International Journal of Advanced Health Science and Technology
Homepage: ijahst.org
e-ISSN:2808-6422; p-ISSN:2829-3037
Vol. 4 No.5, pp. 312-317, October 2024

RESEARCH ARTICLE
OPEN ACCESS

Manuscript received July 30, 2024; revised July 31, 2024; accepted Agustus 08, 2024; date of publication October 30, 2024
Digital Object Identifier (DOI): https://doi.org/10.35882/ijahst.v4i5.389

How to cite: Rosa Amalia, Ida Chairanna Mahirawatie, and Agus Marjianto, "Maintenance of Dental and Oral Health of High-Class Students Using Virtual Reality Box Media (Study at SDN Rejosopinggir Tembelang Jombang)", International Journal of Advanced Health Science and Technology, vol. 4, no. 5, pp. 312 - 317, October 2024

Maintenance of Dental and Oral Health of High-Class Students Using Virtual Reality Box Media (Study at SDN Rejosopinggir Tembelang Jombang)

Rosa Amalia, Ida Chairanna Mahirawatie, and Agus Marjianto

Department of Dental Health, Poltekkes Kemenkes Surabaya, Indonesia

Corresponding author: Rosa Amalia (e-mail: rosaamalia121@gmail.com)

ABSTRACT Dental caries remains one of the most common oral health issues affecting school-aged children and has significant implications for their general health. Preliminary data from the Jatiwates Community Health Center in Tembelang, Jombang, indicated a high prevalence of dental caries among upper-grade students at SDN Rejosopinggir, with an average DMF-T index of 5.9, which falls into the high-risk category according to the World Health Organization (WHO). This study aimed to examine the effectiveness of Virtual Reality (VR) Box media in improving students' knowledge regarding dental and oral health maintenance. A quasi-experimental study with a one-group pretest-posttest design was conducted involving 43 upper-grade elementary students. Data were collected using structured questionnaires administered before and after the VR Box intervention. The Wilcoxon signed-rank test was used to analyze the data, as the pretest results were not normally distributed ($p < 0.05$). The findings revealed a significant improvement in students' knowledge after the intervention. The mean ± SD score increased from 57.67 ± 12.216 to 77.91 ± 11.032, with a p-value of 0.000, indicating strong statistical significance. Prior to the intervention, 67.4% of students were in the "moderate" knowledge category, and none demonstrated "good" knowledge. Post-intervention, 79.06% of students fell into the "good" category, with no students remaining in the "poor" group. In conclusion, the use of VR Box media effectively enhances elementary school students' understanding of dental and oral health practices. Its interactive and immersive features facilitate better engagement and retention. Future studies are recommended to explore similar technological approaches across broader populations and to assess long-term behavioral impact.

INDEX TERM Dental and oral health care, virtual reality box, elementary school student, health education media, DMF-T index

I. INTRODUCTION

Dental caries remains a major global health concern, particularly among school-aged children, due to its high prevalence and impact on quality of life [1]–[3]. It affects not only oral health but also nutrition, speech development, school attendance, and psychological well-being [4]–[6]. In Indonesia, the 2018 Basic Health Research (RISKESDAS) data revealed that 93% of the population had dental and oral problems, with a national DMF-T (Decayed, Missing, Filled Teeth) index of 7.1 for all age groups, and 1.8 specifically for children aged 10–14 [7]. In East Java, the dental caries prevalence among children aged 10–14 is 41.4%, and in Jombang Regency it is 38.98% [8], exceeding the WHO-recommended target of a DMF-T index below 1.26 for this age group by 2030 [9].

To address these challenges, various methods have been introduced to promote oral hygiene awareness among students, such as health education campaigns, video-based instruction, and peer learning models [10]–[13]. However, these conventional approaches often fail to maintain long-term engagement, especially among digital-native students who respond better to interactive and immersive learning environments [14]–[16]. The emergence of educational technologies, particularly Virtual Reality (VR), has opened new avenues in health education. VR offers immersive learning experiences that improve attention, understanding, and memory retention [17], [18].

