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The effectiveness of online media in reducing the plaque rate of elementary school children: A systematic literature review

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ABSTRACT

The high prevalence of dental plaque in elementary school children is still a dental and oral health problem that can affect children's quality of life. The development of information technology encourages the use of online media as an alternative to dental and oral health education. This study aims to analyze the effectiveness of online media in reducing plaque rates in elementary school children through a bibliometric approach and literature review. Article searches were conducted through the Scopus database and the Web of Science in the 2020–2025 publications. The initial search results obtained 307 articles, then after the process of checking duplication, screening, and selection based on inclusion and exclusion criteria, 20 articles were obtained that were eligible for review. Data analysis was carried out using VOSviewer, Biblioshiny, and Rayyan.ai. The results of the study show that online media such as mobile applications, educational videos, gamification, chatbots, and web-based platforms are effective in improving dental and oral health knowledge, tooth brushing behavior, and plaque control in children. In addition, parental involvement through digital media also supports the improvement of children's oral hygiene. In conclusion, online media has the potential as a promotive and preventive media in reducing the number of plaques in elementary school children.

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INTRODUCTION

Dental and oral health is an important part of the health of elementary school-age children. Dental and oral health is a condition when the teeth, mouth, and all related tissues are in optimal condition, so that a person can eat, breathe, talk, and socialize without experiencing pain or discomfort (Thania et al., 2025). The WHO defines dental and oral health as a condition of the oral cavity, teeth, and orofacial structures that reflects a person's ability to perform vital functions such as eating, breathing, and speaking, and includes psychosocial aspects such as confidence, well-being, and the ability to socialize and work without pain, discomfort, or embarrassment (Opoku et al., 2024). One of the most common problems found in the elementary school age group is the high

number of dental plaque. Uncontrolled plaque can develop into caries, gingivitis, and affect the child's quality of life. Dental and oral health behavior is influenced by many factors, one of which is the low level of knowledge about dental and oral health (Femala & Ayatullah, 2020).

One of the most common problems found in the elementary school age group is the high number of dental plaque. Uncontrolled plaque can develop into caries, gingivitis, and affect the child's quality of life. Dental and oral health behavior is influenced by many factors, one of which is the low level of knowledge about dental and oral health(Yunita et al., 2025). Promotive and preventive efforts are the main strategies that can be carried out to prevent the occurrence of dental health problems from an early age. Knowledge enhancement can be done through health counseling activities, which need to be more focused on children aged 6–12 years who are one of the most important groups as targets in dental and oral health promotion programs (Zargar et al., 2025). Because this group is a category that is prone to caries (Femala & Ayatullah, 2020). In addition, health promotion media need to adapt to technological and information advancements, because the main goal is to maintain and improve the health level of individuals, families, groups, and communities (Marissa & Mulyono, 2023).

The development of information technology has encouraged the use of online media as a means of health education, including in dental health promotion programs. Online media allows for the delivery of information that is broader, interactive, and easily accessible to children, parents, and teachers. In addition, the use of online media in improving dental and oral health knowledge needs to be adjusted to school conditions, so that it can be optimally conveyed to children as well as parents and teachers (Talenta Theresia et al., 2022). Examples of online media that are now widely used include educational videos, mobile applications, digital animation, social media, and e-learning platforms. However, despite its growing use, the effectiveness of the media in reducing the number of plaques in elementary school children still requires comprehensive mapping and analysis. Strengthening strategies in the presentation of digital health content can build a safer, more reliable, and evidence-based online health ecosystem, thereby improving the quality of health information available online (Alwadi et al., 2025).

From a theoretical perspective, the effectiveness of digital education in improving oral health behavior can be explained through the Health Belief Model (HBM) and Social Cognitive Theory (SCT). According to the HBM, individuals are more likely to adopt preventive health behaviors when they perceive susceptibility to disease, understand its potential consequences, recognize the benefits of preventive actions, and receive cues that encourage behavior change. Digital educational media can strengthen these perceptions through interactive content, visual demonstrations, reminders, and personalized health messages. Furthermore, SCT emphasizes that behavior is influenced by the interaction between personal factors, environmental influences, and observational learning. Features commonly found in digital platforms, such as educational videos, animations, gamification, and social interaction, allow children to observe proper oral hygiene practices, increase self-efficacy, and reinforce positive behavioral habits. Therefore, digital education is not only a tool for knowledge dissemination but also a mechanism that can facilitate sustainable oral health behavior change among children(Bandura, 1986; Glanz et al., 2015; Jones et al., 2015; Rosenstock, 1974).

