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Research Article

Effectiveness of an AI-Based Educational Video Generator in Enhancing Oral Health Knowledge and Behavior Among Children: A Randomized Controlled Trial

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Abstract

Background: Artificial intelligence (AI) is a new innovation that presents an opportunity for oral health education in children. ***Objective***: To evaluate the effectiveness of an AI-assisted educational video versus standardized in-person oral health education for children regarding oral health knowledge and behaviors. ***Methods***: This randomized controlled trial included 300 children aged 10-12 years (n=150 per group), both boys and girls, who were divided into AI video and standardized face-to-face oral health education groups. Baseline and 2-week follow-up evaluations were conducted for knowledge scores, four behavioral items, and the Silness and Löe Plaque Index. The internal consistency of the knowledge scale was checked (Cronbach's α=0.79). Wilcoxon signed-rank and Mann–Whitney U tests were the primary non-parametric tests used for statistical evaluations, with a median, (IQR), and effect size r provided. Chi-square tests with a Bonferroni adjustment at α=0.0125 were used to evaluate behavioral items. ***Results***: There were significant enhancements in intra-group knowledge ($p<0.0001$ for both groups; r=0.663 for AI; r=0.345 for Control). The clinical efficacy was similar for both strategies with significant reduction of intra-group plaque (AI: $p< 0.001$, r= 0.425; Control: $p< 0.001$, r= 0.331), but no inter-group difference at the end of the intervention ($p= 0.608$; r= 0.030). In the conventional group, the utilization of dental floss was significantly improved ($p=0.0056$), and no other behaviors showed significant improvement across groups. ***Conclusions***: The AI-assisted educational video demonstrated better knowledge retention than the standardized face-to-face oral health education, achieved similar clinical plaque reduction, and can be easily scaled for pediatric preventive dentistry.

Keywords: Artificial intelligence; Children; Dental plaque index; Education; Oral health knowledge.

فعالية مولد فيديو تعليمي قائم على الذكاء الاصطناعي في تعزيز المعرفة والسلوك بصحة الفم بين الأطفال: تجربة عشوائية محكمة

الخلاصة

الخلفية: الذكاء الاصطناعي (AI) هو ابتكار جديد يوفر فرصة للتثقيف في صحة الفم لدى الأطفال. **الهدف**: تقييم فعالية فيديو تعليمي مدعوم بالذكاء الاصطناعي مقابل التعليم الحضوري الموحد لصحة الفم للأطفال فيما يتعلق بمعرفة وسلوكيات صحة الفم. **الطرائق**: شملت هذه التجربة العشوائية المحكمة 300 طفل تتراوح أعمارهم بين 10-12 سنة (n=150 لكل مجموعة)، من الأولاد والبنات، تم تقسيمهم إلى مجموعات فيديو بالذكاء الاصطناعي ومجموعات تعليمية موحدة لصحة الفم وجها لوجه. أجريت تقييمات أساسية وتقييمات متابعة لمدة أسبوعين لدرجات المعرفة، وأربعة عناصر سلوكية، ومؤشر سيلنس ولوي بلاك. تم التحقق من الاتساق الداخلي لمقياس المعرفة (α=0.79 لكرونباخ). كانت اختبارات ويلكوكسون الموقعة للرتبة واختبارات مان–ويتني U هي الاختبارات غير المعلمية الرئيسية المستخدمة في التقييمات الإحصائية، مع توفير متوسط (IQR) وحجم تأثير r. تم استخدام اختبارات Chi-square مع تعديل بونفيروني عند α=0.0125 لتقييم العناصر السلوكية. **النتائج**: كانت هناك تحسينات كبيرة في المعرفة داخل المجموعة ($p<0.0001$ لكلا المجموعتين؛ r=0.663 للذكاء الاصطناعي؛ r=0.345 للضابطة). كانت الفعالية السريرية متشابهة لكلتا الاستراتيجيتين مع انخفاض كبير في اللويحات داخل المجموعة (الذكاء الاصطناعي: r= 0.425، $p< 0.001$؛ عدد الضابطة او الضابطة فقط: r= 0.331، $p< 0.001$)، لكن لم يكن هناك فرق بين المجموعات في نهاية التدخل ($p= 0.608$؛ r= 0.030). في المجموعة التقليدية، تحسن استخدام خيط الأسنان بشكل ملحوظ ($p=0.0056$)، ولم تظهر أي سلوكيات أخرى تحسنا كبيرا عبر المجموعات. **الاستنتاجات**: أظهر الفيديو التعليمي المدعوم بالذكاء الاصطناعي احتفاظا أفضل بالمعرفة مقارنة بالتعليم الفردي المعياري لصحة الفم، وحقق تقليلا سريريا مشابها للبلاك، ويمكن بسهولة توسيعه في طب الأسنان الوقائي للأطفال.

