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DESIGNING AND EVALUATING A 3D ANIMATED ADVERTISEMENT FOR CHILDREN'S ORAL HEALTH AWARENESS

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ABSTRACT

Oral health communication for children requires messages that are accurate, engaging, age-appropriate, and easy to remember. This study developed and evaluated a three-dimensional (3D) animated advertisement as a child-centred communication artefact for children aged six to twelve years. Guided by a design science research orientation, the study translated preliminary design principles from the literature and comparative analysis of animated oral-health materials into a proof-of-concept advertisement using storytelling, character appeal, visual clarity, emotional consequence, and procedural demonstration. A purposive sample of 30 children evaluated the completed artefact through a closed-ended questionnaire completed with parental guidance. Descriptive statistics and percentages were used to examine immediate audience responses, including engagement, recall, memorable elements, and behavioural intention. Results showed that 90% of respondents viewed the cartoon characters positively, 47% recalled the tooth-fairy brushing demonstration, 40% recalled the toothache nightmare, and 63% reported an immediate intention to brush after viewing. These findings represent preliminary audience responses and do not establish long-term improvement in oral-health awareness or behaviour. The study's originality lies in connecting specific creative design principles with observable response indicators in a 3D oral-health advertisement. Practically, the findings suggest that child-focused health animation should combine attractive characters and narrative consequences with clear demonstrations of the desired health action.

Keywords: 3D Animation, Oral Health Communication, Children's Health Education, Animation Design, Animated Health Communication

INTRODUCTION

Children do not learn healthy habits from information alone. They learn more effectively when messages are clear, repeated, meaningful, and connected to their everyday experiences. This is

especially important in oral health promotion, where children are expected to understand the value of brushing, avoid excessive sugary foods, and practice preventive care before dental problems arise. Oral health directly affects children's daily lives. It influences eating, speaking, sleeping, smiling, and social confidence. Poor oral hygiene can cause toothaches, discomfort, difficulty eating, and reduced attention during learning activities. These problems are preventable, but prevention depends largely on awareness and habit formation. Children need to understand what oral hygiene means. They also need to understand why brushing their teeth and caring for their mouths should become part of their daily routine.

Oral health messages are often delivered through posters, pamphlets, verbal reminders, videos, and classroom talks. These formats can communicate accurate information, but they do not necessarily explain how creative design choices shape children's attention, understanding, recall, and willingness to act. Children are increasingly familiar with animated videos, games, short-form media, music, and colourful digital stories, making the design of the message not only its factual content important (Martinez, 2026). The practical problem is therefore twofold: oral-health information must be correct, and the communication format must help young audiences notice, understand, and remember the message without relying on fear or dense verbal instruction.

Prior studies have reported favourable educational or self-care outcomes from cartoon animation, animated video, combined learning, and video-based edutainment (Sadimin, & Sutomo, 2023; Hashemi-Namin, Jahed-Motlagh & Rahmani, 2023; Maulidi, Salim & Utama, 2025). However, these studies mainly evaluate the medium or educational outcome as a whole. They provide less explanation of how individual creative design components such as narrative consequence, character appeal, visual presentation, and procedural demonstration can be combined within a short animated advertisement and linked to distinct immediate audience responses. This leaves a design-oriented gap between evidence that animation can be useful and practical guidance on how to construct an animation for child-focused oral-health communication.

This study addresses that gap by treating the animated advertisement as a designed communication artefact rather than assuming that animation itself produces better health outcomes. The evaluation therefore distinguishes between preference and engagement, what children remember, and their immediate intention to act. These measures are conceptually different from verified improvement in knowledge, sustained awareness, or actual brushing behaviour, which would require pre-test/post-test, observational, clinical, or longitudinal evidence.

Animation offers a practical response because it can combine character, story, colour, sound, movement, emotion, and demonstration within a brief communication experience. In the present artefact, a child character represents familiar behaviour, a toothache sequence makes the consequence of poor oral hygiene visible, and a tooth-fairy character demonstrates a corrective brushing action. These elements served as preliminary design principles to structure the advertisement and provide a basis for interpreting audience responses. The study does not assume that these elements are independently validated causal mechanisms; instead, it evaluates how they function together within an early-stage proof of concept.

