A COMPARATIVE STUDY OF POSTER, VIDEO, AND GAME-BASED EDUCATIONAL INTERVENTIONS ON DENTAL CARIES KNOWLEDGE AMONG ELEMENTARY SCHOOL CHILDREN

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ABSTRACT

Background: Dental caries remains a significant public health problem among elementary school children in Indonesia, with a high prevalence in both rural and urban areas. Effective educational strategies are needed to improve children's knowledge and preventive behaviors related to oral health. Objective: This study aimed to compare the effectiveness of various educational media in improving knowledge of dental caries risk factors among elementary school children. Materials and Methods: A quasi-experimental study with a non-equivalent pre-test and post-test design was conducted among 120 students aged 10–12 years selected using cluster sampling from rural and urban schools in North Sumatra, Indonesia. Participants were divided into seven groups based on the educational media received: posters, leaflets, videos, hand puppets, flipcharts, puzzles, and snakes and ladders. Knowledge was assessed using a validated and reliable questionnaire. Data were analyzed using the Wilcoxon signed-rank test to evaluate within-group differences, the Kruskal–Wallis test to compare effectiveness across media, and the Mann–Whitney test to assess differences between locations, with a significance level of $p < 0.05$. Results: All interactive media showed improvements in knowledge scores; however, hand puppets demonstrated the highest increase ($\Delta = 2.90$; $p < 0.001$), followed by snakes and ladders ($\Delta = 1.66$; $p < 0.05$) and videos ($\Delta = 1.26$; $p < 0.05$). Posters, leaflets, and puzzles did not show statistically significant improvements ($p > 0.05$). No significant differences were found between rural and urban students ($p > 0.05$). Conclusion: Interactive educational media are effective in improving children's knowledge of dental caries risk factors, with hand puppets being the most effective medium. These findings suggest that interactive and participatory media should be prioritized in school-based oral health promotion programs, as they are applicable across both rural and urban settings.

Keywords : *educational media, hand puppets, dental caries, elementary school children, oral* health promotion

INTRODUCTION

Oral health is often not a top priority for many people, even though the mouth serves as the "gateway" for bacteria and germs that can disrupt the health of other bodily organs.[1] Oral health plays a significant role in determining an individual's overall health status.[2]One of the most common conditions is dental caries or tooth decay[3] Tooth decay is a dental tissue disease characterized by tissue damage that begins on the surface of the tooth, in pits, fissures, and interproximal areas, and spreads toward the pulp.[4] Factors influencing tooth decay in elementary school children include brushing habits, brushing frequency, and brushing technique. Non-behavioral factors influencing tooth decay include knowledge.[5,6,7]

Dental caries remains a significant public health problem among children in Indonesia, affecting elementary school students in both urban and rural areas.[8] This highlights the urgent need for comprehensive preventive efforts, especially in improving dental hygiene education, encouraging routine dental check-ups, and limiting the intake of foods that promote tooth decay. A meta-analysis of 27 observational studies involving 8,840 children revealed that 76% of children in Indonesia suffer from dental caries (95% CI: 71%–81%), meaning that more than three out of four children are affected. The prevalence was consistent across regions, with similar rates found in both urban areas like Jakarta (75.4%) and non-urban areas (76.6%), showing no significant regional differences.[9] Preventive behaviors against dental caries among schoolchildren in urban areas of Indonesia remain suboptimal, especially regarding the practice of brushing teeth twice daily and attending regular dental check-ups. Despite having adequate knowledge of oral health, this awareness is not consistently translated into effective preventive actions.[10]

Various factors contribute to the risk of dental caries among elementary school children in Indonesia. These include the consumption of cariogenic foods, frequency and technique of tooth brushing, frequency of dental visits, and the level of knowledge and attitudes toward dental hygiene.[11,12,13] Other influencing aspects are nutritional status such as stunting and BMI, dietary patterns, social habits, timing of tooth brushing, oral hygiene and dental plaque indices, salivary acidity, and access to dental and oral health education.[14.15.16] In the other research report that tooth-brush usage, soda consumption, and educational level of parents were the associated factors for dental caries.[8,17,18]

Health education for school-age children requires appropriate methods and media

tailored to their stage of growth and development, as children at this stage have unique characteristics that influence their motivation or interest in the educational information provided.[19] The selection of methods and media in providing education is very important, especially for children, as it can support the success of the education provided.[20] Choosing the right methods and media is crucial when educating children, as it greatly influences the effectiveness of the learning process.[21] When the approach is appropriate and engaging, it can lead to positive changes in children's knowledge, attitudes, and behaviors.[22]

