Original Article

Effectiveness of Various Artificial Intelligence-guided Oral Health Education Videos among School Children – A Novel Interventional Study

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Abstract

Introduction: Oral diseases are common worldwide and cause pain, anxiety, and lost time. Prevention efforts and oral hygiene practices can reduce dental diseases. School-based oral health programs can raise awareness and promote oral health. Artificial intelligence (AI) transforms oral health education (OHE) with personalized learning, improved diagnostics, and better patient care. Cost-effective interventions, such as videos and infotainment modules, effectively promote oral hygiene. **Objectives:** To assess the knowledge and practices among school children before and after OHE with traditional and AI-generated videos. **Materials and Methods:** An intervention study was conducted among 120 children aged 12. Oral health videos were shown to students after they were divided equally into four groups (AI-generated famous personalities, cartoons, children, and traditional AV groups). Pretested questionnaire were used to assess their oral health knowledge and practices before and after the intervention. **Results:** The study included 120 children, 60% males and 40% females. In the posttest, the AI video group showed a significant increase in knowledge and practice scores compared to the traditional AV group. In addition, among AI-guided video groups, the Same-age children group showed a significant increase in knowledge and practice compared to the famous personality and cartoon groups. **Conclusion:** AI in OHE is an innovation that promotes oral hygiene practices and prevents dental diseases in school children.

Keywords: AI-guided videos, cartoon, famous personality, oral health education, peers

Introduction

A healthy oral cavity is crucial for overall health, aiding in chewing, speaking, and socializing without discomfort. Approximately 90% of school children and adults globally have experienced caries, particularly in Asian countries. Oral health plays a pivotal role in maintaining overall health, and it meaningfully impacts the value of life.[1,2]

Oral health is a crucial aspect of overall well-being, and children are especially vulnerable to developing poor oral hygiene habits. School-based interventions have been identified as an effective means of promoting oral health education (OHE) and improving school children's knowledge, attitudes, and behaviors.[3]

Dental caries and periodontal diseases cause irreversible damage, pain, anxiety, despair, low self-confidence, and lost school/working hours in children and adults.[2] Dental caries is a common oral health issue among children. Early dental visits are essential for improving oral health, and parental perceptions and anxiety can influence children's attendance. Prevention, behavioral change, and education are vital for maintaining oral health. Awareness programs can enhance knowledge about oral care, as many conditions are preventable with early intervention and lifestyle modifications. Effective health messages are necessary to inspire behavioral changes. Children are particularly receptive in adopting positive oral health behaviors during their school years and making school-based education programs beneficial for long-term habits.[3]

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Received: 03-01-2025 **Revised:** 27-05-2025 **Accepted:** 07-08-2025 **Published:** 13-10-2025

Access this article online

Quick Response Code:

Website: www.jiaphd.org

DOI: 10.4103/jiaphd.jiaphd_1_25

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How to cite this article: Selvaraj S, Sennan S, Shavi GR, Shanmugam S, Gunasekaran L, Chellapillai R. Effectiveness of various artificial intelligence-guided oral health education videos among school children – A novel interventional study. J Indian Assoc Public Health Dent 2025;23:309-15.

Educational videos have significant potential with low costs, and classroom interventions using infotainment modules also effectively promote oral hygiene. Child model video proves in enhancing OHE where Artificial Intelligence (AI) is transforming health care, including dental education, by offering personalized learning, improved diagnostics, and better patient care.[4]

However, traditional methods of OHE, such as lectures and pamphlets, have been shown that there is a limited long-term impact on children's oral hygiene practices. Innovative approaches, such as AI-guided educational videos, may offer a more engaging and effective way to deliver oral health information to school children. In recent years, the integration of AI technology into educational resources has emerged as a promising approach to enhance the effectiveness of OHE. AI-guided videos, in particular, have the potential to engage children more effectively, personalize the learning experience, and ultimately results in better retention and application of oral health knowledge.[5-8]

Increased oral health knowledge is crucial for adopting healthy behaviors, especially in developing countries like India. The relationship between awareness, attitudes, and behavior is complex and influenced by various factors. AI is transforming dental education by enabling personalized learning and improving patient care. AI can provide adaptive learning experiences and real-time feedback on oral hygiene practices. By integrating AI with digital innovations, personalized support can enhance self-care and contribute to universal health coverage. AI-guided educational videos for schoolchildren can further improve their oral health knowledge and practices.

