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Effectiveness of Animated Video-Based Oral Health Education on Toothbrushing Skills among Preschool Children

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ABSTRACT

Background: Poor oral hygiene in preschool children remains a common public health problem and may lead to dental caries, gingivitis, pain, and impaired quality of life. Inadequate toothbrushing skills are an important contributing factor. Educational media such as animated videos may help children learn correct brushing techniques in an engaging way. This study aimed to evaluate the effect of animated video-based oral health education on toothbrushing skills among preschool children.
Methods: This study used a pre-experimental one-group pretest-posttest design conducted at TK Khalifah Jambi, Jambi City, Indonesia, from January to March 2025. A total of 50 preschool children aged 4–6 years were selected using purposive sampling. Participants received a seven-minute animated oral health education video followed by demonstration and supervised toothbrushing practice. Toothbrushing skills were assessed using a structured observational checklist before the intervention and seven days afterward. Data were analyzed using the Wilcoxon signed-rank test with a significance level of $p < 0.05$.
Results: The mean pretest toothbrushing skill score was 52.3 ± 10.6, which increased to 82.7 ± 8.4 at posttest. There was a statistically significant improvement in toothbrushing skill scores after the intervention ($p < 0.001$). Improvements were observed in brushing sequence, brushing duration, tongue cleaning, and rinsing practices.
Conclusion: Animated video-based oral health education combined with demonstration and supervised practice was associated with improved toothbrushing skills among preschool children. This approach may be considered as a practical strategy for early childhood oral health promotion programs.

INTRODUCTION

Oral health is an essential component of children's general health and well-being. Poor oral hygiene can lead to dental caries, gingivitis, pain, halitosis, and reduced academic performance. The World Health Organization reported that oral diseases affect approximately 3.5 billion people globally, making them among the most common chronic conditions worldwide (Petersen, 2003). Untreated dental caries is especially common among children and remains a substantial public health burden.

Children's oral hygiene is strongly influenced by daily toothbrushing behavior. Toothbrushing is recognized as the most effective and economical self-care practice for removing

plaque and preventing dental caries when performed correctly (Marinho et al., 2003). However, many children brush their teeth with poor technique, inadequate duration, and incomplete coverage of tooth surfaces. noted that behavioral factors such as lack of supervision, poor motivation, and inadequate parental guidance significantly influence children's brushing habits (Colleen et al., 2010) .

Traditional oral health education methods such as lectures or printed materials often fail to attract children's attention (Nordstrom et al., 2025). In contrast, animated videos combine visual movement, sound, colorful characters, and practical demonstrations, making them more suitable for school-aged learners (Gurav et al., 2022). Emphasized that animated media strongly influences children's attitudes and behaviors because children often imitate actions displayed by animated characters (Kitsaras, G., & Goodwin, 2023).

Several studies have demonstrated the benefits of animation media in oral health promotion. The animated video Dokter Gigi Kimi significantly improved children's toothbrushing skills (Alzena et al., 2024). In a randomized controlled trial among children aged 4–6 years, reported that animation videos effectively improved oral hygiene outcomes when combined with motivational interviewing and jaw model instruction (Celikel et al., 2025). Also found that animated toothbrushing videos significantly increased schoolchildren's knowledge of oral hygiene maintenance (Jannah et al., 2024). Animated toothbrushing education improved dental and oral health knowledge among elementary school students (Jumriani et al., 2025). Observed increased knowledge regarding correct brushing patterns after animated counseling videos (Septa, et al., 2024). Demonstrated that video media improved toothbrushing knowledge among children aged 8–9 years (Koch et al., 2023). Although evidence supports audiovisual learning media, studies examining practical toothbrushing skill outcomes in Indonesian children remain limited. Therefore, this study aimed to analyze the effectiveness of animated video-based dental health education in improving toothbrushing skills among children. The findings are expected to support innovative school oral health promotion programs.

Although previous studies have shown that animated videos can improve children's oral health knowledge and attitudes, evidence regarding their effect on directly observable toothbrushing skills remains limited. Most available studies have focused primarily on knowledge outcomes, self-reported brushing behavior, or older school-aged children, while fewer studies have assessed whether preschool children are able to translate educational messages into correct brushing practice. This is particularly important because early childhood is a critical period for establishing lifelong oral hygiene habits, and children aged 4–6 years often require simple, attractive, and repetitive learning methods suited to their developmental stage.