The widespread influence of technology on children's dental and oral health confirms the importance of understanding the context and content of the topics discussed in the latest literature. Online media has the potential to support the promotion of dental and oral health in children by improving knowledge, behavior, and clinical outcomes (Sharma et al., 2025). Although digital technology has been shown to play a role in supporting children's oral health, the overall picture of the context and themes of the research is still not fully defined. Therefore, it is important for policymakers, dental health workers, and pediatric dentists to know the types of digital applications or interventions used, as well as to examine the characteristics and variety of digital technologies applied in children's dental health practices. This knowledge can help policymakers

in determining the relevance and suitability of digital-based interventions for future children's oral health program planning, especially in reducing the number of plaques for elementary school children. Integrating digital media into conventional oral health programs has the potential to strengthen changes in dental hygiene behavior and improve the resulting health outcomes (Ribeiro et al., 2022). Therefore, this study aims to conduct a bibliometric analysis of digital health interventions or applications in the children's dental and oral health literature in an effort to reduce children's plaque counts, in order to identify research gaps and trends in the development of these topics.

The development of digital technology has brought major changes in the field of health promotion, including dental and oral health in elementary school-aged children. Online media such as mobile applications, educational videos, social media, chatbots, and web-based platforms are starting to be widely used as a means of health education because they have advantages in terms of accessibility, interactivity, and the ability to reach users widely. The use of digital media is considered to be able to increase knowledge, motivation, and behavior to maintain dental health in children and parents. This condition makes online media one of the important innovations in the promotive and preventive strategy of children's dental health.

Previous research has shown that digital-based interventions have the potential to be effective in improving dental and oral hygiene behaviors. Sharma et al (2025) It was found that the use of digital media in mother-child pairs was able to increase motivation to change oral health behavior. Research Kashani et al (2024) It also shows that web-based education is more effective than the brochure method in improving mothers' understanding of children's oral health. In addition, Shirmohammadi et al (2022)Explains that the online caries management platform is able to improve oral hygiene behaviors, sugar consumption behaviors, and dental care practices in a sustainable manner compared to conventional education.

Various other forms of online media have also been developed to support the promotion of children's dental health. Özvarış & Çoğulu (2024) found that the "Brush DJ" app was effective in improving the habit of brushing teeth regularly in children. Research Zolfaghari et al (2021) shows that gamification-based applications can improve parents' dental health knowledge while improving plaque control in children. In addition, the use of educational video games(Alwadi et al., 2025), dental health chatbots (Chang et al., 2024), and edutainment-based learning videos Lekaram et al (2025) It has been proven to increase oral health knowledge and behavior in school-age children.

Not only in children, research also shows the importance of parental involvement in the success of digital interventions. Abdul Haq et al (2023) explained that digital applications can be an effective means of increasing parental awareness about the prevention of caries and dental plaque in children. A similar thing was found in a systematic review by Sharma et al (2025), which states that social media has an important role in providing information and motivating parents to maintain children's dental health. This shows that the success of online media is not only influenced by the technology used, but also by the involvement of families in supporting children's health behaviors.

Although previous studies have reported positive outcomes, variations in digital media types, research methods, and intervention effectiveness, as well as limited studies specifically evaluating plaque index reduction and publication trends, indicate the need for bibliometric and literature review analyses to identify research developments, digital intervention trends, and future research gaps in children's dental health.

RESEARCH METHOD

The article search was carried out by determining research questions using the PICO approach, namely P (*population*) of elementary school age children, I (*intervention*) of digital media or online-based health education, C (*comparison*) of conventional or non-interventional education, and O

(*outcome*) effectiveness on dental hygiene and plaque reduction. Article searches were carried out through the Scopus database and Web of Science (WoS) using keywords related to *online media*, *digital intervention*, *dental plaque*, *oral hygiene*, and *school-age children*.