Aim

The aim of the study was to compare the impact of various AI-guided OHE videos with traditional audio-visual aids on oral health knowledge, and practices among 12-year-old school children.

Objectives

- To assess the oral hygiene knowledge of school children using a validated questionnaire before and after AI-generated and traditional OHE videos
- To assess the oral hygiene practices of school children using a validated questionnaire before and after AI-generated and traditional OHE videos
- To compare the effectiveness of AI-generated OHE videos with traditional videos
- To compare the effectiveness among different types of AI-generated OHE videos in improving knowledge among school children
- To evaluate the overall acceptability and preference for different AI-generated OHE videos among school children.

Materials and Methods

A parallel arm randomized control trial was conducted in July 2024 among 12-year-old students at Government Higher Secondary School, Thekkalur, Tiruppur district. Cluster sampling was used to select participants, and permission from the school authorities was obtained. A detailed schedule for baseline data collection, intervention, and follow-up was prepared in advance. Ethical approval was obtained from the Institutional Review Board (with no. VDCW/IEC/451/2024 and dated May 31, 2024).

The inclusion criteria were healthy and cooperative School children of 12 years of age, parents who accept informed consent to participate, and children who have not received any previous school-based oral health interventions. The exclusion criteria are children who are absent on the day of the study conducted, children with known cognitive impairments or physical disabilities, medically compromised, and children with special health care needs that may affect their ability to comprehend the videos.

The study commenced with the development of an AI-guided video delivering key oral hygiene messages. Reviews by a focus group of experts of faculties from our dental college suggested improvements to its content, which led to the production of an exemplary oral hygiene education video. The contents of the health education video include the importance and functions of teeth, gum disease, dental caries, knowledge of fluoride, harmful oral habits, the proper method of tooth brushing, different oral hygiene aids, reasons, and the appropriate time to seek professional help.

The OHE content was subjected to fliki.ai and D-ID.ai to get the proper video compliance, and for matching audio, voice.ai was used. For group C alone, audio was recorded by the 12-year-old children after getting consent from parents and was subjected to voice.ai for noise cancellation. Then appropriate audio and video were merged to get the final OHE video for each group. A pilot study was conducted among 15 schoolchildren to pretest the questionnaire. A 50-item close-ended questionnaire was translated into the colloquial language. The satisfactory reliability results were obtained from Cronbach's alpha (0.81) and test-retest methods. Based on feedback from this pilot, the questionnaire was refined, and those students were excluded from the final study.

Study questionnaire

The self-administered questionnaire had multiple-choice items categorized into three sections. Section I was about demographic data such as name and gender. Section II (32 items) was about oral health knowledge. Section III (18 items) was about oral hygiene practices.

Grouping

- Group A: OHE given by a famous personality model (AI-generated video)
- Group B: OHE given by a cartoon model (AI-generated video)
- Group C: OHE given by a same-age school child model (AI-generated video)
- Group D: OHE given by dentist (traditional Audiovisual aid).

Data collection

The sample size was calculated to be 99 and rounded to 120. Information sheets and consent forms were distributed to parents through school teachers. Participants drew lots to select among four groups, each comprising 30 schoolchildren. The questionnaires were distributed to all. They were instructed to answer honestly and confidentially, with a response format of multiple-choice questions. Students completed the questionnaire independently within a 30-min time limit, with the investigator available for any inquiries. Baseline data was collected before the intervention, during which Group A received OHE given by a famous personality model (AI-generated video), Group B received OHE given by a cartoon model (AI-generated video), Group C received OHE given by a same-age school child model (AI-generated video), and Group D received OHE given by dentist (traditional Audiovisual aid). Questionnaires were administered immediately after the intervention and collected after 30 min [Figure 1].

Scoring

The questions were assigned one point each for the correct answer and zero points for the wrong answer. The knowledge score for each individual was calculated by adding scores of Section II. The practice score for each individual was calculated by adding scores from Section III.