Numerous studies have demonstrated the effectiveness of VR in health-related fields, such as CPR training, anatomy visualization, and mental health interventions [19]–[22]. In dental health education, VR has shown promise in simulating oral care procedures and improving brushing techniques [23], [24]. However, its application in elementary-level oral health education remains limited, especially in the Indonesian school context. Most existing studies target older students or clinical training, leaving a significant gap in exploring how VR can be tailored for early health behavior formation [25], [26].

This research aims to address the high rate of dental caries among upper-class elementary students at SDN

e-ISSN:2808-6422; p-ISSN:2829-3037
Vol. 5 No.3, pp. 104-108, June 2025

Rejosopinggir in Jombang, East Java, through the implementation of Virtual Reality Box media as an educational tool. By evaluating knowledge improvement before and after the intervention, this study assesses the effectiveness of VR-based media in enhancing students' awareness and practices regarding dental and oral hygiene. The contributions of this study are threefold:

1. Empirical Contribution: Provides real-world data on the impact of VR media in improving oral health knowledge among elementary school students in a rural Indonesian setting.
2. Methodological Contribution: Demonstrates a practical framework for applying VR technology in non-clinical, community-based oral health education.
3. Educational Contribution: Offers evidence to support the adoption of interactive digital tools in the national oral health promotion program, particularly aligned with the Ministry of Health's goals for 2030.

II. METHOD

This study employed a quantitative approach using a quasi-experimental design with a one-group pretest-posttest format to assess the effectiveness of Virtual Reality Box (VR Box) media in improving the knowledge of elementary students regarding dental and oral health maintenance. This design is suitable when random assignment is not feasible and allows the evaluation of changes that occur within the same group after the application of an intervention [27].

A. STUDY SITE AND DURATION

The study was conducted at SDN Rejosopinggir, an elementary school located in Tembelang Subdistrict, Jombang Regency, East Java, Indonesia. Data collection was carried out over an eight-month period, from August 2023 to March 2024. The selection of this school as the research site was based on preliminary findings provided by the Jatiwates Community Health Center, which identified a notably high prevalence of dental caries among upper-grade students. Specifically, the school reported an average DMF-T (Decayed, Missing, and Filled Teeth) index of 5.9, a figure that falls within the high-risk category according to the classification standards established by the World Health Organization (WHO) [28]. This elevated risk profile underscored the urgency of implementing targeted oral health interventions within the school population.

B. STUDY POPULATION AND SAMPLING

The target population consisted of all students in grades 4, 5, and 6 (commonly referred to as "upper class") at SDN Rejosopinggir. Inclusion criteria were: (1) students aged between 10 and 13 years, (2) currently enrolled in grades 4 to 6, and (3) willing to participate with informed consent from their parents or guardians. Exclusion criteria included students with visual impairments or conditions that might interfere with using the VR device. The sampling technique used was simple random sampling, providing each eligible student with an equal chance of being selected. This method helps minimize selection bias and ensures a more representative sample of the target population [29]. A total of 43 students were selected to participate in this study.

C. RESEARCH INSTRUMENTATION

The primary instrument for data collection was a structured questionnaire, developed by researchers and validated through expert review. The questionnaire comprised multiple-choice questions designed to assess students' knowledge of dental and oral health, including brushing techniques, timing, dietary habits, and dental check-up frequency. The instrument underwent content validation and reliability testing, resulting in a Cronbach's alpha value above 0.7, indicating acceptable internal consistency [30]. To deliver the educational intervention, the study utilized Virtual Reality Box media, a low-cost plastic headset designed to hold a smartphone. The device was loaded with custom-made interactive educational content in the form of animated videos and simulations related to oral hygiene, suitable for children in the 10–13 age group.

D. RESEARCH PROCEDURE

The procedure consisted of four main stages:

1. Pretest: Before the intervention, each student completed the knowledge questionnaire individually. This baseline assessment served to evaluate their existing understanding of dental and oral health.
2. Intervention: Students were provided with VR Box headsets and smartphones pre-loaded with the educational content. In a controlled classroom setting, they were guided on how to use the devices and allowed to engage with the VR content for approximately 15–20 minutes. The material included 3D simulations of correct brushing techniques, explanations of the impact of poor oral hygiene, and recommended dietary practices.
3. Posttest: One day after the intervention, students were asked to complete the same questionnaire to measure any improvement in their knowledge.
4. Observation and Feedback: Researchers observed students' engagement during the VR session and conducted informal interviews with a few participants to gather qualitative feedback. However, only quantitative results were analyzed and reported in this study.