The selected articles are English-language publications in 2020–2025 published in journals, books, and conference proceedings. The publication period of 2020–2025 was selected to capture the most recent evidence on digital health education and oral health interventions, particularly following the rapid expansion of digital technologies and online learning platforms during and after the COVID-19 pandemic. This timeframe also allows the identification of current research trends and emerging developments in digital oral health promotion. The search strategy was developed using the following search string: ("online media" OR "digital media" OR "online health education" OR "digital intervention" OR "web-based intervention") AND ("dental plaque" OR "plaque index" OR "oral hygiene") AND ("children" OR "school-age children" OR "primary school students" OR "elementary school students") AND ("effectiveness" OR "impact" OR "outcome"). This search string was applied to the Scopus and Web of Science databases to identify relevant studies. Articles outside of that age range and studies with populations other than elementary school-age children were excluded from the analysis. The initial search results yielded 307 articles. After checking for duplication, there were 292 articles that were then selected based on titles, abstracts, and inclusion and exclusion criteria. The selection stage resulted in 61 articles to be analyzed in *full-text*, and 20 articles were obtained that were eligible for synthesis using *The Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Systematic Review and Research Syntheses*. Bibliometric data analysis is carried out using VOSviewer software for keyword network visualization, Biblioshiny for bibliometric analysis, and Rayyan.ai to assist in the process of screening and article selection.

RESULTS AND DISCUSSIONS

Bibliometric analysis was carried out in scientific publications for the 2020-2025 period, with a total of 307 documents from 143 sources (journals). The five-year time span was chosen to illustrate the latest developments in research on the effectiveness of online media in promoting dental and oral health in elementary school-aged children.

Country Analysis/Geographic Distribution

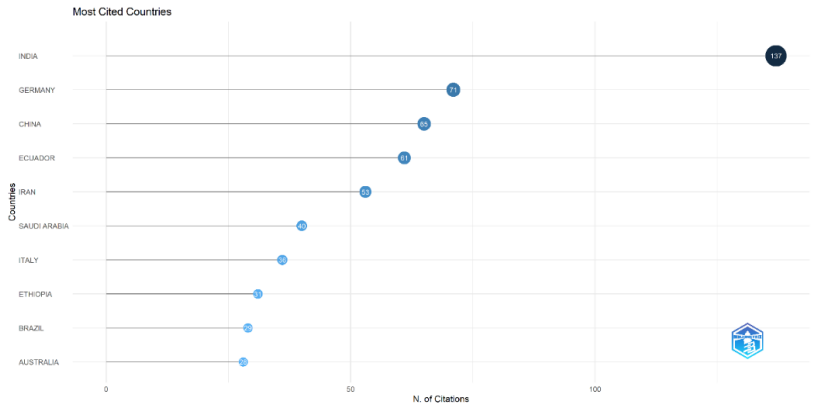

Figure 1. Publication productivity by country

Based on the results of the analysis, it can be seen that research on the effectiveness of online media in reducing plaque rates in children is most widely carried out in India, which is as many as 137 studies. India is the most influential country with the highest citations in children's dental health education research. Countries such as Germany, China, and Ecuador also play a key

role in developing digital interventions on the development of dental and oral health education in children.

This shows that the global trend is experiencing a strong shift towards online media as an effective educational tool in reducing plaque in children. Health services that utilize information technology are currently the focus of global attention, especially because technology is considered to have great potential to improve the quality of human life (Yani, 2018).

Research Topics/Featured Keywords

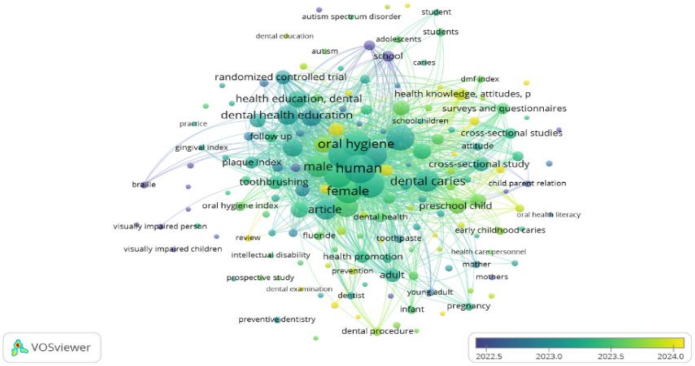

Figure 2. Index keyword overlay visualization map

Based on the image above, it can be seen that in the 2022 period the keywords such as *cross-sectional study, prevalence, mother, oral health literacy,* and *Survey* dominate. This suggests that the initial research focus was more on problem mapping and epidemiological overview. Dental and oral health is a widespread global health problem, especially among children due to increased access to processed foods and sugary drinks. About 80% of school-age children worldwide suffer from oral conditions such as giviticity, cavities, caries, and plaque (Peter et al., 2025).