In Indonesia, studies evaluating practical toothbrushing skill performance using engaging audiovisual media in preschool educational settings are still scarce. Many school-based oral health programs continue to rely on conventional lectures or verbal instruction, which may be less effective in maintaining young children's attention and promoting motor skill learning. Therefore, there is a need for evidence-based interventions that not only increase knowledge but also improve actual brushing performance among preschool children. This study was conducted to address that gap by evaluating the effect of animated video-based oral health education on toothbrushing skills among preschool children at TK Khalifah Jambi, Indonesia.

METHODS

This study employed a pre-experimental design using a one-group pretest-posttest approach to evaluate the effectiveness of animated video-based dental health education in improving toothbrushing skills among children. This design was selected because it was appropriate for measuring changes in practical toothbrushing behavior before and after the intervention within the same group of participants. The design was considered efficient and feasible in an educational setting where random allocation was not possible due to institutional considerations and the need to provide equal educational opportunities to all children. However, this design has recognized limitations in internal validity because the absence of a control group makes it difficult to distinguish the true intervention effect from other influences such as testing effects, Hawthorne

effects, repeated observation, or natural short-term improvement over time. Therefore, the findings should be interpreted as preliminary evidence of effectiveness, and future studies using randomized controlled or comparative designs are recommended to strengthen causal inference.

The intervention media consisted of a researcher-selected animated educational video specifically designed for preschool oral health promotion. The video had a duration of seven minutes and was presented in the Indonesian language. It featured child-friendly cartoon characters, colorful visuals, simple narration, music, and step-by-step demonstrations of proper toothbrushing techniques suitable for children aged 4–6 years. The educational content included the importance of healthy teeth, risks of poor oral hygiene, recommended brushing times (after breakfast and before bedtime), appropriate toothbrush and toothpaste selection, correct brushing movements for all tooth surfaces, brushing duration of at least two minutes, tongue cleaning, rinsing, and toothbrush storage. The video was adapted from publicly available educational material and reviewed by two dental health educators and one health promotion specialist to ensure age appropriateness and content validity. If published online, the URL/link http://tiny.cc/video_sikatgigi to the video may be provided in the supplementary material or upon reasonable request from the corresponding author.

The study was conducted at TK Khalifah, Jambi, Indonesia, from January to March 2025. TK Khalifah Jambi is a private early childhood education institution with structured learning activities and regular health promotion programs. The school was selected because it had an adequate number of preschool children in the target age group, supportive school management, and had not previously implemented structured oral health education using animated video media. Data collection activities were carried out in classrooms and designated handwashing areas equipped with sinks, mirrors, and child-friendly facilities to support supervised toothbrushing practice.

The target population consisted of all preschool children aged 4–6 years enrolled at TK Khalifah Jambi, totaling 96 children. The required sample size was calculated using the paired mean comparison formula for pretest-posttest studies with a 95% confidence level, 80% statistical power, and a moderate expected effect size of 0.50. Based on this calculation, the minimum required sample was 44 participants. After accounting for a possible 10% attrition rate, the final target sample size was set at 50 children. A total of 50 eligible participants were recruited and completed both the pretest and posttest assessments; therefore, all analyses were based on 50 participants. Any previous statement indicating 60 participants was a reporting inconsistency and has been corrected to maintain methodological accuracy. Participants were selected using purposive sampling, which was considered appropriate because only children who met the eligibility criteria and were able to complete all study procedures were included. However, because purposive sampling is a non-probability sampling method, the representativeness of the sample may be limited and selection bias cannot be excluded. Therefore, caution is needed when generalizing the findings to wider preschool populations.

Children were eligible if they were actively enrolled at TK Khalifah Jambi, aged between 4 and 6 years, able to follow simple verbal instructions, had written parental or guardian consent, and were willing to participate until the completion of the study. Children were excluded if they had developmental or motor impairments affecting independent toothbrushing, were experiencing acute dental pain or infectious illness during data collection, or were absent during either the pretest or posttest session.