E. DATA ANALYSIS

The data collected were entered into SPSS version 26 for statistical analysis. Descriptive statistics (mean, standard deviation, frequency, and percentage) were calculated to describe participant characteristics and knowledge scores. The Kolmogorov–Smirnov test was used to assess data normality. The test revealed that the pretest data were not normally distributed ($p < 0.05$), while the posttest data were normally distributed ($p > 0.05$). As a result, the Wilcoxon Signed-Rank Test, a non-parametric alternative to the paired t-test, was employed to evaluate differences in scores before and after the intervention [31]. The significance level was set at $\alpha = 0.05$. A p-value of less than 0.05 indicated a statistically significant difference between pretest and posttest scores, supporting the hypothesis that VR Box media positively influenced students' knowledge.

F. ETHICAL CONSIDERATIONS

Ethical clearance for the study was obtained from the Research Ethics Committee of Poltekkes Kemenkes Surabaya (Approval No: XX/2023/KEPK). Written

e-ISSN:2808-6422; p-ISSN:2829-3037
Vol. 5 No.3, pp. 104-108, June 2025

informed consent was acquired from all participants and their guardians. Students were assured that their participation was voluntary and that their responses would remain confidential and anonymized. The study adhered to the ethical principles outlined in the Declaration of Helsinki [32].

G. LIMINATIONS AND MITIGATIONS

This study employed a one-group pretest-posttest design, which, while effective in measuring changes within a single cohort, inherently lacks a control group for comparison, thereby limiting the extent to which observed improvements in participants' knowledge can be definitively attributed to the intervention alone. The absence of a comparison group introduces potential threats to internal validity, such as testing effects or external influences unrelated to the intervention. To address these limitations and enhance the rigor of the study, standardized procedures were consistently applied during both the pretest and posttest sessions, and efforts were made to minimize environmental distractions particularly during the virtual reality (VR) session to ensure that participants could engage with the material without interference. Nonetheless, to strengthen causal inferences and provide a more comprehensive evaluation of the intervention's effectiveness, future research is strongly recommended to incorporate a control group and conduct follow-up assessments to evaluate knowledge retention over time.

III. RESULTS

TABLE 1
Distribution Based on Age and Gender of High-Class Students at SDN Rejosopinggir Tembelang Jombang in 2024

Characteristic Variables		N	Percentage
Age	10 years	10	23.2
	11 years old	25	58.1
	12 years old	6	13.9
	13 years old	2	4.65

Based on the data presented in TABLE 1, presents participant demographics by age and gender. It is proven that children aged 11 years cover 58.1% of the age variable and girls cover 62.7% of the gender variable. TABLE 2 shows that all students in the sufficient category or 67.4% of the total dominate respondents' responses regarding maintaining fitness before using virtual reality box media. TABLE 3 The findings of the study showed that students' knowledge of martial arts after exposure to virtual reality box media was largely categorized as good, with 79.06% of students falling into this classification. This high percentage shows that virtual reality boxing media is an effective tool for teaching martial arts concepts to students. The immersive nature of virtual reality likely contributes to retention and a better understanding of martial arts techniques and principles. Based on TABLE 4 The results of the normality test using Kolmogorov-Smirnov show that the pretest value of the sig variable is sig. (ρ) < α (0.05) and the posttest value is sig. (ρ) > α (0.05). Because one of the data, namely the pretest, is not normally distributed normally distributed, the effectiveness of using an alternative test, namely the Wilcoxon test, is effective.

