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EFFECTIVENESS OF A DENTAL BOARD GAME ON PRESCHOOL CHILDREN'S ORAL HEALTH KNOWLEDGE

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Abstract

Background: *Preschool children continue to experience various oral health problems, while conventional health education may not always be aligned with how young children learn and develop. Game-based learning offers an interactive way to help children understand and engage with oral health information. A Dental Board Game was previously developed as an educational tool for preschool children, but its effectiveness in improving oral health knowledge has not been fully evaluated.*

Objective: *This study aimed to evaluate whether the Dental Board Game could improve oral health knowledge among preschool children.*

Methods: *The study involved 90 preschool children aged 3–5 years from two kindergartens in Tasikmalaya City, Indonesia, using a quasi-experimental pretest-posttest approach. An oral health knowledge questionnaire was completed before and immediately after the intervention. The intervention involved oral health education through interactive Dental Board Game activities. Knowledge categories and scores were summarized using statistical measures appropriate to the type of data. Data distribution was examined using the Shapiro-Wilk test, and changes in paired knowledge scores were subsequently analyzed using the Wilcoxon Signed-Rank Test.*

Results: *The mean oral health knowledge score increased from 51.44 ± 22.81 before the intervention to 86.22 ± 13.87 after the intervention. Analysis of the paired knowledge scores using the Wilcoxon Signed-Rank Test showed a statistically significant difference between pretest and posttest scores ($Z = -7.545$; $p < 0.001$).*

Conclusion: *The Dental Board Game significantly improved oral health knowledge among preschool children. This interactive educational tool may be used as an alternative approach to support oral health promotion in kindergarten settings.*

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Introduction

Early childhood represents an important period for establishing oral health knowledge and behaviors that may influence children's oral health throughout their lives (Chen et al., 2020). During the preschool years, children begin to develop greater independence in daily activities, including toothbrushing, food selection, and other oral hygiene practices, while remaining dependent on parents, caregivers, and educational environments for guidance and reinforcement of healthy behaviors (Khan et al., 2021). Consequently, early oral health promotion provides an important opportunity to introduce preventive concepts and establish positive oral health practices before unhealthy behaviors become firmly established (Bramantoro et al., 2021).

Maintaining good oral health during early childhood is important because oral health problems can affect children's daily activities and overall well-being. The consequences of poor oral health in children extend beyond dental conditions. Oral pain and discomfort may interfere with children's ability to eat, sleep, concentrate, and participate comfortably in daily and educational activities (Graziani and Tsakos, 2020). Therefore, oral health promotion in early childhood is important not only for preventing dental disease but also for supporting children's overall health, development, and quality of life. One important component of oral health promotion is the development of appropriate knowledge regarding toothbrushing, dietary habits, oral hygiene, and dental care, which can provide a foundation for healthy oral health practices.

Preschool age is a critical period for introducing oral health knowledge and establishing healthy habits. Children aged 3–5 years are still developing their cognitive, communication, and attention capacities. At this developmental stage, children tend to respond better to concrete experiences, visual stimuli, repetition, interaction, and play than to prolonged verbal explanations. Consequently, oral health education for preschool children requires educational approaches that are adapted to their developmental characteristics and are able to maintain children's attention and active participation.

Conventional oral health education, such as verbal explanations, lectures, posters, leaflets, or flash cards, may provide useful information but generally offers less opportunity for active interaction than game-based learning. Previous studies have shown that these conventional approaches can still improve children's oral health knowledge. However, preschool children may have difficulty maintaining attention when information is delivered mainly through passive listening or static educational materials. Educational media therefore play an important role in transforming health information into learning experiences that are more concrete, engaging, and appropriate for children's developmental characteristics. The selection of suitable educational media is consequently an important consideration in strengthening school-based oral health promotion.

Game-based learning offers a potential approach to address this challenge. Previous studies have explored the use of games as educational media for children's oral health. Shi et al. (2023), for example, compared conventional oral health education with a “Dental Truth or Dare” board game among 160 preschool children aged 3–4 and 5–6 years. The board game group demonstrated improved oral health knowledge across follow-up assessments, with the effects remaining above baseline at three months. Another study also reported the use of a dental board game to improve children's oral and dental health knowledge (Miko et al., 2024). These findings indicate that game-based approaches have been explored as educational media for children's oral health. However, the Dental Board Game evaluated in the present study had not previously been evaluated among preschool children aged 3–5 years in the kindergarten setting included in this study. Therefore, evaluating the Dental Board Game in this setting was necessary to determine whether it was associated with changes in children's oral health knowledge.

As a game-based learning medium, board games can integrate educational information with visual materials, questions, challenges, and interaction among players. Previous studies have reported promising applications of board games in children's oral health education. A study among preschool children found that the use of a board game was associated with better oral health knowledge and hygiene outcomes than conventional educational methods (Shi et al., 2023). A systematic review of randomized controlled trials also reported positive findings for game-based oral health education, suggesting that this approach may complement conventional methods (Patil et al.,

2024). These findings suggest that presenting oral health information through play may help children become more interested and actively involved in the learning process.

