMIR Research Protocols. DOI: https://doi.org/10.2196/53901.

[12] Weronika Magdalena Żydowicz, Jaroslaw Skokowski, Luigi Marano, Karol Polom. Current Trends and Beyond Conventional Approaches: Advancements in Breast Cancer Surgery through Three-Dimensional Imaging, Virtual Reality, Augmented Reality, and the Emerging Metaverse. Journal of Clinical Medicine. 2024; 13: 915.

[13] Panagiotis Antoniou, Eleni Dafli, George Giannakoulas, Gaukhar Igimbayeva, Olga Visternichan, et al. Education of Patients with Atrial Fibrillation and Evaluation of the Efficacy of a Mobile Virtual Patient Environment: Protocol for a Multicenter Pseudorandomized Controlled Trial. JMIR

Research Protocols. 2024; 13.

[14] Koolivand H, Shooreshi MM, Moradpoor H, Borji M, Bahrami M, et al. Comparison of the effectiveness of virtual reality-based education and conventional teaching methods in dental education: a systematic review. BMC Medical Education. 2024; 24: 1-15.

[15] Mehrnoosh Khoshnoodifar, Navaz Emadi, Leili Mosalanejad, Sara Maghsoodzadeh, Nasrin Shokrpour. et al. A new practical approach using TeamSTEPPS strategies and tools: – an educational design. BMC Medical Education. 2024; 24: 1-10.

[16] Li H, Li B. The state of metaverse research: a bibliometric visual analysis based on CiteSpace. Journal of Big Data. 2024; 11: 1-14.

[17] Sun-Hwa S, On-Jeon Baek. Experiences of Patient Safety Education and Factors Affecting the Willingness to Participate in Patient Safety in Undergraduate Nursing Students in South Korea. Healthcare. 2023; 12: 1-54.

[18] Océane Richard, Jollant Fabrice, Billon Grégoire, Attoe Chris, Vodovar Dominique, et al. Simulation training in suicide risk assessment and intervention: a systematic review and meta-analysis. Medical Education Online. 2023; 28.

[19] Jae WO, Kim JE. Effectiveness of a virtual reality application-based education programme on patient safety management for nursing students: A pre-test–post-test study. Nursing Open. 2023; 10: 7622-7630.

[20] T Latinovic. The Meaning of the New Era of Industry 4.0, Healthcare 4.0 and Education 4.0 Concerning the Development of 5g Networks, Iot and Smart Everything. Annals of the Faculty of Engineering Hunedoara. 2023; 21: 147-152.