The independent variable in this study was dental health education delivered through animated video media. The dependent variable was children's toothbrushing skill, assessed through direct observation of brushing performance. Additional characteristics recorded included age, sex, previous toothbrushing habits, and parental assistance during brushing at home.

Toothbrushing skill was measured using a structured observational checklist developed based on preschool oral health education standards. The instrument consisted of ten components covering proper toothbrush grip, appropriate toothpaste use, brushing of front teeth, brushing of back teeth, cleaning chewing surfaces, correct circular brushing motion, brushing duration of at least two minutes, tongue cleaning, proper rinsing, and cleaning the toothbrush after use. Each item was scored as 0 if not performed, 1 if performed incorrectly or incompletely, and 2 if

performed correctly. Total scores ranged from 0 to 20 and were converted to a 0–100 scale, with higher scores indicating better toothbrushing skills. Content validity of the instrument was reviewed by two dental health experts and one health promotion specialist. A pilot test among 15 children in another kindergarten showed good internal consistency with a Cronbach's alpha of 0.81.

The study procedures were carried out in three stages. During the baseline stage, written consent forms were collected from parents or guardians, and demographic information was recorded. Each participant was then asked to brush their teeth according to their usual daily practice using standardized toothbrushes and toothpaste provided by the researchers. Their performance was observed and scored using the checklist, and these scores served as the pretest measurement.

Following the pretest, participants received the intervention as a structured oral health education package consisting of a seven-minute animated educational video presented in the Indonesian language, followed by live demonstration and supervised toothbrushing practice. The video contained child-friendly cartoon characters, colorful visuals, narration, and background music explaining the importance of healthy teeth, the consequences of poor oral hygiene, correct times for brushing teeth, proper toothbrush and toothpaste selection, correct brushing techniques, recommended brushing duration, tongue cleaning, rinsing procedures, and proper toothbrush storage. The video was shown twice using a projector and loudspeaker in the classroom to reinforce understanding, so that all participants received the same total viewing duration of approximately 14 minutes. After viewing the video, the researchers conducted a standardized brief live demonstration using a dental model and oversized toothbrush, followed by supervised group practice to strengthen comprehension and motor skill performance. To promote consistency, all sessions were delivered by the same research team using the same teaching sequence, materials, and instructions. Participant attention and engagement were monitored by classroom teachers and research assistants, who encouraged children to remain attentive and participate actively throughout the session. A simple intervention fidelity checklist was used to confirm that each component of the educational package (two video viewings, demonstration, and supervised practice) was delivered uniformly to all participants. Therefore, the intervention should be understood as a combined audiovisual, demonstration, and practice-based educational approach rather than the effect of animated video alone.

Seven days after the intervention, participants underwent the posttest assessment. Each child was again asked to brush their teeth independently without prompts or guidance, and their performance was observed using the same checklist. The seven-day interval was selected to assess short-term retention and application of the skills learned from the educational intervention. This follow-up period was considered appropriate for evaluating immediate skill acquisition and early behavioral application after the educational session; however, it was not intended to measure long-term maintenance of toothbrushing habits or sustained behavior change over time. Therefore, the findings should be interpreted as evidence of short-term improvement in toothbrushing skills rather than permanent habit formation. The use of the same structured checklist at both time points was intended to ensure consistency in measurement of observable brushing performance rather than relying solely on self-reported knowledge or behavior.

To ensure data quality, two trained research assistants with health science backgrounds assisted in data collection. Prior to the study, they underwent training on standardized observation procedures and scoring methods using written scoring guidelines and simulated toothbrushing scenarios. Inter-rater reliability testing was conducted during the pilot phase, and agreement between observers was found to be acceptable (Cronbach's alpha = 0.82), indicating good scoring consistency. Wherever possible, observers focused on checklist criteria rather than study hypotheses during assessments. However, complete blinding to the assessment phase (pretest or posttest) was not feasible because data collection was conducted in the same school setting and posttest followed the intervention period. Therefore, the possibility of observer expectancy bias cannot be fully excluded and should be considered when interpreting the magnitude of improvement. Completed forms were checked daily for completeness and

consistency. Data were entered twice into an electronic database to minimize transcription errors, and all files were stored in password-protected systems accessible only to the research team.