Meanwhile, in 2023 and above, the keywords that appear a lot are *oral health education, toothbrushing, plaque index, randomized controlled trial*, and *Prospective Study*. This suggests that recent research trends are increasingly leading to technology-based interventions, including apps, educational videos, and social media. Changes in interventions in health are shifting by leveraging digital technology (Bastani et al., 2022). The development of dental health apps tailored to individual characteristics can increase oral health awareness, as well as support compliance among children, parents and dentists (Pisano et al., 2025).

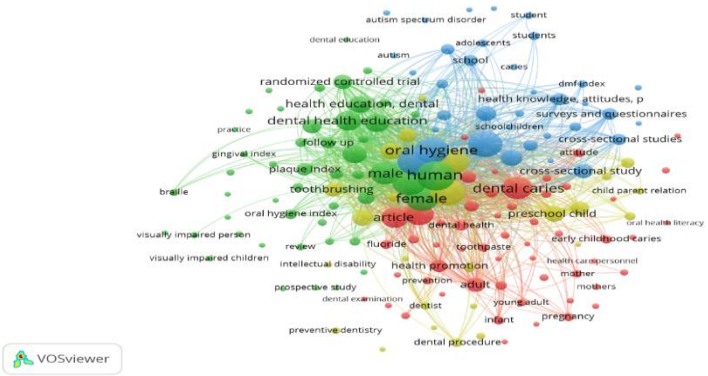

Figure 3. Keyword network visualization map

Based on the results of bibliometric analysis using VOSviewer, a network map (*Network Visualization*) that shows the relationship between topics in publications related to children's dental health, *Oral Hygiene*, educational media, and plaque indicators. From the map, it can be seen that the most dominant keywords include: *humans, humans, oral health, oral hygiene, child, dental health education*, and *index plate*. This shows that online media has an important role in promoting children's dental health, especially through education on toothbrushing behavior which has been proven to be an intervention to reduce plaque. By providing dental and oral health education, it can increase children's motivation to maintain dental and oral health and improve oral hygiene status by reducing plaque and dental caries (Gurav et al., 2022).

Keyword mapping shows that online media and digital education have become part of modern dental health interventions, this can be seen from the emergence of keywords such as *Social Media, Oral Health Knowledge, Parents*, and *Toothbrushing*. Research trends also show an expansion in the educational media used, ranging from educational videos, applications, social media, to media for people with disabilities. This reflects that there is a technological adaptation in health promotion, especially dental and oral health. Dental health promotion with various media aims to provide knowledge and encourage the audience to change behavior to pay attention to dental and oral health (Yunita et al., 2025). In addition, parents also have an important role in improving dental and oral health in children, as well as a large amount of time for children to spend with their parents. Therefore, it is important to provide accurate information to parents, especially mothers, to increase awareness of children's dental health (Kashani et al., 2024). The following are the results of PRISMA after bibliometric search and determination of the article reviewed.

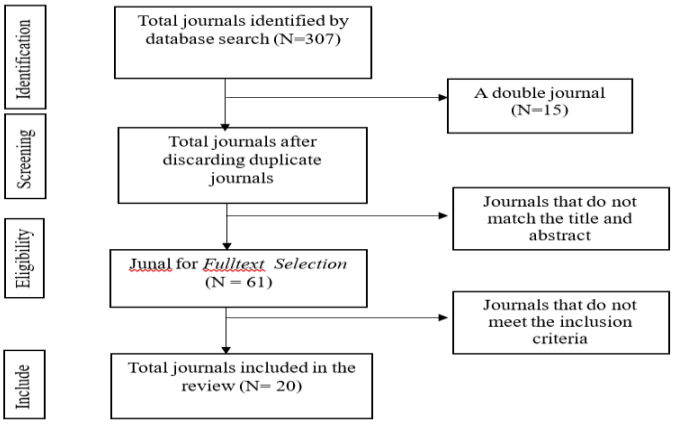

Figure 4. PRISMA graph for journal selection flow

Table 1. The reviewed studies suggest that different types of online media offer distinct advantages in promoting children's oral health