One of the ongoing challenges in society is the limited knowledge and awareness among parents regarding the growth and development of their children, particularly in maintaining oral health.[23,24,25] This includes a lack of understanding about the importance of preventive measures to reduce the risk of dental caries in children.[3,26] Additionally, dental health educators still lack awareness of the role of educational media in the success of outreach efforts to enhance respondents' knowledge about children's oral health.[27] Previous studies have identified various types of educational media that effectively engage elementary school children, including posters, leaflets, hand puppets, educational board games such as snakes and ladders, flipcharts, and instructional videos.[28.29,30,31] Enhancing elementary school children's knowledge of dental caries risk factors can be effectively achieved through the use of educational media that are engaging and capable of capturing their attention.[32]

Although numerous studies have demonstrated that individual educational media—such as posters, videos, and interactive games—can improve children's oral health knowledge,[20] there is still limited evidence directly comparing the effectiveness of different media in a single population. Most previous research has focused on the impact of a single type of intervention without evaluating which medium is more effective in producing sustained knowledge and behavioral change among elementary school children.[20] This study provides one of the first comparative analyses of multiple educational media within a single population of elementary school children in Indonesia. Therefore, a comparative approach is needed to identify the most appropriate and effective educational media tailored to children's characteristics, learning preferences, and developmental stages, particularly in the Indonesian context where caries prevalence remains high.

MATERIALS AND METHODS

This study employed a quasi-experimental non-equivalent control group design with pre-test and post-test measurements. The study was conducted as two group based on two locations: group 1 is from rural areas at Bangun and Lae Hole elementary school, and group 2 is from urban areas at SD St. Yosef. Due to the use of cluster sampling without random assignment at the individual level, this study applied a non-equivalent group design.

The sample in this study consisted of elementary school students aged 10–12 years, selected using cluster sampling, A total of 120 students, with 60 students each location group. Each intervention group was exposed to only one type of educational media to allow comparison of effectiveness across media. The independent variable was the type of educational media (posters, leaflets, videos, hand puppets, flipcharts, puzzles, and snakes and ladders) and the dependent variable was students' knowledge of dental caries risk factors, measured using a structured questionnaire. The questionnaire consisted of two sections:
(1) knowledge assessment on dental caries risk factors, and
(2) evaluation of educational media, including visual appearance, clarity of content, attractiveness, and message retention.

Each group was assigned to receive only one type of educational media, namely posters, leaflets, videos, hand puppets, flipcharts, puzzles, and snakes and ladders. The allocation of students into intervention groups was conducted at the class/group level to avoid contamination between interventions.

Thus, each student was exposed to only one type of educational media, and comparisons were made between groups to evaluate the relative effectiveness of each medium in improving knowledge of dental caries risk factors.

The average incidence of dental caries was 43.3%, and at St. Yosef elementary school reached 40%. The research was conducted between July and September 2023. The sampling technique used was cluster sampling. Data collection was conducted using two methods. Primary data was collected through knowledge measurement using a questionnaire, which included questions about the evaluation of educational media (including evaluation of media appearance based on color, images, and shape), evaluation of content that is easier to understand, evaluation of the appeal to encourage brushing teeth, and evaluation of remembering educational messages. A pilot study was conducted

on a sample of students with similar characteristics to ensure clarity and feasibility of the questionnaire. Secondary data was obtained from the results of student screening, including information on the number of male and female students. This study used posters, leaflets, videos, hand puppets, flipcharts, puzzles, and snakes and ladders. All items of the knowledge and media evaluation questionnaires demonstrated acceptable validity, with corrected item–total correlation values exceeding 0.30 and statistically significant p-values ($p < 0.05$). The reliability analysis showed that the knowledge questionnaire had a Cronbach's alpha of 0.82, while the media evaluation questionnaire achieved 0.85, indicating good to high internal consistency.

Data collection was conducted between July and September 2023. Secondary data were obtained from student screening records, including demographic characteristics such as gender. Data processing involved editing, coding, transferring, tabulating, and cleaning to ensure data accuracy.

Data were analyzed using statistical software. Descriptive statistics were used to summarize respondents' characteristics and knowledge scores. The normality of the data was tested using the Kolmogorov–Smirnov test, and homogeneity of variance was assessed using Levene's test. To evaluate within-group differences between pre-test and post-test scores, paired *t*-tests were used for normally distributed data, while the Wilcoxon signed-rank test was applied for non-normally distributed data. To compare the effectiveness of different educational media, Analysis of the Kruskal–Wallis test was used to compare gain scores between groups. A significance level of $p < 0.05$ was considered statistically significant.