This study has three objectives. First, to derive preliminary animation design principles for children's oral-health communication through comparative analysis of relevant literature and existing animated oral-health materials. Second, to translate these principles into the design and production of a 3D animated advertisement. Third, to evaluate children's immediate responses to the advertisement in terms of engagement, recall of memorable elements, and behavioural intention. The contribution of the study is therefore a preliminary design-oriented framework that links creative decisions in a 3D health advertisement with observable audience-response indicators, while deliberately avoiding claims of long-term behavioural effectiveness.

RELATED WORK

A. Oral Health and its importance for Children

Oral health is a significant component of overall health and quality of life. It supports basic human functions such as eating, speaking, smiling, and social interaction. The FDI World Dental Federation (FDI) defines oral health as more than the absence of disease. It also includes functional,

psychological, and social well-being (Alsabeeha et al., 2026). This broader understanding is important because oral diseases can affect daily comfort, confidence, communication, and participation in social activities.

For children, oral health is especially critical. Childhood is a formative stage when health habits are learned, reinforced, and normalized. Poor oral hygiene during this period can lead to tooth decay, pain, difficulty eating, sleep disturbances, and reduced concentration in school. These effects may seem minor, but they can affect children's learning, emotional well-being, and self-confidence. Therefore, oral health promotion among children should not be treated solely as a dental issue. It should be understood as part of early health education and preventive behavior development.

Dental caries remains one of the most common oral health problems among children. It is a biofilm-mediated disease in which dietary sugars are converted into acids that gradually demineralize the tooth structure (Koontongkaew et al., 2024; Pitts et al., 2017). This process is closely tied to daily habits. Brushing frequency and technique, sugar intake, fluoride exposure, and dental visits all influence oral health outcomes. Therefore, children need more than general reminders to "brush their teeth." They need to understand why oral hygiene matters, how dental problems develop, and what preventive actions they can take in their daily lives.

B. Oral Health Awareness and Existing Approaches

Oral health awareness refers to knowledge and understanding of practices that prevent oral diseases and promote good oral hygiene. It includes awareness of proper brushing techniques, healthy eating habits, regular dental visits, and personal responsibility for oral care. Previous studies indicate that oral health promotion is more effective when messages are clear, repeated, age-appropriate, and suited to the target audience (Henriques & Damasio, 2025). Health communication also plays an important role in translating professional dental advice into information that is accessible and understandable to the public (Yiğit & Başal, 2024).

Traditional oral-health education commonly uses pamphlets, posters, classroom talks, demonstrations, and verbal reminders (Peerbhay et al., 2025). These formats remain valuable for communicating factual information, but child-focused health communication also depends on whether young audiences attend to the message, understand it, remember relevant content, and perceive a clear action they can perform (Peerbhay et al., 2025). These dimensions should not be treated as interchangeable. Attention concerns whether the message captures interest; understanding concerns comprehension; recall concerns what remains memorable after exposure; behavioural intention reflects a stated willingness to act; and actual behaviour requires evidence that the action is subsequently performed and sustained. The present study evaluates only the former immediate-response dimensions and does not equate them with verified behavioural change.

Figure 1 presents a comparative synthesis of related oral-health animation and video studies. Sinor (2011) compared cartoon animation with conventional health promotion, illustrating the potential of animation as an alternative delivery format. Sadimin et al. (2021) examined animated video as an oral-health telepromotion medium for elementary-school students. Hashemi et al. (2021) evaluated combined learning using a randomized controlled design and reported outcomes related to self-efficacy and self-care behaviour. More recently, Lekaram et al. (2025) investigated video-based edutainment in a randomized clinical trial with school-age children. Across these studies, the dominant emphasis is on educational effectiveness, self-care outcomes, or the overall value of video or animation. Less attention is given to decomposing the creative artefact itself and asking which design features are intended to support which type of audience response.