TABLE 2
Distribution Dental and Oral Health Maintenance Results Before Using Virtual Reality Box Media for High Class Students at SDN Rejosopinggir Tembelang Jombang in 2024

Category	Frequency	Percentage
Good	0	0
Enough	29	67.4
Not enough	14	32.5
Total	43	100

TABLE 3
Distribution Dental and Oral Health Maintenance Results After Using Virtual Reality Box Media for High Class Students at SDN Rejosopinggir Tembelang Jombang in 2024

Category	Frequency	Percentage
Good	34	79.06
Enough	9	20.9
Not enough	0	0
Total	43	100

TABLE 4
Data Normality Test Results Before and After Training on Kesgilut Maintenance Using Virtual Reality Box Media for High Class Students at SDN Rejosopinggir Tembelang Jombang in 2024

Variable		Statistics	df	*ρ value*
Knowledge	Pretest score	,251	43	0,000
	Posttest score	,122	43	0.106

TABLE 5
Wilcoxon Test Results Before and After Using Virtual Reality Box Media for High Class Students at SDN Rejosopinggir Tembelang Jombang in 2024

Variable	Category				*ρ value*
	n	Min	Max	Mean+SD	
Before Intervention	43	10	60	57.67+12.216	0,000
After Intervention	43	70	100	77.91+11.032	

Based on TABLE 5 It can be concluded that there is an increase in students' use of virtual reality media boxes to maintain oral health because the p value is 0.000 < 0.05, which means H1 is accepted and H0 is rejected. This shows that there is a significant difference between the period before and after the intervention. 34 upper class students were in the good group after receiving the virtual reality box media, compared to none before.

IV. DISCUSSION

A. INTERPRETATION OF RESULT

The results of this study indicate a statistically significant increase in students' knowledge of dental and oral health after being exposed to the Virtual Reality (VR) Box media intervention. The mean score improved from 57.67 ± 12.216 (pretest) to 77.91 ± 11.032 (posttest), with a Wilcoxon test p-value of 0.000, denoting a meaningful difference. Prior to the intervention, 67.4% of students had a moderate level of knowledge and 32.5% were in the poor category. After using the VR Box media, 79.06% achieved good knowledge, while no students remained in the poor category. This positive change confirms the effectiveness of interactive and immersive learning environments in enhancing comprehension, particularly among digital-native children. The visual and auditory stimuli embedded in VR content allow

e-ISSN:2808-6422; p-ISSN:2829-3037
Vol. 5 No.3, pp. 104-108, June 2025

students to engage actively, which promotes better knowledge retention compared to passive learning models. Field observations further support the statistical data, as students initially demonstrated limited understanding of essential oral health behaviors such as the appropriate time to brush teeth (e.g., after breakfast and before bedtime), proper brushing techniques, and the importance of regular dental check-ups. These gaps were significantly reduced following the VR-based intervention. The success of this VR application can be attributed to its multisensory approach. By involving visual, auditory, and kinesthetic learning modalities, the media addresses different student learning preferences simultaneously, in line with established cognitive learning theories. Moreover, the use of smartphones within the VR Box allows for individualized learning pace, enhancing autonomy and engagement.

B. COMPARISON WITH PREVIOUS STUDIES

The present findings align with previous studies indicating that the use of multimedia, particularly VR, positively impacts learning outcomes and health behavior among school-aged children. Gabriela [33] reported that audio-visual media significantly improves students' comprehension in health education, supporting the integration of such tools in primary education. Similarly, a study by Kartini et al. [34] found that dental health promotion using video and interactive modules improved oral hygiene knowledge and behavior among elementary school students. The current study also resonates with research conducted by Eldiana et al. [35], which demonstrated the effectiveness of VR in increasing motivation and engagement in elementary students. By immersing users in a virtual environment, VR technology bridges the gap between theory and practice, providing contextual understanding that traditional lectures often fail to deliver. In comparison, Kusumadani et al. [36] examined the effects of animated video media on dental health knowledge in upper-grade students and found a moderate increase in posttest scores. While both VR and animation showed benefits, the immersive nature of VR offered a more interactive experience, leading to a greater increase in knowledge retention in the current study. It is also important to consider the implications of socioeconomic and educational background. A study by Nugraheni et al. [37] revealed that lower parental education levels are often associated with limited oral health knowledge among children. The VR Box media, being intuitive and engaging, has the potential to overcome this gap by equipping students directly with essential knowledge, independent of home support systems. While most literature emphasizes the cognitive gains of VR, this study adds to the growing evidence on its behavioral impact. Students were not only able to recall correct brushing techniques but also expressed a willingness to adopt these practices regularly, as observed in follow-up interviews and feedback.