Yes	Article Title	Author (APA 7th)	Year	Method	Research Results
1	Influence of digital media in the oral health education of mother-child pairs	Ribeiro et al.	2022	Quantitative	Digital media increases oral health behavior in mothers and children.
2	Evaluating the effectiveness of web-based oral health education on enhancing mothers' awareness	Kashani et al.	2024	Experiments	Web-based education is more effective in improving maternal understanding than brochures.
3	Effectiveness of online caries management platform in children's caries prevention	Yan et al.	2023	Experiments	Online platforms improve children's oral health behavior and knowledge.
4	Digital Application for Promoting Evidence-Based Children's Oral Health	Abdul Haq et al.	2023	Experiments	Digital applications effectively support the prevention of childhood caries and plaque.

Yes	Article Title	Author (APA 7th)	Year	Method	Research Results
5	Effects of a Mobile Application to Improve Oral Hygiene in Children	Özvarış & Çoğulu	2024	Qualitative	The "Brush DJ" app improves children's toothbrushing habits.
6	Development and evaluation of a gamified smart phone mobile health application	Zolfaghari et al.	2021	Experiments	Gamification apps improve plaque control and oral health practices.
7	App-based oral health promotion interventions on modifiable risk factors associated with early childhood caries	Ajay et al.	2023	SLR	Mobile apps are effective in raising awareness of the dental health of parents.
8	The gamification and development of a chatbot to promote oral self-care	Chang et al.	2024	Experiments	Educational chatbots improve children's oral self-care behavior.
9	A Video-Game-Based Oral Health Intervention in Primary Schools	Aljafari et al.	2022	Experiments	Educational video games improve the dental health knowledge of school children.
10	Effectiveness of edutainment use in video-based learning on oral health education	Lekaram et al.	2025	Experiments	Entertainment-based educational videos are effective in improving oral health behaviors.
11	Effect of game-based teaching on the oral health of children	Patil et al.	2023	SLR	Game-based teaching improves oral hygiene and lowers plaque.
12	Enhancing Oral Hygiene in Children through an Innovative Motivational Model	Fathi et al.	2025	Experiments	The motivational model effectively improves plaque control in children.
13	A smartphone application promoting preschoolers' oral health	Shirmohammadi et al.	2022	Experiments	Smartphone applications improve plaque index compared to conventional education.
14	Effectiveness of a school-based educational intervention on oral health knowledge	Taheri et al.	2025	Experiments	Digital interventions in schools significantly lower plaque index.
15	Impact of virtual supervised tooth brushing on caries experience and quality of life	Alayadi et al.	2023	Quantitative	Virtual supervision of brushing teeth has the potential to improve children's oral health.
16	Use of social media by parents as a resource for knowledge on children's oral health	Sasikala et al.	2025	SLR	Social media helps increase parents' knowledge about children's dental health.
17	The effectiveness of education through videos and lectures about brushing teeth against plaque accumulation	Herlinawati et al.	2020	Experiments	Video education is more effective in reducing plaque index than lectures.
18	Effectiveness of Oral Health Educational Methods among School Children Aged 5–16 Years	Gurav et al.	2022	Meta-analysis	Educational media is effective in improving oral hygiene, but the effect on plaque is still limited.
19	Effect of Traditional and Virtual Oral Hygiene Instruction to School Health Instructors	Golshah et al.	2021	Experiments	Virtual instruction is more effective in increasing knowledge and lowering plaque index.
20	Clinical Evaluation of a newly Developed Smart Phone Oral Hygiene Application	Barakat et al.	2024	Experiments	The "Go Go Brush" application has the potential to improve the oral health of preschoolers.

