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VIRTUAL REALITY FOR TOOTHBRUSHING TRAINING AMONG ELEMENTARY SCHOOL STUDENTS: A QUASI EXPERIMENTAL STUDY

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ABSTRACT

Introduction: Virtual reality (VR) has emerged as a transformative tool in educational training across various fields, including dentistry. Several studies have shown that VR can enhance the transfer of skills learned in training to real-world applications. This study presents a virtual reality video intervention with horizontal toothbrushing technique.
Aim: The aim is to assess the effect of an educational intervention program on toothbrushing practice among elementary students at public elementary school 10 in Padang City.
Methods: A quasi-experimental (pre-post) study design was conducted by 40 children with purposive sampling techniques. Pre-intervention and 4 weeks post-intervention assessments were conducted to assess the changes in the practices of toothbrushing properly. The measurement tool uses a 0–20-point scoring method. Wilcoxon's test was performed to investigate the differences between before and after intervention virtual reality toothbrushing training.
Results: There was an improvement in toothbrushing skills performance, mean score before intervention 9.5 (minimum 4, maximum 14 points) and after intervention 17.5 (minimum 12, maximum 20 points). A significant improvement was observed before and after the virtual reality-based toothbrushing training ($p < 0.05$) among study participants.
Conclusion: Virtual reality-guided toothbrushing training could improve the toothbrushing skills of children. These findings suggested that virtual reality-based health promotion could be implemented among students at elementary school.

INTRODUCTION

Conventional education methods have been shown to be insufficient in effectively improving children's tooth brushing skills. Traditional approaches often lack engagement and fail to address the unique learning needs of children, which can lead to poor oral hygiene practices. According to the 2018 Basic Health Research (Riskesdas), the prevalence of dental caries among children in Indonesia is estimated to be approximately 57.6%, with even higher rates among specific age groups, such as toddlers, where it can reach up to 90%.[1] This high prevalence is often attributed to inadequate oral hygiene practices, poor dietary habits, and limited access to dental care services.[2]

Periodontal disease is also prevalent among Indonesian children, with studies indicating that the prevalence of gingivitis can be as high as 74%.[3] The overall prevalence of periodontal disease among children has been reported to reach 85.6% in certain regions, highlighting the urgent need for targeted public health interventions. Factors contributing to the high rates of periodontal disease include poor oral hygiene, lack of parental supervision in tooth brushing, and the consumption of sugary foods, which are common in many households. The role of parental influence on children's oral health cannot be overstated. Research indicates that children's oral hygiene behaviors are significantly influenced by their caregivers, particularly regarding tooth brushing frequency and techniques.[4,5] The families may not recognize the importance of regular toothbrushing due to limited health literacy. Additionally, children from these backgrounds may have diets high in sugar and low in nutritional value, further exacerbating the risk of dental caries.[6,7] A systematic review indicated that inadequate oral hygiene practices, particularly insufficient toothbrushing frequency, are closely linked to the prevalence of periodontal diseases and dental caries. The frequency and technique of toothbrushing are critical factors in maintaining oral health. The mechanical action of toothbrushing is essential for the removal of this biofilm, and failure to perform this action effectively can lead to inflammation and subsequent periodontal disease. Integrating oral health education into school curricula can help instill good oral hygiene habits from an early age, potentially leading to a decrease in the prevalence of these oral diseases in future generations.[2,8]

A variety of media can be employed to improve toothbrushing habits among children. By utilizing animated videos, interactive apps, storytelling, educational materials, mass media campaigns, engaging parents, and virtual reality, it is possible to enhance children's understanding of oral hygiene and promote better toothbrushing practices. Virtual reality (VR) technology has emerged as a promising tool for enhancing toothbrushing habits among children. By creating immersive and engaging environments, VR can effectively educate children about proper oral hygiene practices, making the learning process enjoyable and interactive. Several studies have explored the potential of VR in promoting oral health behaviors, particularly toothbrushing. One notable study by Genaro et al. highlights the use of VR in oral hygiene instruction, demonstrating that immersive experiences can significantly enhance children's understanding of proper toothbrushing technique.[9] The study found that children who participated in VR-based oral hygiene education showed improved knowledge and motivation regarding their dental care practices. Additionally, Aminabadi et al. conducted a randomized controlled trial that assessed the impact of VR on preschool oral health status. The findings indicated that using VR to educate children about oral hygiene practices, including tooth brushing, was engaging and positively influenced their attitudes towards dental care.[10]

SD 10 Sungai Sapih is one of the public elementary schools in Kuranji sub-district, Padang city. Based on the results of previous research conducted by Putri in 2017, more than half of children experience dental care (68.2%), more than half have low knowledge (66.8%) on how to maintain oral hygiene. It is hoped that there will be promotive efforts through health education for school- age children about dental care.[11] This study underscores the potential of VR to create a dynamic learning environment that encourages to adopt better oral hygiene habits elementary school students in SD 10 Sungai Sapih, Padang city.

RESEARCH METHOD

The type of research is designated as a quasi-experiment with one-group pretest-posttest design. Sampling was conducted using the purposive sampling technique. This study employed an initial test (pretest) to ascertain the magnitude of the effect or influence of the independent variable on the dependent variable. Following a one-month intervention comprising 12 repetitions of utilizing virtual reality video presentation on horizontal tooth-brushing techniques, a post-test was conducted. The Inclusion criteria were children with grade V, willing to participate in the study, having a parent or guardian willing to sign an informed consent form, and being cooperative during the study. The exclusion criteria were students who were sensitive to the use of VR and students who refused to participate in the study. Of the total 48 students, only 40 met the inclusion and exclusion criteria.