A design-oriented synthesis of this literature suggests four directly observable response-linked dimensions for the present artefact: character appeal, narrative consequence, procedural demonstration, and behavioural cueing. Visual clarity operates across these dimensions as a production principle because characters, consequences, and demonstrations must remain visually legible to the target audience. Character appeal is expected to support attention and emotional connection; narrative consequence can make risk visible within a relatable story; procedural demonstration can show the desired brushing action; and behavioural cueing can prompt an immediate stated intention. This distinction is important because the study evaluates associations between these designed elements and children's reported responses rather than testing the independent causal effect of each element.

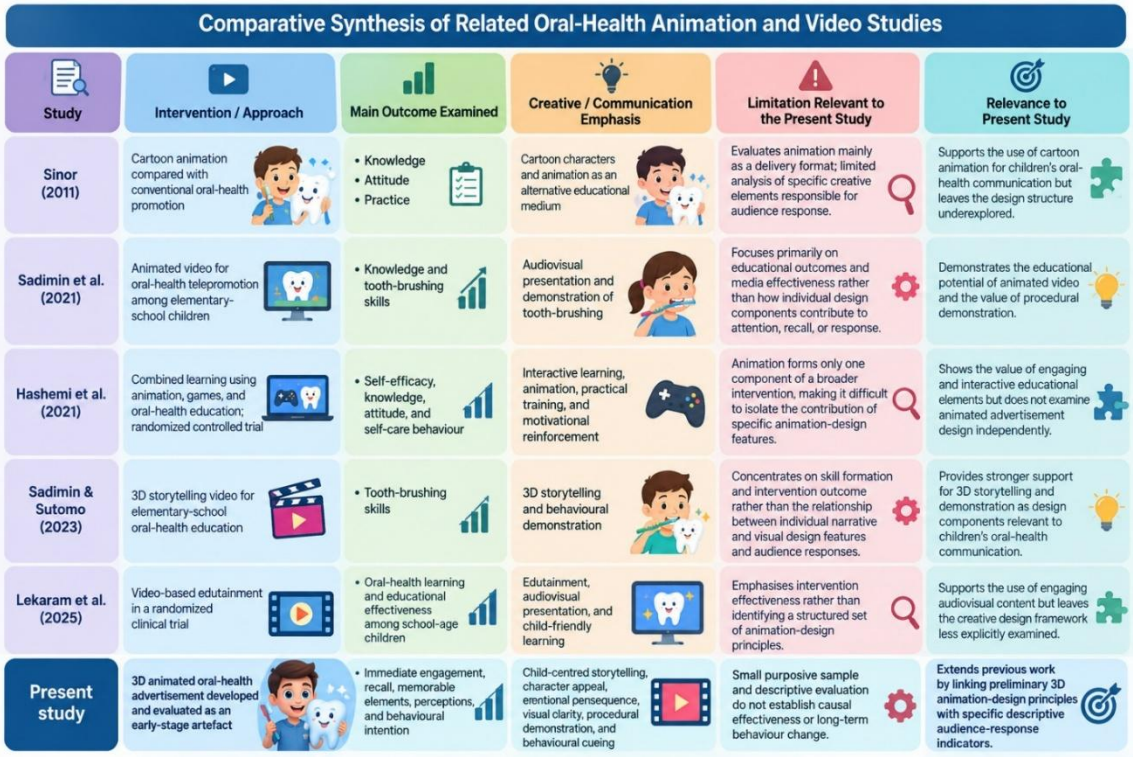


Figure 1. Comparative synthesis of related oral-health animation and video studies

C. Animation Intervention

Animation is valuable in children's health communication because it can translate abstract or procedural information into visible action. Concepts such as tooth decay, the consequences of excessive sugar intake, and correct brushing technique may be difficult for young audiences to understand through text alone. Movement, facial expression, sound, colour, staging, and sequential action allow an animation to show both a problem and a response. Praveen and Srinivasan (2022) similarly emphasise the relationship between animation, visual attention, and cognition, supporting the need to consider how design choices organise what viewers notice and process rather than treating animation as a single undifferentiated medium. Bétrancourt and Chassot (2008) further show that animation can direct children's attention to essential information and support procedural understanding.