Statistical analysis

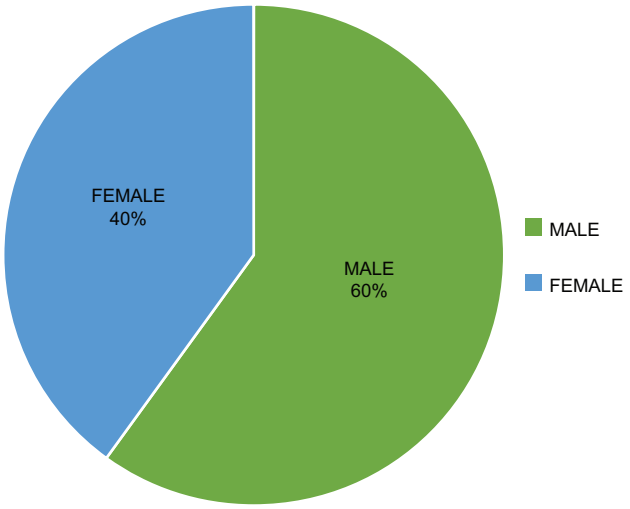
Data were analyzed using IBM Corporation (International Business Machines Corporation) Statistical Package for the Social Sciences software Version 26 (SPSS 26.0). Inc., Chicago, USA. Descriptive statistics were performed. Frequencies, percentages, means, and standard deviation were calculated on responses to questions. Data normality was assessed using the Shapiro–Wilk test. Comparisons between before and after intervention were assessed using the Wilcoxon sign rank test. Comparison between three AI groups was assessed using the Kruskal–Wallis test. A $P \leq 0.05$ was considered significant.

Results

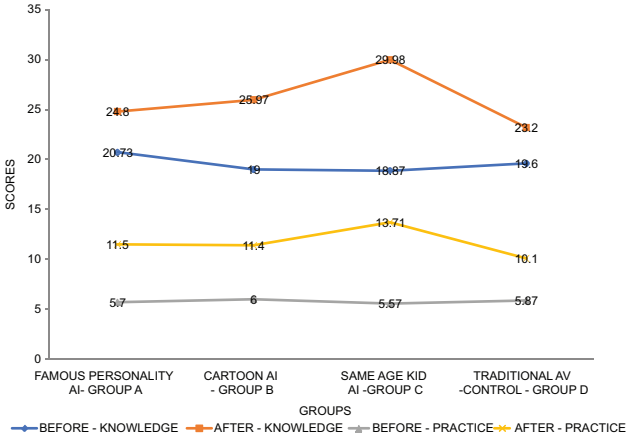
Pie Chart 1 shows the gender distribution of the study which includes 72 boys (60%) and 48 girls (40%), respectively.

Line Diagram 1 reveals that there is increased oral health knowledge and practices in all four groups compared to baseline data. The AI-guided groups outperformed the traditional AV group, with the Group C – Same-age kid group (mean 29.98) showing the highest knowledge, followed by the Group B – Cartoon AI group (mean 25.97) and Group A – Famous personality groups (mean 24.8). Similarly, behavior change was also led by the Group C – Same-age kid group (mean 13.71), while the Group B – Cartoon AI group (mean 11.4) and Group A – Famous personality groups (mean 11.5), respectively.

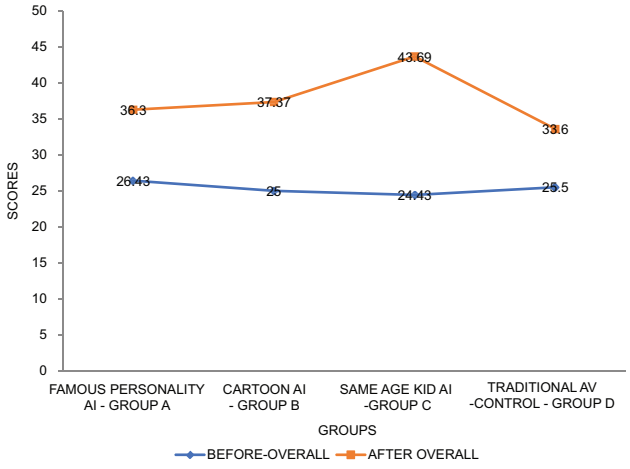
Line Diagram 2 shows that the overall score of the AI-guided groups improved more than that of the traditional AV



Pie Chart 1: Gender distribution



Line Diagram 1: Oral health knowledge, practices scores among groups before and after oral health education. AI: Artificial intelligence, AV: Audiovisual aid



Line Diagram 2: Overall scores of oral health knowledge and practices among the groups before and after oral health education. AI: Artificial intelligence, AV: Audiovisual aid

group (mean 33.6). When comparing within AI groups, Group C – The same-age kid AI group (mean 43.69) was leading, followed by Group B – The cartoon AI group (mean 37.37), and Group A – The famous personality AI group (mean 36.3).