Findings

In table 1 show the study obtained of children characteristic gender and frequency of brushing teeth from all the responden.

Table 1. Demographic characteristics of respondents(n=120)

Characteristic	Frequency	Percentage
Gender		
Male	70	58,3
Female	50	41,7
Frequency of brushing teeth		

< 2 times a day	80	66,7
≥ 2 times a day	40	33,3

Based on the data, out of a total of 120 respondents, 27 (45%) were male and 33 (55%) were female. This composition shows that female respondent participation was slightly higher than male participation. Based on toothbrushing frequency in terms of toothbrushing behavior, it was found that 40 respondents (66.67%) had a toothbrushing frequency categorized as insufficient, while only 20 respondents (33.33%) had adequate toothbrushing habits. These results indicate that the majority of respondents do not yet have optimal toothbrushing habits.

Table 2. Overview of several educational media preferred by respondents

Type of Media	Size	Type of material	n	Percentage
Poster	high 120 cm x wide 90 cm.	Kanvas	10	16,67
Leaflet	Paper A4	Paper	5	8,33
Video	3 minutes duration	Animated Video	17	28,33
Hand Puppet	20cm x 30 cm	Planel	40	66,67
Flipchart	50cmx60 cm	Carton	6	10
Puzzle	70 cmx 80 cm	Foam/styrofoam	11	18,33
Snakes and Ladders	100 x 100 cm	Banner	30	50

Table 2 shows that hand puppets were the most preferred educational media among students (33.3%), followed by snakes and ladders (25.0%) and videos (14.2%). This preference is consistent with the effectiveness results, indicating that more engaging and interactive media tend to be more appealing to children.

Table 3. Frequency distribution of knowledge levels education based on Dental Caries Promotion Education Media with Wilcoxon test (n=120)

Media	Average level of knowledge		(Δ)	P value*
	Pre test	Post test		
Poster	14,51 ± 2,18	14,81± 2,33	0,30± 0.15	p>0,05
Leaflet	13,17 ± 5,4	13.71± 5,33	0,54 ± 0,07	p>0,05
Video	15,31 ± 4,17	16,57± 4,31	1,26±0,14	p<0,05*
Hand puppet	15,28 ± 3,12	18,18± 4,17	2,90±1,05	p<0,000*
Flipchart	14,52 ± 2,05	14,88± 3,01	0,36 ±0,98	p<0,05*
Puzzle	15,45 ± 3,18	16,32± 4,19	0,87 ±1,01	p>0,05
Snakes & ladders	15,01 ± 5,16	16,67± 5,18	1,66±0,02	p<0,05*

note: *: significancy (p<0,05)

Based on Table 3 above, it is known that the Hand Puppet medium provides the highest average increase in knowledge (Δ = 2.90), followed by the Snakes and Ladder medium (Δ = 1.66) and the Video medium (Δ=1.26), which demonstrate high potential effectiveness as educational media. Meanwhile, the Poster medium provides the lowest increase (Δ = 0.30), so it can be considered less effective compared to other media. Based on statistical tests using the dependent t-test in Table 2, it is also evident that the most statistically and practically effective medium is the Hand Puppet (Δ = 2.90; p < 0.000), as it not only produces the highest increase but is also highly statistically significant. The Video and Snakes and Ladder media are also statistically significant, although their increases are not as high as the Hand Puppet. Posters, Leaflets, and Puzzles did not show statistical significance (p > 0.05), so their effectiveness in improving knowledge should be reconsidered or may need to be combined with other methods. Flipcharts, although showing a small increase, were statistically significant, which could be due to consistent understanding despite the small increase.

DISCUSSION

The findings of this study demonstrate that interactive educational media are more effective than passive media in improving elementary school students' knowledge of dental caries risk factors. Among the various media evaluated, hand puppets showed the highest effectiveness, followed by videos and snakes and ladders, while posters, leaflets, and puzzles did not produce significant improvements. These results highlight the importance of aligning educational strategies with children's developmental characteristics, particularly their preference for interactive, engaging, and multisensory learning experiences.

The superior effectiveness of hand puppets observed in this study is consistent with previous research indicating that interactive and participatory approaches significantly enhance knowledge retention and engagement among children. For example, Sharfina (2020) reported that the use of hand puppets in oral health education significantly improved toothbrushing knowledge among elementary school students. Similarly, studies on health education have emphasized that children are more responsive to storytelling, role-play, and character-based learning, as these methods stimulate imagination and emotional involvement, which are critical for memory retention and behavioral change. Compared to conventional methods, hand puppets create a more immersive learning environment, allowing children to actively interact with the educational content rather than passively receiving information.