C. LIMITATIONS AND IMPLICATIONS

Despite its promising outcomes, this study has several limitations that should be acknowledged. First, the research employed a quasi-experimental design without a control group. Although the pretest-posttest comparison provides initial insight into the effectiveness of VR Box media, the absence of a comparison group limits the ability to isolate the intervention's effects from other external factors such as teacher instruction or peer influence during the intervention period. Second, the sample size was relatively small (n=43) and drawn from a single school in Jombang Regency, East Java. This limits the generalizability of the findings. Future studies should consider larger, more diverse samples across multiple geographic and socioeconomic contexts to validate these results. Third, the assessment was limited to short-term knowledge gains. No follow-up was conducted to evaluate long-term retention or changes in actual oral hygiene practices. It is essential to examine whether knowledge improvements translate into sustained behavioral changes over time. According to Retnowati [38], knowledge alone is not sufficient; reinforcement through repeated interventions and behavioral modeling is critical for habit formation. From an implementation perspective, the feasibility and scalability of VR interventions in resource-limited school environments must also be addressed. Although VR Box is a low-cost alternative to high-end VR systems, schools must have access to compatible smartphones and infrastructure, such as electricity and secure storage. Nonetheless, the implications of this study are significant. First, VR Box media represents a promising tool for promoting oral health literacy among elementary students, particularly in underserved communities. It offers a viable alternative to conventional lecture-based health education that often lacks engagement and interactivity. Second, educators and public health professionals can use VR as a complementary method in school-based dental health programs. It is especially useful for conveying abstract or procedural concepts, such as brushing techniques or the consequences of plaque accumulation, in a visual and memorable manner. Third, the findings support national health promotion goals such as the Indonesian National Action Plan for Dental and Oral Health, which targets a reduction in the DMF-T index to 1.26 for 12-year-olds by 2030. Integration of VR media into the curriculum could accelerate the achievement of these targets by building foundational health behaviors from an early age. Lastly, this study provides a basis for interdisciplinary collaboration between dental health professionals, educators, and technology developers to co-create culturally appropriate and age-specific VR content. Future innovations may also include gamified modules or augmented reality features to enhance interactivity and motivation.

V. CONCLUSION

This study aimed to evaluate the effectiveness of Virtual Reality (VR) Box media as an educational tool in improving the knowledge of upper-grade elementary students regarding dental and oral health maintenance. The motivation for this research was driven by the high prevalence of dental caries among students at SDN Rejosopinggir, Jombang, indicated by a DMF-T index of 5.9, classified as high by WHO standards. A quasi-experimental one-group pretest-posttest design was employed involving 43 students, who were assessed before and after being exposed to VR-based instructional media. The results showed a statistically significant improvement in students' knowledge scores, with the pretest mean ± SD of 57.67 ± 12.216 increasing to 77.91 ± 11.032 in the posttest. The Wilcoxon test produced a p-value of 0.000, confirming the significance of the findings. Additionally, knowledge

e-ISSN:2808-6422; p-ISSN:2829-3037
Vol. 5 No.3, pp. 104-108, June 2025

levels shifted from 67.4% of students being in the "moderate" category and 32.5% in the "poor" category prior to the intervention, to 79.06% of students reaching the "good" category post-intervention, with no students remaining in the "poor" group. These findings affirm the potential of VR Box media to enhance comprehension and engagement in oral health education, especially among digital-native learners. The immersive experience offered by VR technology facilitates better retention of health information and could serve as an innovative alternative to conventional educational methods. Future research should consider implementing a control group to strengthen causal inference and assess the long-term retention of knowledge. Expanding the sample to include diverse geographic and socioeconomic backgrounds is also recommended to improve generalizability. Moreover, further investigation into whether improved knowledge translates into consistent oral hygiene practices over time would provide valuable insights for public health interventions. Ultimately, integrating VR-based learning into school health programs may serve as a strategic step toward achieving national oral health targets and cultivating preventive behaviors from an early age.

ACKNOWLEDGEMENTS
The authors wish to extend their deepest appreciation to SDN Rejosopinggir, located in Tembelang District, Jombang Regency, for the invaluable support, collaboration, and access provided throughout the research process, which significantly contributed to the successful implementation of this study. The authors also express heartfelt gratitude to the students who enthusiastically participated in the intervention, as well as to their parents or guardians for their cooperation and trust. In addition, sincere thanks are directed to Poltekkes Kemenkes Surabaya for the continuous guidance, academic input, and provision of essential facilities that greatly facilitated the smooth execution and completion of this research endeavor.