The reviewed studies suggest that different types of online media offer distinct advantages in promoting children's oral health. Mobile applications were found to be particularly effective in supporting long-term oral hygiene behaviors through features such as reminders, progress tracking, and personalized feedback. Educational videos were primarily effective in improving oral health knowledge and demonstrating proper toothbrushing techniques in an easily understandable format. Chatbot-based interventions provided interactive learning experiences and real-time responses, which may enhance user engagement and reinforce self-care behaviors. Meanwhile,

gamification-based interventions appeared to be the most successful in increasing children's motivation and participation by incorporating rewards, challenges, and game elements into oral health education. Although all digital approaches showed positive outcomes, current evidence suggests that gamification and mobile application-based interventions may have greater potential to influence sustained behavioral change and plaque reduction among school-age children

The findings of this review have important implications for the development of technology-based school health programs. Schools can integrate digital oral health education into existing health promotion activities through mobile applications, educational videos, gamified learning, and virtual toothbrushing supervision. The consistent positive outcomes reported across the reviewed studies suggest that digital interventions can complement conventional school-based oral health programs by increasing student engagement, supporting parental involvement, and facilitating continuous monitoring of oral hygiene practices. Furthermore, technology-based approaches may provide a scalable and cost-effective strategy for improving oral health behaviors and reducing plaque accumulation among school-age children, particularly in settings with limited access to dental health professionals.

CONCLUSION

The use of online media as an effort to effectively reduce the number of plaque in elementary school children is used to reduce the number of plaque in elementary school children, due to the development of information technology and the habits and lifestyles of people who depend on online media. So that health promotion, especially dental and oral health, also needs to develop and innovate. One of them is by utilizing online media so that it is easier to be accepted by the public. Using online media such as online applications or gamification and online videos will help children be more interested in dental and oral health education. This is done as an effort to reduce plaque in children, especially elementary school children.

This effort is expected to answer the problems and needs that continue to shift in the order of life in society, especially at school age. Through online media that is presented in an interesting way for children, it is hoped that health-related information can be conveyed well which can increase understanding of health and motivate behavior change. The role of parents, such as mothers, also has a high contribution in reducing plaque rates in elementary school children. So that it is also important to provide education related to dental and oral health to parents. Future research should prioritize large-scale randomized controlled trials with longer follow-up periods, direct comparisons between different digital intervention formats, and standardized plaque index measurements to strengthen the evidence regarding the long-term effectiveness of online media in reducing dental plaque among children.

To maximize the effectiveness of digital oral health interventions for elementary school children, future digital media should be designed according to children's developmental characteristics and learning preferences. Interactive features such as gamification, animations, storytelling, rewards, and age-appropriate visual content should be incorporated to enhance engagement and motivation. In addition, parental involvement and teacher support should be integrated into digital platforms to reinforce oral health behaviors beyond the learning environment. User-friendly interfaces, culturally relevant content, and personalized feedback mechanisms are also recommended to improve the accessibility, acceptability, and long-term effectiveness of digital oral health education programs.

Limitation and future research this research has several limitations. First, the articles analyzed only came from the Scopus and Web of Science (WoS) databases, so there is a possibility that there is still relevant research from other databases that have not yet been identified. Second, the study only limited articles to the 2020–2025 range and used English-language articles, so some important publications in other languages were not included in the analysis. Third, the variation in

research design, type of online media, and measurement indicators used in each study caused the research results to be quite heterogeneous and difficult to compare directly.

In addition, most of the studies found focused more on improving dental health knowledge and behavior than long-term clinical evaluation of declining plaque index. Some studies also have relatively short intervention durations, so the effectiveness of online media in maintaining long-term behavior change is still not optimally ascertained.

The next research is expected to expand the data source by involving more international and national databases so that the results of the study will be more comprehensive. In addition, experimental research with a randomized controlled trial (RCT) design and a longer follow-up duration is needed to evaluate the effectiveness of online media on the continuous reduction of plaque and dental health in children. The development of digital media based on artificial intelligence (AI), gamification, virtual reality, and interactive applications adapted to the characteristics of elementary school children is also a research opportunity in the future.

Furthermore, future research is expected to explore the involvement of parents, teachers, and health workers in supporting the success of digital interventions. The integration of online media into school health programs also needs to be studied further so that it can be an effective promotive and preventive strategy in improving the dental and oral health of elementary school-age children.

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