The effectiveness of videos and snakes and ladders in this study also supports previous findings that audiovisual and game-based learning can enhance children's understanding of health information. Videos combine visual and auditory stimuli, making abstract concepts easier to understand, while educational games such as snakes and ladders introduce elements of play that increase motivation and participation. However, their effectiveness was lower than that of hand puppets, which may be explained by the level of direct interaction involved. While videos are generally one-way media and games may focus more on play than content depth, hand puppets facilitate real-time interaction, discussion, and feedback, which are essential components of effective learning.

In contrast, the lack of significant improvement observed in the poster, leaflet, and puzzle groups aligns with earlier studies suggesting that passive educational media have limited impact on behavior change, particularly among younger age groups.

According to health education theory, passive media tend to rely heavily on reading ability and individual motivation, which may not be optimal for elementary school children who benefit more from guided and interactive learning. This finding is also in agreement with systematic reviews indicating that traditional health education methods alone are insufficient to produce meaningful and sustained improvements in oral health behaviors.

An important finding of this study is the absence of significant differences between rural and urban students in terms of intervention effectiveness. This suggests that well-designed educational media, particularly those that are interactive, can be universally applied across different settings. This is particularly relevant in the Indonesian context, where disparities in access to health education and services often exist between rural and urban areas. The results indicate that focusing on the quality and delivery method of education may be more important than geographic factors in determining outcomes.

Furthermore, this study reinforces the concept that improving knowledge alone is not sufficient; rather, the method of delivery plays a critical role in translating knowledge into potential behavioral change. The inclusion of interactive discussions during the intervention likely contributed to increased student engagement and deeper understanding, supporting the idea that participatory learning enhances both cognitive and affective domains.

Despite these strengths, this study has several limitations. The use of a quasi-experimental design without randomization may introduce selection bias, and the relatively short duration of the intervention limits the ability to assess long-term behavioral changes. Future research should consider randomized controlled trials with longer follow-up periods to evaluate the sustainability of the observed effects. Additionally, further studies could explore the integration of digital interactive media to expand the reach and scalability of oral health education programs.

CONCLUSION

This study demonstrates that interactive educational media are effective in improving elementary school students' knowledge of dental caries risk factors and supporting positive behavioral changes. Among the media evaluated, **hand puppets** were identified as the most effective, followed by videos and snakes and ladders, due to their ability to

actively engage students through interactive and multisensory learning experiences.

No significant differences were found between rural and urban students, indicating that these educational approaches are equally applicable across different settings. These findings suggest that oral health promotion programs should prioritize the use of interactive and participatory media, particularly hand puppets, as practical and cost-effective tools to enhance children's engagement, understanding, and adoption of proper oral hygiene practices. Also these findings can support school-based oral health promotion policies and integration into primary school curricula.

The authors want to thank the Director of Politeknik Kesehatan Kementerian Kesehatan Medan Year 2023- January 2025, DR. RR. Sri Arini Winarti Rinawati, SKM, M.Kep, the head of the dental health department, drg. Yetti Lusiani, M. Kes., the headmaster of Sekolah Dasar Negeri Bangun, Norsayan Naibaho s.Pd SD and the headmaster of Sekolah Dasar negeri Laehole, Mutiara Kudadiri, and the headmaster of sekolah dasar St.Yoseph Medan, Rikardo Sinaga S.Pd and the research team for the collaborative efforts in the research.

Ethical Permissions: This research complied with the ethical feasibility as the part of research activity. The researchers provided the principle of confidential information about the respondents. This research was held after the Research Ethics Commission of Poltekkes Kemenkes Medan No. 2307/KEPK/POLTEKKES KEMENKES MEDAN 2023.

Conflicts of Interests: Nothing is declared by the authors. Authors' Contribution: Kirana Patrolina Sihombing (First Author), Introduction Writer/Methodologist/ Main Researcher/ Statistical Analyst (60%); Irma Syafriani and Manta Rosma (Second and Third Author), Assistant Researcher/Discussion Writer (40%). Funding/Support: This study is funded by the Ministry of Health Republic of Indonesia and Medan Ministry of Health Polytechnic for the funding support with the grant number LB.01.02/01/0698/2023 under the research scheme of Flagship Basic Research of Higher Education Institutions.

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