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INTRODUCTION

Oral diseases are considered one of the most prevalent chronic diseases in children across the world, as dental caries is still a major public health problem. The prevalence of caries in primary teeth is very high, and if untreated, it can have an impact on children's quality of life, nutrition, growth, and school performance [1,2]. Oral diseases are strongly related to dietary habits, oral hygiene practices, socioeconomic status, and parental awareness, emphasizing the importance of preventive education early in childhood [3]. Conventional oral health education techniques such as lecture and demonstration provide fundamental information but have limited effectiveness in ensuring long-term behavior change [4]. Children learn best through interactive and engaging methods, making modern digital tools essential for promoting oral health. In the rapidly evolving dental landscape, artificial intelligence (AI) has become an innovative technology, ranging from diagnostics to preventive education [5,6]. Personalized and engaging educational content could be provided through AI-powered tools like chatbots and interactive applications, potentially enhancing children's knowledge and behaviors related to oral hygiene [7]. Recent evidence has begun to explore the

potential role of artificial intelligence in pediatric oral health education. An interventional study involving children aged 10–15 years evaluated an AI-generated oral health educational video and reported improvements in their oral health knowledge accompanied by reductions in plaque and gingival index outputs. Although these findings provide encouraging evidence for the use of AI-generated multimedia in pediatric oral health promotion, the intervention was primarily evaluated as an AI-based educational exposure, and the evidence remains limited regarding its effectiveness relative to a standardized, clinician-delivered educational approach. In addition, the relatively short intervention period and limited follow-up restrict conclusions regarding whether AI-based education provides an advantage over conventional professional instruction [8]. More recently, Lim *et al*. evaluated an AI-driven oral healthcare platform among 204 Vietnamese primary school children aged 8–10 years, comparing the intervention with pamphlet-based oral health education. The AI intervention was associated with improvements in oral hygiene status and selected oral health behaviors over the study period. However, the comparison was with pamphlet-based education rather than a standardized face-to-face educational session delivered by a dental professional, and the intervention involved a broader digital healthcare platform rather than an AI-generated educational video alone [9]. Thus, although emerging studies support the potential of AI-based approaches in pediatric oral health promotion, an important evidence gap remains regarding whether a brief, AI-generated educational video can achieve outcomes comparable or superior to standardized conventional oral health education delivered directly by a dental professional. According to our knowledge, there are no studies that have simultaneously compared these two educational modalities using oral health knowledge, self-reported preventive behaviors, and an objective clinical measure of dental plaque assessed by a blinded examiner. Therefore, the present randomized controlled trial was designed to directly compare an AI-generated oral health educational video with standardized face-to-face oral health education among 10–12-year-old schoolchildren, assessing short-term changes in oral health knowledge, selected oral hygiene behaviors, and Silness and Löe Plaque Index scores. By directly comparing two standardized educational modalities within the same randomized population and incorporating both behavioral and objective clinical outcomes, this study seeks to provide more clinically relevant evidence regarding the potential role of AI-generated educational videos as an adjunct or alternative to conventional pediatric oral health education.

METHODS

Study design and ethical approval

This randomized controlled trial received ethical approval no. (ISU.38.1.26) and was conducted in primary schools at Al-Karkh sector, Baghdad, Iraq, from September 2025 to April 2026. Children's parents and guardians gave informed consent to enrollment, and children gave assent. Subjects were asked to voluntarily participate, and they could withdraw from the study at any time.