In the present study, the comparison between all the groups regarding overall oral health knowledge and practices at two intervals (before and after intervention) in which Group A – The famous personality AI group was 27.01 ± 12 before intervention and 39.03 ± 14 after intervention which is statistically significant ($P < 0.05$). Similarly, Group B – The cartoon AI group was 25.5 ± 18 before intervention and 39.4 ± 12 after intervention which is statistically significant ($P < 0.05$). Group C – Same Age Kid AI group were 25.03 ± 11 as before intervention and 45.9 ± 12 as after intervention which is statistically significant ($P < 0.05$). Group D – Control – Traditional AV group were 26.1 ± 17 before intervention and 34.08 ± 17 after intervention which is highly significant ($P < 0.001$) were shown in Table 1.

Intercomparison between the AI groups reveals that Group B – Cartoon AI group (39.4 ± 13) and Group A – Famous Personality AI group (39.03 ± 14) were statistically not significant which is contrary when Group C – Same age kid AI group (45.9 ± 12) shows a statistically significant difference ($P < 0.05$) when compared to the Group B – Cartoon AI (39.4 ± 13) and Group A – Famous personality AI (39.03 ± 14) groups is illustrated in Table 2.

Discussion

Promoting oral health in schools benefits the community by extending health awareness to local families. Infotainment, such as animated movies, can effectively teach good oral hygiene. In addition, homes are crucial in shaping children's health behaviors, where schools emphasize the importance of promoting oral health and overall well-being.[9,10]

Poor oral health significantly impacts a school student's quality of life, in which school students cannot concentrate on their studies due to dental issues.[11,12] An initiative taken by the World Health Organization for school students states that schools serve as vital platforms for health promotion, particularly in India where they may be the only access point for health resources.[13] Well-trained teachers can help to establish positive oral health practices by educating students about oral health which can spread oral health knowledge to families and communities, benefiting those without access to formal healthcare.[14]

In the present study, 12-year-old children were selected according to Jean Piaget's theory, in which children will develop a sense of semi-logical reasoning which infers physical cause-and-effect, and children will be very influential in their lives, habits, beliefs, skills, and attitudes among the same age group which tends to be long-lasting.[15] The age of 12 years has been a global indicator for comparisons and surveillance of disease trends at the international level.[12,16] Proper use of a toothbrush requires a certain degree of dexterity and skill. Children who are as young as 11 years of age cannot brush effectively.[17] It was expected that above 12 years of age, students can clearly understand the subject being taught to them. They have enough manual dexterity to master the proper technique of brushing.[18] A study conducted by Ingle *et al*. in 2012 found that 8-year-old children are not an appropriate group to start with OHE intervention, as they could not follow the oral hygiene instructions properly in daily life.[19]

There are various methods for delivering OHE to children, including sessions led by dentists, peer groups, and issuing pamphlets. However, in today's e-learning era, video delivery is effective in engaging elements like music, animations, and narration to reach larger audiences with less manpower. Peer group and role model approaches also significantly enhance oral health behavior in which information from peers can influence beliefs and practices. Studies containing videos featuring child models effectively engage children, in promoting better oral health awareness and habits.

In our study, Group A – The famous personality AI group was effective when compared to before and after intervention which is similar to various studies conducted by Nyandindi *et al*.[20] in 1996, among urban and rural school children of Ilala district, Tanzania, Frencken *et al*.[21] in 2001, among 439 boys and 526 girls, Luo *et al*.[22] in 2007, among school children of the urban district of Deyang city, Angelopoulou *et al*.[23] in 2015, among 184 students in Greece, Haleem *et al*.[24] in 2012, among adolescents aged 10–11 years, Edomwonyi *et al*.[11] in 2020 among 400 school students in Lagos State shows that OHE with teacher-led sessions increases the knowledge of children. This result suggests that teachers are effective in delivering

Table 1: Comparison of overall scores of oral health knowledge and practices before and after intervention

	Before	After	*P*
Group A – Famous personality (AI)	27.01±12	39.03±14	0.001*
Group B – Cartoon (AI)	25.5±18	39.4±12	0.001*
Group C – Same age kid (AI)	25.03±11	45.9±12	0.001*
Group D – Control – traditional AV	26.1±17	34.08±17	0.001*

*Statistically significant. AI: Artificial intelligence, AV: Audiovisual Aid

Table 2: Intracomparison of overall scores of oral health knowledge and practices between artificial intelligence-generated video groups after intervention

Group - group	Median±IQR	*P*
Famous personality (A)	39.03±14	0.849
Cartoon (B)	39.4±13	
Famous personality (A)	39.03±14	0.001*
Same age kid (C)	45.9±12	
Cartoon (B)	39.4±13	0.001*
Same age kid (C)	45.9±12	