The efficacy of the toothbrushing technique was evaluated using a checklist comprising 20 closed questions, which were assessed directly by enumerators selected by the researcher and exhibiting similar perceptions of the assessment. The questionnaire exhibited adequate internal reliability, as indicated by a kappa value of 0.81. On the assessment sheet, a score of 1 is assigned to indicate successful completion of the task, while a score of 0 is given in the event of an unsuccessful attempt. The total score is calculated with a minimum of 0 and a maximum of 20. The data analysis employed in this study is the Wilcoxon test.

The study methods were approved by the Health Research Ethics Commission of the Faculty of Medicine, Baiturrahmah University, as indicated by the issuance of certificate No. 030/ETIK-FKUNBRAH/03/01/2023.

RESEARCH FINDINGS

The proposed study is concerned with the impact of virtual reality-based toothbrushing training on toothbrushing properly (Figure 1). Twenty participants from the sample were excluded, as they could not complete the training protocol.

Table 1. Participants Characteristic

Gender	*n*	%
Male	15	37,5
Female	25	62,5
Total	40	100,0

Although we targeted all elementary school children at fifth-grade (60 participants), only 40 participants completed the study. The majority were female (25, 62.5%).

Figure 1. The Virtual Reality-Based Simulation Education on Horizontal Toothbrushing Skills

Table 2. Comparison of Pretest and Posttest Scores on Toothbrushing Skills Performance

Group	*Min*	*Max*
Pretest	4	14
Posttest	12	20

Before toothbrushing skills training use virtual reality, the minimum score is 4 and maximum score 14. After training the minimum score is 12 and the maximum score up to 20 (Table 2).

Table 3. Results of Wilcoxon Test in Mean Scores for the Pretest and Posttest

Group	*Mean*	*Std. deviation*	*p value*
Pretest	9.53	2.76	4
Posttest	17.45	2.43	12

At the baseline, there were significant differences in average pretest (9.53±2.76) and posttest (17.45±2.43) scores. After the team training, a statistically significant increase was observed in the performance of toothbrushing skills among the study participants (p = 0.000) (Tabel 3).

DISCUSSION

The implementation of virtual reality (VR) in dental training presents several challenges, including technical issues such as equipment malfunctions and the necessity for specialized training. Additionally, the variability in children's responses to VR suggests that prior experiences with technology can influence the effectiveness of VR interventions. The observation that female children

tend to be more cooperative than male children in various contexts, including health-related behaviors such as tooth brushing. The role of parental involvement and monitoring can significantly impact children's cooperation in health practices. Research indicates that parental supervision and encouragement are crucial in promoting positive oral hygiene behaviors among children.[12] Gender differences in parenting styles may also play a role in shaping cooperative behaviors. Research by Halpern and Perry-Jenkins found that parents often engage differently with their children based on gender, which can influence children's attitudes and education among children. The findings indicated that children in the experimental group who engaged with VR outperformed their peers in the control group.[14-17] This reinforces the idea that VR can be a valuable tool for teaching and practicing skills, including those related to oral health.

This result was similar with study by Genaro et al. highlights the use of VR in oral hygiene instruction, demonstrating that immersive experiences can significantly enhance children's understanding of proper toothbrushing techniques.[9] The study found that children who participated in VR-based oral hygiene education showed improved knowledge and motivation regarding their dental care practices. Additionally, Felemban et al. found that VR distraction significantly suggesting that incorporating VR into toothbrushing education could alleviate fears associated with dental care.[18] By associating tooth brushing with positive experiences in a virtual environment, children may be more likely to engage in regular brushing habits.

These findings in line with research by Oestergaard et al. demonstrated that VR simulation significantly improved basic psychomotor skills. The randomized educational trial showed that participants who trained using VR simulators performed better in tasks compared to those who did not receive VR training.[19] This reinforces the notion that VR can effectively bridge the gap between theoretical knowledge and practical application. The randomized educational trial showed that participants who trained using VR simulators performed better in laparoscopic tasks compared to those who did not receive VR training.[20,21] Therefore, other study also indicated that VR training effectively increased self-efficacy among participants, suggesting that immersive learning environments can enhance confidence and competence in practical skills.[22] This aligns with findings from other studies that highlight the positive effects of VR on skill acquisition and retention.

Toothbrushing skills performance had statistically significant greater improvements than before VR training. In a related context, Zacharias et al. conducted a randomized controlled trial that demonstrated the effectiveness of interventions aimed at improving children's teeth brushing skills. The study found that children who received structured oral hygiene education, including the use of visual aids, showed significant improvements in their brushing skills and oral hygiene status.[23] Similar with Purnama's research on tooth brushing skills in preschool children indicated that structured training

programs significantly improved children's oral hygiene practices.[24] Incorporating VR into such training programs could further enhance engagement and retention of skills, as children are likely to respond positively to interactive and gamified learning experiences. Moreover, the review by Huang et al. discussed the applications of VR in dentistry, emphasizing their potential to improve educational outcomes and practical skills among dental students.[25,26,27] This suggests that similar VR applications could be adapted for children to teach them effective tooth brushing techniques in a fun and engaging manner. The immersive nature of VR allows for engaging and interactive learning experiences that can significantly enhance tooth brushing techniques and overall oral hygiene practices. However, the proposed study was constrained by the small sample size. Consequently, it is recommended that future studies increase the sample size in the virtual reality-based toothbrushing training.

CONCLUSION

The utilization of virtual reality-guided toothbrushing training has the potential to enhance the oral hygiene practices of children. These findings indicate that the integration of virtual reality- based health promotion strategies within the curriculum of elementary school students may be a promising avenue for consideration. By leveraging this technology, healthcare providers and educators can foster better oral hygiene practices, ultimately leading to improved dental health outcomes for children.

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