Sample size calculation

For sample size, G*Power software (version 3.1.9.7) was used before data collection. A medium effect size (Cohen's d= 0.35) was expected for the change in oral health knowledge and Plaque Index scores based on similar studies of educational interventions in pediatric oral health [10,11]. Setting the significance level (α) at 0.05 (two-tailed) and statistical power (1 - β) at 90%, a minimum of 132 participants per group (264 total) was required to detect a significant difference between the study and control groups. The sample size was expanded to reflect an expected dropout rate of around 12% (due to potential loss to follow-up, school absence, or an incomplete post-intervention questionnaire), which yields a total sample size of N = 300 children. Accordingly, 300 children aged 10-12 years (boys and girls) from multiple primary schools were randomly divided into two groups.

Inclusion criteria

Children who were allowed to participate in this study include school-age 10-12-year-olds and healthy children (mentally and physically).

Exclusion criteria

Children who were excluded from the study included those with an orthodontic appliance, those who have undergone extensive dental treatment, those with a systemic disease that impacts oral health, those with an intellectual or developmental disability that interferes with responding to the questionnaires, those currently participating in another oral health education program, and those unable to complete follow-up.

Experimental procedure and people allocation

The control group (group A) was given standard oral health education that consisted of a fixed, real-time face-to-face verbal session, utilizing an oral health education brochure, and a toothbrushing demonstration on a typodont model. All control sessions were carried out with the same investigator (a pediatric dentist), who followed a script that was predetermined and standardized. The topics of proper brushing technique, the value of fluoride, a healthy diet, and regular dental visits were the same that the study group had been given. Sessions took place in specific classrooms in the school in small groups (around 15-20 students per session). The control session took about 6 minutes to accommodate for verbal explanation, physical demonstrations, and interactive engagement. The study group (group B): for this group, an educational video

was produced using a multi-stage AI-assisted workflow rather than being generated by a single AI model in one step. The generation process involved several AI platforms and tools, with human involvement throughout the process to develop the visual concept, formulate prompts, select suitable outputs, refine the generated scenes, generate the audio, and assemble the final video appropriate for 10- to 12-year-old primary school children. It was in Arabic, with a total time of 2:10 minutes.

Visual and animation planning

ChatGPT was used to develop highly detailed prompts for both the generation of individual images/scenes and the subsequent animation/motion prompts. The prompts were specifically refined to control the desired visual appearance, composition, anatomical/clinical elements, camera movement, and animation characteristics.

Image and scene generation

Gemini was used to generate the required images and visual scenes based on the developed prompts.

Video generation and iterative refinement

Dzine was used as the primary platform for generating video sequences. Different available models/versions within the platform were tested iteratively, and the generated outputs were reviewed and refined until the desired final visual result was obtained. Thus, the final video was not produced through a single generation attempt or a single model.

Audio generation

ElevenLabs was used to generate the audio components/narration used in the video.

Human editing and final assembly

Canva was used for the final assembly of the generated video sequences and audio. The generated visual and audio components were combined and arranged manually to produce the final video.

Randomization, allocation concealment, and blinding

The study participants were randomly allocated to group A (control) or group B (study) in a 1:1 ratio by means of a simple computer-generated random sequence (Research Randomizer, www.randomizer.org). Sequentially numbered opaque sealed envelopes (SNOSE) were created by an independent research assistant, who was not involved in participant recruitment, intervention delivery, or clinical evaluations to ensure allocation concealment. Each participant's assigned envelope was opened after baseline assessments were made. Because of the educational aspect of the intervention, it was not possible to blind the participants and instructors. This study, however, used a single-blind design of an outcome assessment. The clinical examiner who evaluated the Silness and Löe Plaque Index at baseline and at the two-week follow-up was completely blinded to group assignment and did not know the key for randomizing the groups throughout the study.