The present design framework therefore treats narrative, character, visual presentation, and demonstration as complementary communication functions. A relatable child character provides an entry point into the story. The toothache nightmare functions as a narrative consequence that makes the risk of neglect visible without presenting clinical imagery. The brushing sequence provides procedural modelling by showing the action that should follow recognition of the problem. Visual clarity supports all four functions by keeping the characters, actions, and health message understandable within the limited duration of an advertisement.

Importantly, attractive animation alone cannot demonstrate improved awareness or behaviour. An entertaining character may increase liking without improving comprehension; a memorable scene may support recall without producing sustained action; and an immediate intention to brush may not translate into later brushing behaviour. For this reason, the present study uses a staged interpretation: design principles inform the artefact, the questionnaire captures immediate audience responses, and those responses are interpreted as preliminary evidence about communication potential rather than as proof of behavioural effectiveness. This conceptual separation directly guides the methodology and the interpretation of the descriptive findings.

METHODOLOGY

This study adopted a Design Science Research (DSR) orientation (Vaishnavi & Kuechler, 2015) because the research problem required both the development of a communication artefact and an early-stage evaluation of how the intended audience responded to it. The DSR process was organised into five connected phases: (1) problem identification and comparative analysis, (2) derivation of preliminary design requirements, (3) artefact development, (4) audience evaluation, and (5) interpretation and design reflection. The phases were used to make the relationship between the research gap, design decisions, production process, and evaluation explicit.

Phase 1: Problem identification and comparative analysis. The study first examined oral-health communication challenges described in the literature and reviewed existing animated oral-health materials. The underlying project compared examples such as Brush Along with Budd! (Smeddinck, 2016), Live Mouth Smart (Sudeep, 2017), Oral Health Animation, and Dr Strong Teeth (Kumar, Hebbal & Kangusamy, 2025), considering strengths and weaknesses in character appeal, storyline, informative content, colour, audiovisual presentation, and duration. This comparative review was combined with research literature on animated oral-health education to identify recurring creative features and unresolved design weaknesses. The purpose was not to claim a systematic review or independent validation of mechanisms, but to derive preliminary design requirements for the proof-of-concept artefact.

Phase 2: Preliminary design requirements. Findings from the comparative analysis were translated into design requirements for the artefact. These included a relatable child-centred narrative, appealing characters, a visible consequence of poor oral hygiene, clear visual presentation, and a procedural demonstration of tooth brushing. These requirements were treated as provisional design principles to be explored through the artefact rather than as independently validated mechanisms.

Phase 3: Artefact development. The design requirements informed scriptwriting, storyboarding, character and environment design, animation layout, production, rendering, editing, audio integration, voice-over, and final assembly. The resulting 3D advertisement was developed as a proof of concept that combined entertainment and preventive health communication within one coherent narrative sequence.

Phase 4: Audience evaluation. The completed advertisement was evaluated quantitatively through a researcher-developed, closed-ended questionnaire delivered using JotForm. The questionnaire was tailored to children aged 6-12 years and organised around demographic/oral-health practices, user experience with animated advertisements, and attention/effectiveness feedback. We incorporated child-friendly categorical options and slider-scale items using smiley emoticons or text to make responses easier for younger participants. Parents were encouraged to help their children complete the questionnaire. The evaluation focused on immediate response indicators, including engagement with animated dental advertising, response to characters, memorable scenes, and stated intention to brush; it did not include a pre-test, control group, clinical measure, or longitudinal observation of subsequent behaviour.

Phase 5: Interpretation and design reflection. Percentages were examined alongside the creative features embedded in the advertisement. This final phase produced a preliminary design-response map showing where strong audience responses corresponded with character appeal, narrative consequence, instructional modelling, and behavioural cueing. Because the design principles were not manipulated independently, the map is interpretive and should not be read as evidence that any single feature caused a specific response.

D. Development of Proof of Concept – Animated Advertisement

The animated ad was created as a proof of concept to promote oral health among children aged 6 to 12. It involved scriptwriting, storyboarding, character design, environment and asset creation, animation layout, production, rendering, and post-production. Fig. 2 shows the storyboard, Fig. 3 the rendering, and Fig. 4 the post-production.