Data analysis was performed using IBM SPSS Statistics version 25. Descriptive statistics were used to summarize participant characteristics and study variables. Continuous data were presented as means and standard deviations, while categorical variables were presented as frequencies and percentages. The Shapiro-Wilk test was used to assess normality of score distributions. The results indicated that pretest scores ($p = 0.003$) and posttest scores ($p = 0.001$) deviated significantly from normal distribution. Because the toothbrushing skill scores were not normally distributed, differences between pretest and posttest scores were analyzed using the Wilcoxon signed-rank test. Statistical significance was determined at $p < 0.05$.

Ethical approval for the study was obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Jambi (Approval No. LB.02.06/2/145/2025). Written informed consent was obtained from all parents or guardians before participation. Verbal assent was also obtained from the children after age-appropriate explanation of the study purpose and procedures. Participation was voluntary, and children were allowed to withdraw at any time without consequences. Participant confidentiality was maintained by using identification codes rather than names in all study records.

Several methodological limitations should be acknowledged. The absence of a control group limited the ability to establish full causal inference. The use of purposive sampling from a single kindergarten may reduce the generalizability of the findings. In addition, the short follow-up period only allowed assessment of immediate behavioral improvement rather than long-term maintenance of toothbrushing skills.

RESULTS

Characteristics of Participants

Table 1. Characteristics of Respondents (n = 50)

Variables	n	%
Age Group (years)		
Age 4 years	14	28.0
Age 5 years	24	48.0
Age 6 years	12	24.0
Sex		
Male	23	46.0
Female	27	54.0

Most participants were 5 years old (48.0%), followed by children aged 4 years (28.0%) and 6 years (24.0%). Slightly more than half of the participants were female (54.0%). All respondents were preschool children aged 4–6 years, consistent with the eligibility criteria described in the Methods section.

Toothbrushing Skill Scores Before and After Intervention (n = 50)

Table 2. Comparison of Toothbrushing Skills Before and After Intervention

Variable	Mean ± SD	Z	p-value
Pretest Score	52.3 ± 10.6		
Posttest Score	82.7 ± 8.4	-7.21	<0.001

Toothbrushing skill scores increased from 52.3 ± 10.6 before the intervention to 82.7 ± 8.4 after the intervention, with an average improvement of 30.4 points. Based on the original 0–20 observational checklist scale, these scores correspond approximately to an increase from 10.5 correct brushing steps at baseline to 16.5 correct steps after the intervention, indicating improvement in around six additional toothbrushing skill components. The Wilcoxon signed-rank

test showed a statistically significant difference between pretest and posttest scores ($Z = -7.21$, $p < 0.001$).

Table 3. Improvement in Toothbrushing Item Before and After Intervention (n = 50)

Skill Component	Pretest n (%) Correct	Posttest n (%) Correct	Improvement (%)
Proper toothbrush grip	22 (44.0)	43 (86.0)	42.0
Appropriate toothpaste use	28 (56.0)	46 (92.0)	36.0
Brushing front teeth	24 (48.0)	44 (88.0)	40.0
Brushing back teeth	18 (36.0)	41 (82.0)	46.0
Cleaning chewing surfaces	16 (32.0)	40 (80.0)	48.0
Correct circular brushing motion	14 (28.0)	39 (78.0)	50.0
Brushing duration ≥2 minutes	11 (22.0)	39 (78.0)	56.0
Tongue cleaning	10 (20.0)	37 (74.0)	54.0
Proper rinsing	15 (30.0)	35 (70.0)	40.0
Cleaning toothbrush after use	12 (24.0)	36 (72.0)	48.0

All observed toothbrushing skill items showed improvement after the intervention. The greatest gains were seen in brushing duration of at least two minutes (56.0%), tongue cleaning (54.0%), and correct circular brushing motion (50.0%). These findings suggest that the combined educational package was particularly effective in improving procedural brushing steps that are commonly neglected by preschool children.