Intervention and outcome measures

Before delivering any educational intervention, both groups were asked to complete a pre-intervention questionnaire designed to assess their baseline knowledge and behaviors regarding oral health practices (Appendix 1). For content validity, the questionnaire was examined and judged by three senior academic pediatric dentists. The questionnaire was presented in the children's mother tongue to guarantee full understanding. A pilot study of 20 primary school children was conducted (these children were excluded from the final analysis) to make it clear and understandable. The internal consistency of the knowledge scale was confirmed with a Cronbach's alpha coefficient of $\alpha = 0.79$, which shows satisfactory reliability. The questionnaire consisted of 10 multiple-choice questions related to oral hygiene and preventive dental care. Each correct answer was given a score of 1.0, while incorrect answers were given 0. The total score for each participant ranged from 0 to 10, with higher scores indicating better oral health knowledge (appendix I). After the pre-intervention test, the two groups received oral health education using different teaching methods. Two weeks after the educational session, both groups completed the same questionnaire again as a post-intervention test to evaluate changes in oral health knowledge and to determine which educational method had a greater impact. A structured questionnaire of four items assessed participants' oral hygiene behaviors at baseline and two weeks after the intervention was used. The questions evaluated key self-reported habits such as frequency of daily toothbrushing, sugar intake in food, dental visit motivations, and using dental floss. Responses were captured on a standardized multiple-choice response sheet to observe change between the two groups in terms of behavioral compliance. Appendix (I). Silness and the Löe Plaque Index (1964) were used to assess the clinical oral hygiene status on four tooth surfaces (buccal, lingual, mesial, and distal) of index teeth with a plane dental mirror and WHO periodontal probe under natural daylight [12]. Figure 1 shows the workflow of the study. All clinical assessments were made by a single, calibrated pediatric dentist who was blinded to group allocations throughout the study to ensure the outcome assessment blinding. The intra-examiner calibration was carried out with a pilot sample of 15 children (not included in the final analysis) who were examined twice 48 hours apart, prior to the collection of data. The intra-examiner reliability showed excellent agreement and diagnostic consistency with Cohen’s kappa coefficient (κ) of 0.85.

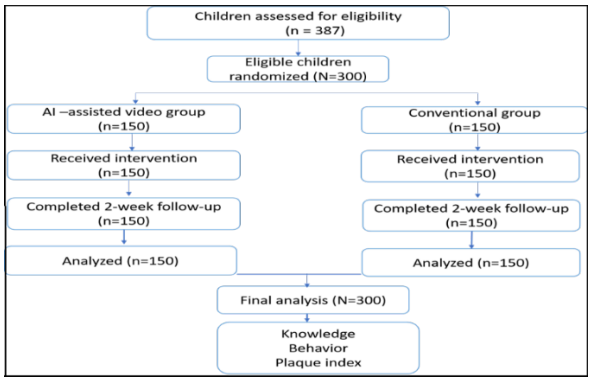


Figure 1: CONSORT flow diagram of participant recruitment, randomization, intervention allocation, follow-up, and analysis.

Statistical analysis

Statistical analyses were done using SPSS Software (Version 26). The normality of continuous data distribution was measured by the Shapiro–Wilk test. For continuous variables with non-parametric distribution, the data was presented as median and interquartile range median (IQR), alongside mean ± SD and 95% confidence intervals. In the case of continuous non-parametric measures, the Mann–Whitney U test was used for between-group comparisons (control vs. AI group), and the Wilcoxon signed-rank test was used to assess the intra-group changes (baseline to 2-week follow-up). The chi-square (χ^2) test was used for the categorical variables and the responses to questions on the behavioral questionnaires. To account for multiple testing across the four behavior items and to control the Type I error rate, a Bonferroni correction was used, lowering the statistical significance threshold to $p< 0.0125$ (0.05/4). Effect sizes were computed to quantify the magnitude of the intervention effect and presented for non-parametric tests as (r). For all other primary statistical evaluations, $p< 0.05$ was considered statistically significant.

RESULTS

The results of this study reveal significant knowledge improvement in both groups post-intervention ($p< 0.0001$). The control group demonstrated an increase in knowledge score from before intervention (7.50 ± 1.84) to post intervention (8.43 ± 1.64). Likewise, the AI group demonstrated a considerable knowledge gain before intervention (7.61 ± 1.42) and after intervention (8.93 ± 1.20). Non-parametric tests were used, as the score distributions were not normal as determined by Shapiro–Wilk testing (Table 1). For comparisons between conventional education strategy and artificial intelligence one, the Mann-Whitney U test is used. Students in both groups demonstrate no significant difference before an intervention, in contrast to after intervention in both of them (Table 2).