Maya was used for animation, Blender for rendering, and Adobe Premiere Pro for editing, audio integration, voice-over, transitions, and final assembly. The storyline focuses on Ammy, a child

character who neglects oral hygiene advice, experiences a toothache nightmare, and later receives guidance from the tooth fairy, who demonstrates proper brushing techniques.

The advertisement's design drew on a comparative analysis of prior oral-health animation/video approaches and existing animated oral-health materials. The analysis indicated that some examples emphasised songs, characters, or general entertainment, whereas others prioritised factual health information with less narrative development. The proof of concept therefore combined five production-level principles: narrative relatability, character appeal, emotional consequence, visual clarity, and procedural demonstration. For evaluation purposes, these principles were interpreted through four observable design-response dimensions: character appeal, narrative consequence, instructional modelling, and behavioural cueing. Visual clarity was treated as a cross-cutting production principle rather than a separately measured survey outcome. This distinction resolves the difference between the five design principles used during development and the four response-linked dimensions shown in the evaluation map.

Figure 2

Storyboard samples of early narrative sequence of the 3D advertisement.



Figure 3

Rendering process - 3D animated advertisement.

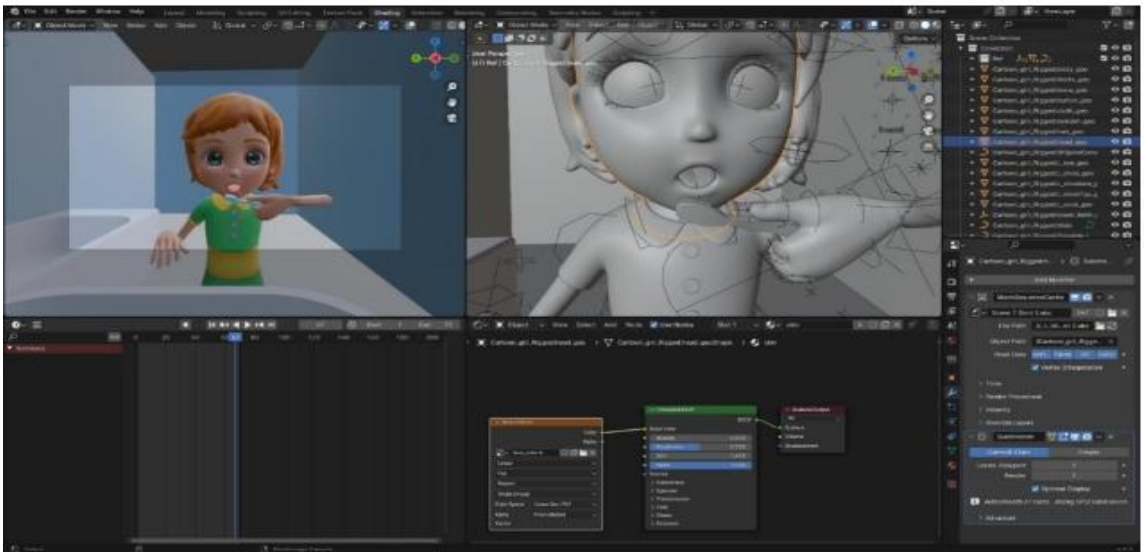


Figure 4

Scenes from the 3D animated oral-health advertisement.



E. Sampling

The evaluation used a purposive sample of 30 children aged 6 to 12 years, matching the intended audience of the animated advertisement. The age range was selected because the original project treated ages 6-12 as an important developmental period for establishing oral-health habits. The researcher recruited participants through their circle, including children in their households and relatives who worked as kindergarten teachers, providing access to participants within the required age range. The questionnaire was disseminated through JotForm, and parents were encouraged to guide children during completion to support comprehension. The sample was appropriate for an early-stage proof-of-concept audience evaluation and was used to identify descriptive response patterns rather than to make population-level estimates.