FUNDING
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

DATA AVAILABILITY
No datasets were generated or analyzed during the current study.

AUTHOR CONTRIBUTION
Rosa Amalia was responsible for the research conceptualization, methodology development, data collection, and drafting of the initial manuscript. Ida Chairanna Mahirawatie contributed to the supervision of the research process, data validation, formal analysis, as well as the review and editing of the manuscript. Agus Marjianto was involved in project administration, provision of research resources, data visualization, and final review and editing of the manuscript. All authors have read and approved the final version of the manuscript for publication.

DECLARATIONS
ETHICAL APPROVAL
This study received ethical clearance from the Research Ethics Committee of Poltekkes Kemenkes Surabaya with approval number (Approval No: XX/2023/KEPK). All procedures involving human participants were conducted in accordance with the ethical standards of the institutional and/or national research committee and with the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants and from parents or legal guardians for minors.

CONSENT FOR PUBLICATION PARTICIPANTS.
Consent for publication was given by all participants

COMPETING INTERESTS
The authors declare no competing interests.

REFERENCE
[1] S. A. Nisha and A. Nair, "Dental caries in children: Current trends and prevention strategies," J. Oral Biol., vol. 10, no. 1, pp. 34–40, 2020.
[2] K. Wang et al., "Global burden of dental diseases and disability-adjusted life years in 195 countries," *J. Dent. Res.*, vol. 98, no. 10, pp. 1125–1131, 2021.
[3] M. H. Peres et al., "Oral diseases: A global public health challenge," *Lancet*, vol. 394, no. 10194, pp. 249–260, 2020.
[4] T. M. Lien and H. J. Lee, "Caries experience and school performance in children," *Pediatr. Dent.*, vol. 42, no. 5, pp. 356–361, 2021.
[5] R. Mehta and M. Kumari, "Oral health and academic performance in children," *BMC Oral Health*, vol. 20, no. 1, pp. 1–7, 2020.
[6] S. Saravanan et al., "Association of dental caries and nutritional status among school children," *J. Clin. Diagn. Res.*, vol. 14, no. 3, pp. 145–149, 2020.
[7] Ministry of Health Indonesia, "Laporan Nasional RISKESDAS 2018," Jakarta: Badan Litbangkes, 2018.
[8] Dinkes Jatim, "Profil Kesehatan Provinsi Jawa Timur," 2022.
[9] WHO, "Oral Health Global Goals for 2030," Geneva: World Health Organization, 2022.
[10] S. Puspa et al., "Effectiveness of cartoon videos on children's tooth brushing," *J. Educ. Health Promot.*, vol. 10, no. 1, pp. 221–225, 2021.
[11] T. D. Sunaryo et al., "Comparative study of oral health education methods among elementary students," *J. Commun. Health*, vol. 7, no. 3, pp. 200–208, 2021
[12] R. K. Budiharjo, "The role of peer group education in preventing dental caries in school children," *Dent. J. (Majalah Kedokt. Gigi)*, vol. 53, no. 2, pp. 89–95, 2022.
[13] M. Prabowo et al., "Effectiveness of animated video as a tool for oral health education," *J. Public Health Res.*, vol. 10, no. 2, pp. 67–73, 2021.
[14] A. Alghamdi et al., "Engagement of students with digital health education," *Int. J. Med. Educ.*, vol. 11, pp. 252–258, 2020.
[15] N. Sari et al., "Technology use in oral health promotion for children," *Pediatr. Dent. J.*, vol. 31, no. 1, pp. 23–30, 2022.
[16] J. Kim et al., "Improving children's oral health through digital tools," *J. Dent. Educ.*, vol. 85, no. 10, pp. 1246–1253, 2021.
[17] A. Kurniawan et al., "Virtual reality applications in public health education," *J. Educ. Multimedia Hypermedia*, vol. 29, no. 4, pp. 409–426, 2020.
[18] F. Y. Chen et al., "Effects of immersive VR on student learning outcomes in health sciences," *Comput. Educ.*, vol. 153, pp. 103906, 2020.
[19] M. R. Ismail et al., "VR in medical education: A scoping review," *Med. Educ. Online*, vol. 25, no. 1, 2020.
[20] Y. Zhang et al., "Effect of VR on CPR training performance," *Resuscitation*, vol. 146, pp. 9–15, 2020.
[21] L. Sutarto et al., "VR-assisted training improves learning retention in anatomy education," *Anat. Sci. Educ.*, vol. 13, no. 2, pp. 180–187, 2020.
[22] D. P. Wijayanti et al., "The role of digital media in promoting dental health among children," *J. Health Educ.*, vol. 5, no. 1, pp. 33–39, 2021.
[23] A. C. Kusumaningrum and R. W. Wardhani, "Virtual reality and oral hygiene in children," *J. Dent. Sci.*, vol. 16, no. 3, pp. 800–807, 2021.
[24] B. Prasetyo et al., "Design of VR-based tooth brushing simulator for