Table 1: knowledge scores before and after intervention

Group	Phase	Median IOR [Q1, Q3]	Mean± SD	W	*p*-value	Effect Size (*r*)
Control	Before	8[7 ,9]	7.50±1.84	2771.5	0.0001*	0.345
Control	After	9[8,10]	8.43±1.64			
AI.	Before	8[7, 8.75]	7.61±1.42	800.0	<0.0001*	0.663
AI.	After	9[8,10]	8.93±1.20			

Table 2: Difference between groups before and after intervention

Comparison	Mann-Whitney U	Standardized Z	*p*-value	Effect Size (*r*)
Con. Vs A.I Before	11283	-0.044	0.965	0.003
Con. Vs A.I After	9425.5	-2.540	0.011*	0.147

Four behavioral items were assessed that focused on oral hygiene practices: toothbrushing frequency, past dental visits, dietary sweet consumption, and use of dental floss. After applying the Bonferroni correction for multiple comparisons with the conventional group ($\alpha= 0.0125$), only Q4, indicating use of dental floss, showed a statistically significant increase ($p=0.0056$), while no significant difference was found for Q1, Q2, and Q3. However, there was no statistically significant difference in behavior before and after the intervention for any of the items assessed in the AI group (Table 3), which shows the detailed behavioral frequency distributions and intra-group comparisons. Table 4 showed no significant difference between both groups in Q1, Q2, and Q3 regarding post-intervention children's behaviors, except in Q4, which revealed a significant difference ($p= 0.003$). The intra-group evaluations showed that the plaque index score decreased significantly after educational interventions in both the conventional group (from 1.125 ± 0.581 to 0.783 ± 0.476) and the AI group (from 1.086 ± 0.563 to 0.738 ± 0.411), with p-values < 0.001 (Table 5). In contrast, no statistically significant difference was observed between inter-group results for the baseline or post-intervention data (Table 6).

DISCUSSION

Effective and engaging oral health education is a critical part of pediatric dentistry, where early habits provide long-term preventive success. This study evaluates the potential of integrating artificial intelligence (AI)-assisted educational content into pediatric oral health programs. Methodologically, the strengths of the trial are due to the randomized design, group homogeneity at baseline, single-blinded assessment of results, and validated clinical scores on the basis of the Silness and Löe Plaque Index. One of the significant outcomes of this study is that of educational delivery time and efficiency.

Table 3: Descriptive statistics for behavior along with intra-group comparison

Conventional method group			
Q1	Before n(%)	After n(%)	X^2 *p*-value
A	43(28.67)	25(16.67)	6.851 0.0325
B	95(63.33)	115(76.67)	
C	12(8)	10(6.67)	
Q2			
A	119(79.33)	120(80)	0.0
B	31(20.67)	30(20)	1.0
Q3			
A	77(51.33)	80(33.33)	0.125
B	57(38)	55(36.67)	0.939
C	16(16.67)	15(10)	
Q4			
A	60(40)	85(56.67)	7.689
B	90(60)	65(43.33)	0.006*
Artificial Intelligence method group			
Q1	Before	After	X^2 *p*-value
A	40(26.67)	35(23.33)	1.17 0.557
B	100(66.67)	108(72)	
C	10(6.67)	7(4.67)	
Q2			
A	121(80.67)	121(80.67)	0.0
B	29(19.33)	29(19.33)	1.0
Q3			
A	75(50)	80(53.33)	0.379 0.828
B	60(40)	55(36.67)	
C	15(10)	15(10)	
Q4			
A	84(56)	89(59.33)	0.219
B	66(44)	61(40.67)	0.64

Table 4: Post intervention comparison between study and control groups regarding four oral health behaviors questions

Question	Chi-square	Df	*p*-value
Q1	8.761	6	0.187
Q2	0.115	3	0.990
Q3	0.575	6	0.997
Q4	13.944	3	0.003*

*Statistically significant at Bonferroni adjusted threshold (α= 0.05/4 = 0.0125).