The questionnaire was developed for this project around the research objectives and included closed-ended items on age and brushing practices, dental experiences, exposure to animated dental advertisements, sources of oral-health information, response to cartoon characters, immediate intention

to brush, memorable scenes, and suggestions for improvement. The analysis used descriptive statistics because the research objective was to characterise immediate audience responses to an early-stage artefact rather than test causal relationships or clinical effectiveness. Frequencies and percentages were calculated to identify dominant response patterns across the measured indicators. Results were then interpreted in relation to the design principles embedded in the advertisement. This level of analysis is appropriate to a preliminary audience evaluation with a small purposive sample, but it does not support inferential claims about all children, improvement over baseline, or sustained behavioural change. Accordingly, the discussion uses terms such as response, recall, preference, engagement, and intention rather than effectiveness or improvement unless referring to findings from previous controlled studies.

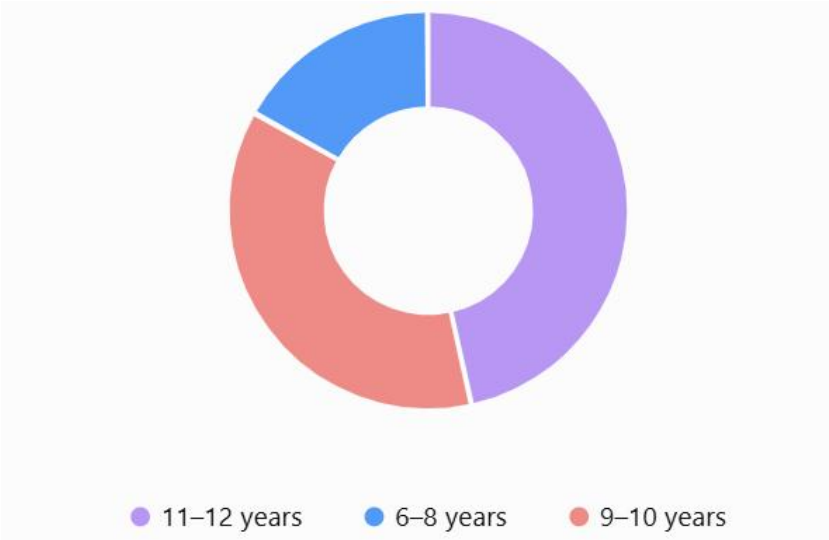
RESULTS AND DISCUSSION

F. Demographic Analysis

The participant distribution reflected the intended target group selected through purposive sampling. As shown in Fig. 5, 17% of participants were aged 6 to 8 years, 37% were aged 9 to 10 years, and 47% were aged 11 to 12 years. Regarding daily oral hygiene practices, 77% reported brushing their teeth twice a day, while 23% reported brushing once a day. This suggests that most respondents were familiar with basic brushing routines; however, the 23% who brushed once a day indicates that continued reinforcement of proper oral hygiene practices remains necessary.

Figure 5

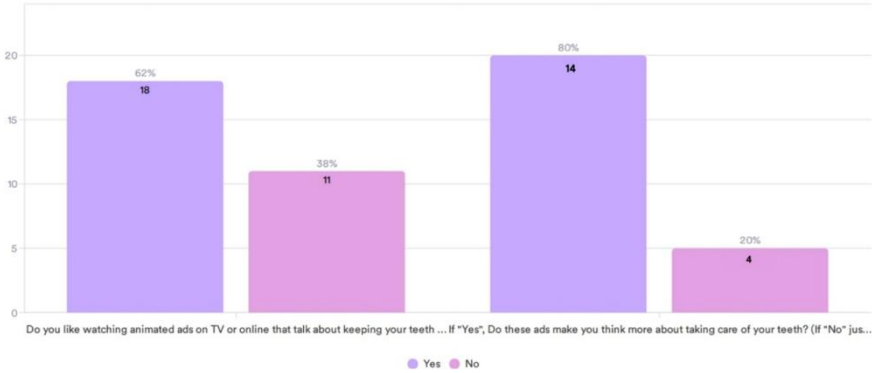
Age distribution of the target respondents.



The data also indicate a strong need for preventive awareness. 73% of respondents reported experiencing dental issues such as toothaches or caries, and 80% of those with concerns sought professional dental treatment. These findings strengthen the problem statement by showing that oral health education is not abstract for the target group; many children had direct or family-mediated experience with dental problems. In addition, parents emerged as an important source of oral health education, with 40% of respondents identifying them as a source of knowledge, as illustrated in Fig. 6. This suggests that animated advertisements should complement, not replace, parental guidance.