*Statistically significant. IQR: Interquartile range

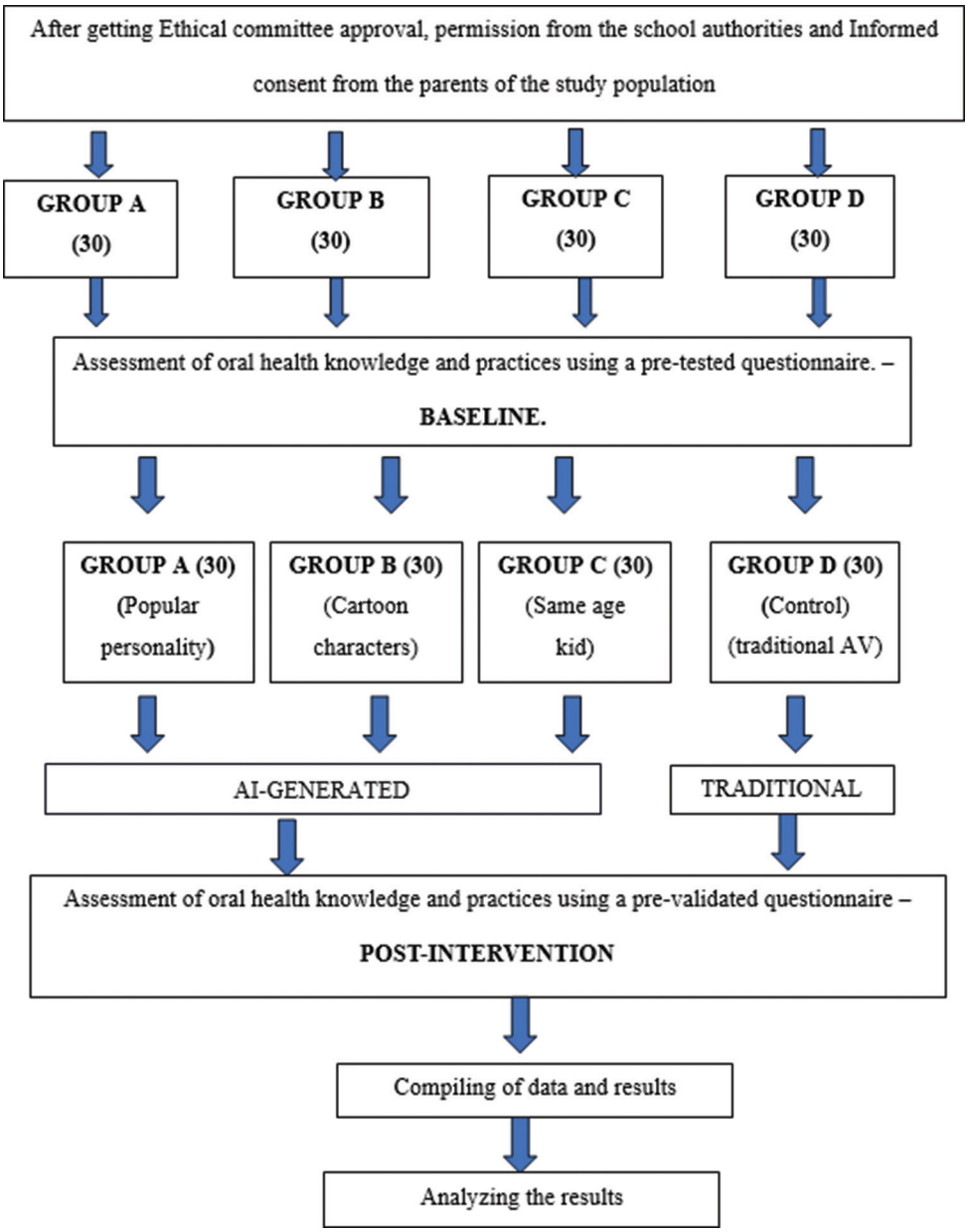


Figure 1: Methodology

OHE because the teachers are more familiar with and often play a role model for the school children.