Table 5: Intra-group descriptive statistics for plaque index and its differences before and after intervention

Groups	Mean± SD	Median	IQR	Wilcoxon	*p*-value	Effect size *r*
(A) Before	1.125±0.581	1.0	0.75	2657	<0.001	0.331
(A) After	0.783±0.476	0.7	0.5			
(B) Before	1.086±0.563	1.0	0.588	1901.5	<0.001	0.425
(B) After	0.738±0.411	0.7	0.55			

Table 6: Mann-Whitney *U* test for plaque difference between groups

Group	Mann-Whitney *U*	*p*-value	Standardized *Z*	Effect size *r*
Control baseline vs. A.I. baseline	11749	0.506	-0.665	0.038
Control post vs. A.I. post	11635	0.608	-0.513	0.030

The face-to-face instruction required 6 minutes with active presentation and physical demonstration, but the 2-minute AI-assisted, human-curated educational video was comparable to the face-to-face instruction for achieving clinical plaque reduction ($p< 0.001$) and significant acquisition of knowledge. This time difference underscores another practical benefit: AI tools simplify professional tasks and lower the time spent in the classroom while maintaining the effectiveness of the clinical programs and their retention of knowledge. AI tools provide a valuable and efficient method for school-based oral health programs by converting essential preventive concepts into a concise visual representation, saving time in the process. This study suggests that oral health education (OHE) yields a nuanced yet promising outcome. Firstly, the analysis indicated that there was no statistically significant difference between the conventional group and the study group at baseline, indicating baseline homogeneity. Secondly, both groups had a knowledge score that increased significantly from baseline to post-intervention. The key finding, however, is revealed in the post-intervention intergroup analysis, which showed a statistically significant difference between the two groups in favor of the AI video intervention group. This means that both approaches are successful in raising awareness, but the latter—with the help of artificial intelligence—achieves a much stronger magnitude of knowledge in terms of knowledge acquisition. A large methodological strength of this study is the absence of any significant differences between the two groups at baseline ($p= 0.965$).

It eliminates selection bias and guarantees that the change in the post-intervention is due to the way the intervention is delivered and not to pre-existing differences in knowledge. The initial oral health literacy scores for both cohorts were comparable, and their final higher score for the AI group was validly internal. The improvement in both groups demonstrates that a structured intervention will be better than nothing. But the differences in the post-intervention scores of the two groups may be due to a number of specific education benefits, as standard conventional presentations often present static text and diagrams, which can cause cognitive fatigue [13]. AI video intervention dynamically coordinates visual and auditory information, resulting in better dual coding memory retention [14]. Furthermore, conventional teaching may vary according to the educator's energy, time, and teaching methods. While AI offers consistency in the delivery of instruction, it minimizes variation among teachers [15]. On the other hand, AI-generated, human-curated educational videos may provide greater interactivity and increase learner engagement. The participants are naturally more attentive to the technologically advanced and modern media [16]. One of the most intriguing outcomes of this study was the behavioral reaction at the two-week follow-up. Overall, there were stable levels of the broad behavioral measures across the cohort, and these findings are consistent with the well-established fact that a two-week window is not long enough to form

long-lasting habits [17]. A significant exception was found in the conventional education group, however, where the children showed a statistically significant increase in the usage of dental floss when compared to the AI group. This finding is a local behavioral improvement in the standardized face-to-face education class that can be explained by the psychology of human interaction and pedagogic authority. The face-to-face transfer of information from a clinician/educator to the child creates a "therapeutic alliance" in the field of pediatric dentistry [18]. Children are very sensitive to the explicit teaching and apparent authority of an adult person. A human educator can emphasize the urgency of flossing through tone of voice, eye contact, and emotional encouragement—factors that establish a sense of immediate accountability [19]. The results led to a clear difference in efficacy between the AI intervention and the conventional one: the AI intervention was found to be more effective at explaining the "how" and "why," directly resulting in higher knowledge scores. But, in contrast, the face-to-face human teaching had a greater behavioral impact, as it led the children to actually perform the oral hygiene procedure in the brief period of follow-up. The findings from the current investigation are consistent with other emerging literature from around the world regarding the positive impact of AI-based educational strategies on pediatric oral health outcomes. Pagrut *et al*. (2026) recently showed that an AI oral health education model can effectively enhance the oral health knowledge and awareness of schoolchildren aged 10-15 years [8]. Likewise, Lim *et al*. (2026) demonstrated the effectiveness of an AI-based digital healthcare application for improving oral health behaviors and oral plaque control in children [9]. Our findings extend these studies to show that a 2-minute AI-assisted, human-curated educational video can achieve clinical plaque reduction similar to a 6-minute in-person session and impart knowledge that is retained much more effectively and can save a significant amount of clinical time and effort. While there were some knowledge differences (favoring AI) and behavioral frequency differences (favoring conventional style), the clinical outcomes showed a surprising degree of convergence. There was no significant difference between the two groups, but both groups had a statistically significant improvement in the Plaque Index (PI) from baseline. This clinical equivalence can be explained in two major ways: compensatory mechanisms, in which both interventions were effective in disrupting dental biofilm, but in different ways. The AI group was able to brush their teeth more effectively in each session due to increased technical knowledge, whereas the conventional group compensated for their technical limitations by brushing and flossing more frequently. Both techniques (high-quality technique and higher mechanical frequency) have been shown to be very effective at achieving a parallel and identical decrease in total plaque over a brief two-week period [20]. Various frequencies and levels of physical skill can achieve short-term clinical results (Plaque Index values) [21]. Alternatively, this phenomenon could be attributed to the “Hawthorne effect," which is particularly common in short-term clinical trials of oral hygiene practices. The children's knowledge of an upcoming test in two weeks immediately heightened their motivation, evident in all of them. The expectation of a clinical examination serves as a common denominator for both groups and encourages them to physically remove plaque just before the next clinical examination, thus obscuring any long-term differences between the educational approaches [22]. The results strongly support a blended model for oral health education for children. Using AI alone can maximize knowledge, but it doesn't have the emotional responsibility to increase frequency. On the other hand, human teachers can be very effective for driving frequency but may not be effective in teaching structured, standardized knowledge due to time constraints. The next step in preventive strategies should be to utilize clinicians to set goals and hold them accountable while also incorporating AI tools to educate and reinforce the intricate geometric concept of plaque removal.