Figure 6

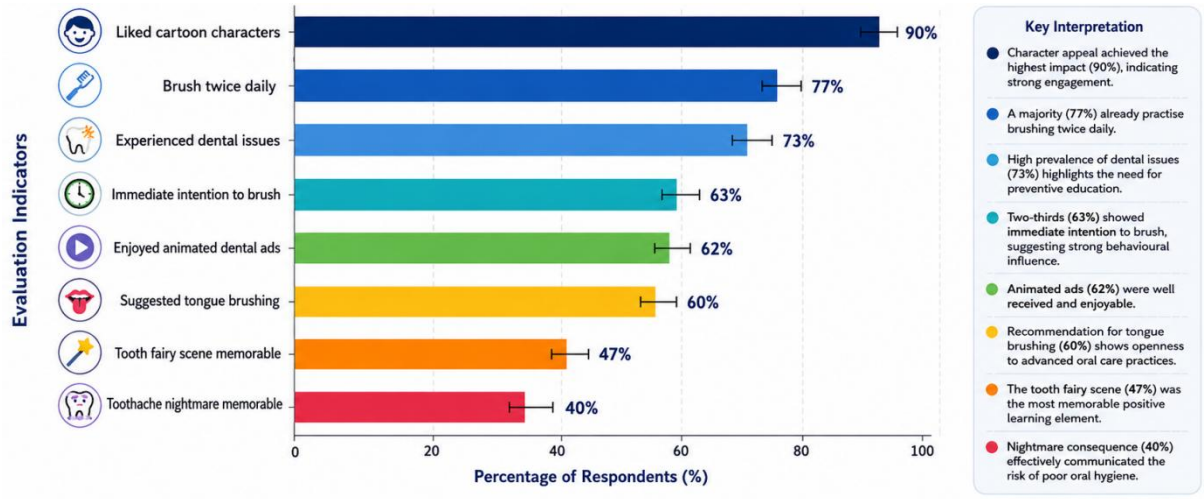
Reported sources of oral-health knowledge among respondents.



Ninety percent of respondents reported a favourable opinion of the cartoon characters. This result indicates strong character preference within the sample and supports interpreting character appeal as a potentially useful attention and engagement feature. However, the percentage should not be interpreted as evidence that the characters independently caused improved oral-health awareness, because the study did not manipulate character design separately or compare it with a control condition.

Figure 7

Key descriptive indicators from the audience evaluation.



As shown in Fig. 7, the animated advertisement generated favourable immediate responses. Sixty-two percent of respondents reported enjoying animated advertisements about dental health, and among those responding favourably, 80% indicated that such advertisements made them think more about dental hygiene. In addition, 90% expressed a positive view of the cartoon characters. Together, these results suggest that character-centred animated presentation can be engaging for the sampled children. They do not, however, demonstrate an increase in objectively measured knowledge or awareness because no baseline or comparison condition was used.

The tooth-fairy character provides a useful example of how a design principle can be cautiously linked to audience response. Rather than presenting brushing as a rule delivered by an adult authority, the advertisement used a fantasy guide to demonstrate the routine in an approachable form. This interpretation is consistent with literature showing the educational potential of animation and edutainment (Lekaram et al., 2025; Praveen & Srinivasan, 2022; Hashemi et al., 2021). Nevertheless, the current data show only that children responded favourably to the character and remembered related content; they do not establish that the tooth fairy was more effective than another character type.

The most memorable elements were the tooth fairy's demonstration of proper tooth-brushing technique, cited by 47% of respondents, and Ammy's toothache nightmare, cited by 40%. These

descriptive findings reflect two different communication functions: the brushing scene represents corrective action, while the nightmare represents a narrative consequence. Their recall suggests that both the proposed solution and the consequence of neglect were salient to part of the sample. This supports the design rationale for pairing a visible health risk with an explicit demonstration of what the child can do, while remaining a measure of recall rather than proof of learning gain. 63% of respondents reported an immediate intention to brush their teeth after viewing the advertisement. This result is interpreted strictly as behavioural intention following exposure. It does not demonstrate that participants subsequently brushed, improved their technique, or maintained the behaviour over time. The finding can therefore be treated as evidence that the advertisement functioned as an immediate behavioural cue for some respondents, but confirmation of actual behaviour would require observation, repeated measurement, or longitudinal follow-up.