In the present study, the overall score of Group B – Cartoon AI group (mean 37.37) has improved more than that of the traditional AV group (mean 33.6). Similarly, a study conducted by Hashemi *et al*.[25] in 2021, among 82 students in Iran, Syaputri *et al*.[26] in 2023 among 32 school children in Indonesia; Anwar *et al*.[27] in 2019, among 82 children aged 10–12 years at Toddopuli Superior Primary School in Makassar City, Indonesia, Yanti *et al*.[28] in 2017 among 92 children in Yayasan Karya Murni Medan. It is contrary to the study conducted by Suwarsono *et al*.[29] in 2023 dental health education using video media (47.3) was found to be more effective in increasing dental and oral health maintenance behavior compared to using animated video media (43.9). When comparing all these studies the majority showed OHE with cartoon animated audiovisual method effectively increases the knowledge of children. This is due to the incorporation of animation, following the provision of an OHE program for school children, which was a fun-loving, and engaging method.

In the current study, Group C – Same age kid AI group (45.9 ± 12) shows a higher oral health knowledge and practices when compared to the Group B – Cartoon AI (39.4 ± 13) and Group A – famous personality AI (39.03 ± 14) groups, respectively. It is similar to the various peer group studies conducted by Kavitha *et al*.[30] in 2023, among 120 schoolchildren in Puducherry, Sharma *et al*.[31] in 2023, among 120 students at three selected schools in Mysuru City, India, Aleksejuniene

and Pang[32] in 2022, among 372 children of British Columbia, Canada; Yeo *et al*.[8] in 2020, among school students of Batley, West Yorkshire, Karami Joyani *et al*.[33] in 2018, among female students in Tehran, Iran, Vangipuram *et al*.[12] in 2016, among government school children in Bengaluru. This is because using the child as a model is an effective tool for improving knowledge, and these children will be more confident and comfortable receiving instructions from children of their age group. Kids of the same age's voices play a major role in easy acceptability and increased involvement among their age students.

In the current study, the overall score of the AI-guided groups ([43.69 + 37.37 + 36.3]/3 = 39.12) improved more than that of the traditional AV group (33.6) which is similar to several studies conducted by Piraneh *et al*.[34] in 2022, among 137 students in Iran, Chatterjee *et al*.[35] in 2017, among 60 primary school children, Mahmood[36] in 2016 among 128 children of Al-Yamama primary school in Baghdad City which shows that video is a better tool for health education than PowerPoint, pictures, and lectures. This is due to the videos being more practically influencing their knowledge through audio and visual at the same time. In our study, AI videos are higher when compared to AV because they will be more engaging, demonstrating, attractive, and encouraging the children to improve their oral health behavior.

The results of this current study were similar to a study conducted by Ram Surath Kumar *et al*.[37] in 2022, among 100 students found the interactive game-based visual performance technique (22.4%) more effective than the conventional OHE talk (7.8%) in reducing gingival and plaque scores. It also improves knowledge and practices.

Aljafari *et al*.[38] in 2017 also conducted a study that showed children and parents played a computer game for OHE and received a DVD game was equally effective in improving the knowledge of high-risk children and led some families to make positive dietary changes. This shows that innovations or methodologies create curiosity and enthusiasm among the students which leads to more involvement and long-lasting memory in maintaining overall oral health. It also highlights the effectiveness of these innovative, cost-effective educational methods.

This study marked the first use of AI-guided OHE videos among school children, assessing their oral health knowledge and hygiene practices. The videos provided students with a valuable opportunity to enhance their understanding of oral health, fostering positive practices and empowering them to educate their peers. However, the study had limitations; long-term effects on knowledge and practices could not be assessed due to the short duration, and participants may have provided socially desirable answers, possibly skewing the results.

OHE is vital for promoting good hygiene and preventing dental diseases, particularly in children. Integrating AI in this education can motivate schoolchildren in Tamil Nadu to adopt better oral health practices from an early age. By collaborating with local dentists and schools, we can enhance oral health knowledge through culturally relevant content. Partnering with government departments will allow us to promote AI-guided OHE videos accessible both online and offline, especially in areas with limited internet. We will also develop specific metrics to address Tamil Nadu's oral health challenges and collect feedback to improve video effectiveness.

Conclusion

In the digital world, AI-powered OHE can effectively promote good hygiene practices in children through personalized and interactive learning. It helps children understand the significance of maintaining oral health while identifying those in need of support for targeted interventions. School-based oral health programs should be integral to primary education, as schools play a crucial role in imparting health-related knowledge and behaviors. Enhancing these programs can better serve the goal of improving children's oral health. Implementing AI-guided OHE videos offers a promising way to boost awareness and preventive practices among school children, providing engaging and culturally relevant experiences.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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