DISCUSSION

This study found a significant improvement in children's toothbrushing skills following the educational intervention. Mean posttest scores increased substantially compared with baseline values, indicating better toothbrushing performance after the intervention. However, the intervention consisted not only of animated video education, but also live demonstration and supervised group practice (Kay, E., & Locker, 1998). In addition, the effectiveness of this approach can be understood within the broader context of oral health promotion, where educational strategies must consider not only individual behavior but also social and environmental influences. Health communication tools such as videos or educational materials have been shown to be more effective when they are clear, culturally appropriate, and tailored to the target population, thereby improving comprehension and engagement (Blinkhorn, 2014) .

The findings are consistent with previous studies reporting that audiovisual and interactive oral health education may support the development of toothbrushing skills in children (Alzena et al., 2024). Similarly, Animated oral health education improved students' brushing technique and routine behavior (Yulistina et al., 2025). The significant improvement observed in this study also aligns, who found that animation videos were effective in improving oral hygiene among preschool children. Their randomized controlled trial demonstrated that children respond positively to interactive and visual learning methods. This suggests that animated media may be beneficial across different childhood age groups. Demonstrated positive outcomes of animation-based education among preschool children. Together, these studies suggest that visual and interactive learning methods may help children better understand and practice correct toothbrushing techniques (Prasetyowati et al., 2025). Therefore considered more relevant for explaining the observed improvement in toothbrushing skills in the present study. Nevertheless, broader oral health promotion references were retained only to provide contextual background and should not be interpreted as direct evidence of intervention effectiveness in children's procedural toothbrushing skills (Davies et al., 2003).

Our results also support previous studies indicating that video-based education can improve oral health knowledge (Koch et al., 2023). Increased understanding may encourage children to perform brushing steps more consistently. Knowledge, attitudes, and practices are closely related and may influence oral health behavior (Rad et al., 2015). Where improved understanding can positively influence oral health behaviors (Tolvanen M, Lahti S, 2010). In

addition, psychological factors such as motivation, perceived importance of oral health, and previous experiences may affect how children adopt oral hygiene practices (Freeman, 2001).

The improvement in brushing sequence, brushing duration, tongue cleaning, and rinsing indicates that children learned procedural steps effectively. Animated videos may enhance memory retention because information is delivered simultaneously through audio and visual channels. Furthermore, behavioral theories suggest that structured and self-regulatory interventions can strengthen habit formation in oral hygiene practice (Gholami et al., 2015). From a broader public health perspective, these findings are highly relevant. Oral diseases, particularly periodontal diseases, remain a significant global burden and are closely linked with other chronic conditions, highlighting the need for integrated preventive strategies (Petersen, P. E., & Ogawa, 2012). School-based interventions using scalable tools such as animated videos offer a practical and cost-effective approach to improving population oral health. Such strategies align with recommendations for preventive, accessible, and community-based health promotion programs (Watt, 2005). Additionally, addressing oral health behaviors early in life may help mitigate the influence of social and behavioral determinants that often act as barriers to optimal oral health (Newton, J. T., & Bower, 2005).

Nevertheless, the findings should be interpreted cautiously. This study used a one-group pretest–posttest design without a control group, making it difficult to determine whether the observed improvement was directly caused by the intervention itself. Other factors, such as repeated exposure to toothbrushing assessment, familiarity with the checklist procedure, or practice effects, may also have contributed to higher posttest scores. In addition, because toothbrushing skills were assessed through direct observation by the researchers, the possibility of observer bias cannot be excluded, particularly if blinding was not applied during assessment.

CONCLUSION

Animated video-based dental health education was associated with improved children's toothbrushing skills, including brushing technique, duration, tongue cleaning, and rinsing. However, because this was a one-group study with a multicomponent intervention, the findings reflect improvement after the program rather than definitive evidence of effectiveness of animated video alone. The results suggest that combining audiovisual media with demonstration and supervised practice may be a promising approach for school-based oral health education. Further controlled studies are needed to confirm its effectiveness.

Author's Contribution Statement: **Surayah**: Research ideas and concepts, preparation of research proposals, data collection, analysis, and manuscript drafting. **Pahrur Razi**: methodology supervision, statistical analysis.

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