IMPLICATIONS AND LIMITATIONS

This study offers practical implications for the design of child-focused oral health animation. Entertainment elements should be combined with clear instructional content so that visual appeal supports, rather than distracts from, the intended health message. The strong positive response to the cartoon characters suggests that character design can function as a communication device that makes oral health information more approachable. Similarly, recall of both the toothache nightmare and the tooth fairy brushing demonstration indicates the potential value of linking a negative consequence with a clearly demonstrated corrective action.

For short oral health animations, the findings support a practical design sequence: introduce a relatable child centred situation, communicate the consequence of poor oral hygiene without excessive fear, use an approachable guide or character, demonstrate the recommended behaviour clearly, and conclude with a simple behavioural cue. Future productions may extend the content to include flossing, tongue cleaning, healthy dietary choices, and regular dental visits. These recommendations are based on the present artefact and descriptive audience responses and should therefore be treated as preliminary design guidance rather than clinically validated prescriptions.

Several limitations should be acknowledged. The small purposive sample and recruitment through personal and kindergarten related networks limit representativeness and generalisability. Data were self reported and collected immediately after exposure, meaning that the study assessed preference, recall, engagement, and behavioural intention rather than sustained knowledge, observed brushing behaviour, or clinical outcomes. Parental assistance may also have influenced questionnaire responses. In addition, the researcher developed questionnaire was not supported by documented psychometric validation or reliability testing.

The study also did not employ a pretest and posttest design, comparison group, behavioural observation, clinical indicators, or longitudinal follow up. Documentation of institutional ethical approval or waiver, written parental consent, and child assent was also not reported in the project documentation. Future studies involving children should address these procedural requirements and use larger and more diverse samples, validated instruments, behavioural measures, parental feedback, and longitudinal assessment. Such studies would help determine whether the immediate engagement observed in this study translates into sustained oral health knowledge, improved brushing practices, and measurable health outcomes.

CONCLUSION

This study contributes to oral health communication by developing and descriptively evaluating a 3D animated advertisement designed for children aged 6 to 12 years. Its principal contribution is a preliminary design framework linking five production principles, narrative relatability, character appeal, emotional consequence, visual clarity, and procedural demonstration, to observable audience responses. The evaluation showed strong character appeal and notable recall of key narrative and instructional elements, with 90% of participants responding positively to the cartoon characters, 47% recalling the tooth fairy brushing demonstration, 40% recalling the toothache nightmare, and 63% reporting an immediate intention to brush. These findings indicate that carefully structured animation can enhance the salience and memorability of oral health messages, although they do not establish sustained behavioural or clinical effectiveness.

The study has practical relevance for dentists, oral health educators, schools, public health agencies, parents, and animation practitioners by translating creative design decisions into specific communication objectives. The framework can inform the development of child centred oral health materials for dental clinics, school programmes, community campaigns, and digital platforms. The study also aligns with SDG 3: Good Health and Well Being by supporting preventive health education and early engagement with healthy oral care practices among children. Its broader contribution lies in demonstrating how animation design can be systematically integrated into preventive health communication rather than treated solely as an entertainment device.

Future research should test the framework using larger and more diverse samples and stronger evaluative designs. Pretest and posttest assessment, repeated exposure, behavioural observation, parental feedback, clinical indicators, and longitudinal follow up are needed to determine whether immediate engagement translates into improved knowledge, brushing technique, routine adherence, and oral health outcomes. Comparative studies should also examine the effects of different character designs, narrative structures, animation styles, message lengths, and age specific adaptations. Such work would help establish which design features are most effective for particular oral health objectives and support the development of more evidence based animation strategies for child health communication.

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AUTHOR CONTRIBUTIONS

All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by all authors.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

DATA AVAILABILITY

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

ETHICS STATEMENT

Informed consent was obtained from all individual participants included in the study.

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