Study Limitations

The main limitations of this study are only 2-week follow-up, the potential testing effect due to repetition of the same knowledge questionnaire, the risk of cross-contamination among children in the same school/classroom, and finally, one setting (Baghdad) with restricted generalizability. Thus, longer follow-up periods are recommended, as are multi-center trials conducted in various geographic regions, with randomized questionnaire variations to reduce the possibility of testing bias and cluster-randomization at the school level to avoid cross-contamination.

Conclusion

Both educational approaches were associated with improved oral health knowledge and reduced plaque scores after two weeks. The AI-assisted video group had higher post-intervention knowledge scores than the conventional education group, whereas no statistically significant between-group difference in plaque index was detected. Longer follow-up and appropriately powered trials are needed to determine whether AI-assisted education provides sustained behavioral or clinical benefits.

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Conflict of interests

The authors declared no conflict of interest.

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Data sharing statement

The data that supports the findings of this study are available from the corresponding author upon a reasonable request.

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Appendix 1: Pre-intervention questionnaire contents

Appendix I (English translated version)	
	Knowledge Questions
1	What is the best time to brush your teeth?
a	After food
b	Before sleep
c	After breakfast and before sleep
2	What do you use to clean your teeth?
a	Toothbrush only
b	Water only
c	Toothbrush with toothpaste
3	What is the benefit of dental floss?
a	Removing food debris from between teeth
b	Cleaning the mouth
c	Cleaning the tongue
4	Why do we use toothpaste?
a	To make the mouth taste sweet only
b	To strengthen teeth and protect them from decay
c	To make the mouth feel cold
5	What is the benefit of fluoride in toothpaste?
a	A substance that strengthens teeth and prevents decay
b	Gives a sweet taste
c	Makes teeth white
6	How often is it best to visit the dentist?
a	Every 6 months
b	Once every 3 years
c	Only when feeling pain
7	What happens if you do not brush your teeth?
a	They become whiter
b	They decay, cause pain, and produce an unpleasant odor
c	New teeth will grow
8	Which foods strengthen teeth and make them healthy?
a	Milk, cheese, and vegetables
b	Sweets and soft drinks
c	Potato chips
9	What foods cause tooth decay?
a	Chocolate and sticky sweets
b	Apples and carrots
c	Rice and milk
10	How do we keep a beautiful and healthy smile?
a	We brush our teeth, reduce sugars, and visit the dentist
b	We eat chocolate daily
c	We do not care about hygiene
	Behavior Questions
1	How many times a day do you brush your teeth?
a	Once
b	Twice or more
c	Never
2	Have you ever visited a dentist before?
a	Yes
b	No
3	How many times a day do you eat sweets?
a	Once
b	Twice or more
c	Never
4	Do you use dental floss?
a	Yes
b	No