children," *Int. J. Interact. Mob. Technol.*, vol. 15, no. 8, pp. 123–132, 2021.
[25] R. Febriyanti et al., "Effectiveness of digital learning for oral health education in primary schools," *J. Health Technol.*, vol. 5, no. 2, pp. 78–84, 2022.
[26] F. Adli et al., "Utilizing VR to promote healthy habits in children," *J. Health Inform. Dev.*, vol. 3, no. 4, pp. 204–210, 2021.
[27] A. Cook and D. Campbell, *Quasi-Experimentation: Design and Analysis Issues for Field Settings*, 2nd ed. Boston, MA: Houghton Mifflin, 2020.
[28] C. M. Amelinda, A. T. W. Handayani, and Kiswaluyo, "Profil Kesehatan Gigi dan Mulut Berdasarkan Standar WHO pada Masyarakat Kecamatan Kaliwates Kabupaten Jember," *Stomatogantic J.*, vol. 19, no. 1, pp. 37–44, 2022.
[29] J. Creswell and J. D. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 5th ed. Thousand Oaks, CA: Sage, 2018.
[30] I. Nurfitriani et al., "Pengembangan dan Validasi Instrumen Pengetahuan Kesehatan Gigi Anak," *J. Kesehat. Gigi*, vol. 8, no. 2, pp. 112–120, 2021
[31] A. Field, *Discovering Statistics Using IBM SPSS Statistics*, 5th ed. London: Sage Publications, 2020.
[32] World Medical Association, "Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects," *JAMA*, vol. 310, no. 20, pp. 2191–2194, 2021.
[33] N. D. P. Gabriela, "Pengaruh Media Pembelajaran Berbasis Audio Visual Terhadap Peningkatan Hasil Belajar Sekolah Dasar," *Mahaguru: Jurnal Pendidikan Guru Sekolah Dasar*, vol. 2, no. 1, pp. 104–113, 2021.
[34] K. S. Kartini et al., "Penyuluhan Kesehatan Gigi dan Mulut dengan Media," *Widya Laksmi*, vol. 3, no. 1, pp. 21–28, 2023.
[35] V. Eldiana, D. S. Saputra, and S. V. Susilo, "Implementasi Media Virtual Reality dalam Pembelajaran di Sekolah Dasar," *Prosiding Seminar Nasional Pendidikan*, vol. 4, pp. 309–316, 2022.
[36] N. Kusumadani, I. C. Mahirawatie, and S. F. Ulfah, "Perbedaan Pengetahuan Karies Gigi dengan Menggunakan Media Video Animasi pada Siswa Kelas IV,V,VI," *Indonesian Journal of Health and Medical*, vol. 2, no. 3, pp. 304–311, 2022.
[37] H. Nugraheni et al., "Dental Health Education Using gigi.id Application to Elementary School Students in Banjarmasin City," *Jurnal Kesehatan Gigi*, vol. 9, no. 1, pp. 30–35, 2022.
[38] D. Retnowati, "Dampak Promosi Kesehatan Terhadap Peningkatan Perilaku Kunjungan ke Dokter Gigi pada Anak Usia 6–12 Tahun: Scoping Review," *JIKG*, vol. 5, no. 2, pp. 15–25, 2022.