However, evidence supporting game-based oral health education in general does not necessarily establish the effectiveness of every educational game across different populations and settings. An educational tool may be developed and validated in terms of its content, design, and feasibility, but its effectiveness should also be evaluated in the specific target population and implementation context. This distinction is important because the effectiveness of an educational intervention may be influenced by children's age, educational context, game characteristics, and the way the intervention is implemented.

The Dental Board Game used in this study was previously developed and validated as an educational tool for preschool children (Miko, 2025). The game provides oral health information about tooth functions, healthy and cariogenic foods, appropriate toothbrushing time, proper toothbrushing techniques, oral hygiene, dental visits, and healthy daily habits. The activities use pictures, questions, simple challenges, discussion, and feedback to encourage children to take an active role in learning.

Although the Dental Board Game had been developed and validated previously, its effectiveness in increasing oral health knowledge among preschool children had not been adequately examined. This represents an important research gap because the development and validation of an educational medium do not necessarily demonstrate its effectiveness in producing measurable learning outcomes when implemented among its target users. Previous studies have reported promising findings regarding the use of board games and game-based approaches for children's oral health education. Shi et al. (2023), for example, reported improvements in oral health knowledge and hygiene outcomes among preschool children following a board game-based intervention. In addition, a systematic review of randomized controlled trials found that game-based oral health education could improve children's oral health knowledge and oral hygiene outcomes compared with conventional teaching (Patil et al., 2024).

Accordingly, this study examined whether participation in the Dental Board Game was associated with improved oral health knowledge among preschool children aged 3–5 years in Tasikmalaya City, Indonesia. The findings are expected to contribute to the evidence regarding board games as an engaging approach to school-based oral health education for young children.

Methods

Study Design, Population, and Sample
A one-group pretest-posttest quasi-experimental design was used to examine changes in children's oral health knowledge following participation in the Dental Board Game. The study was conducted among preschool children aged 3–5 years in two kindergartens in Tasikmalaya City, Indonesia, from May to July 2026. The study population consisted of children enrolled in the selected kindergartens who met the eligibility criteria. A total of 90 children were included in the study using total sampling.

The study was conducted at TK Sejahtera 4 and TK Al-Muttaqin II, Tasikmalaya City, Indonesia, during May–July 2026.

The study involved 90 preschool children aged 3–5 years, consisting of 60 children from TK Sejahtera 4 and 30 children from TK Al-Muttaqin II.

Total sampling was used, in which all eligible children in the two participating kindergartens were included as study participants. The accessible population consisted of 90 eligible children, and all 90 children were included in the study.

The inclusion criteria were children aged 3–5 years who were registered as students at the participating kindergartens, were able to participate in the learning activities, attended the pretest and posttest, and had obtained parental or guardian consent. The pretest and posttest were conducted on the same day. The children completed the pretest before the intervention, participated in the Dental Board Game session, and then completed the posttest immediately after the intervention.

Children who did not complete the assessment or were absent during the intervention were excluded from the analysis.

The intervention consisted of oral health education using the Dental Board Game, an interactive educational board game previously developed for preschool children.

The educational content delivered through the Dental Board Game covered six basic oral health topics: (1) tooth function; (2) healthy and unhealthy foods; (3) appropriate toothbrushing time; (4) correct toothbrushing technique; (5) maintaining oral hygiene; and (6) routine dental visits and healthy daily habits. The intervention used pictures, questions, simple challenges, discussion, and feedback to facilitate children's active participation during the learning activities. Each intervention session lasted approximately 30–45 minutes.

Each intervention session lasted approximately 30–45 minutes. Oral health knowledge was assessed using a structured questionnaire consisting of 10 questions related to children's oral health.

The questions were designed using simple language and visual support appropriate for preschool children. The use of developmentally appropriate educational and assessment materials is important when working with preschool children because their cognitive and communication abilities are still developing.

Knowledge was assessed before the intervention (pretest) and immediately after the intervention session (posttest), on the same day. The posttest was administered within [X] minutes after completion of the 30–45-minute Dental Board Game session.

The total knowledge score was classified into three categories: good, moderate, and poor, based on the predetermined scoring criteria.

Participant characteristics and oral health knowledge were summarized according to the type of data. Categorical variables were presented as frequencies and percentages, whereas knowledge scores were summarized using the mean and standard deviation.

The total oral health knowledge score was treated as a numerical outcome and its distribution at the pretest and posttest assessments was examined using the Shapiro-Wilk test. The scores were not normally distributed; therefore, the non-parametric Wilcoxon Signed-Rank Test was used to compare the paired pretest and posttest knowledge scores. A p-value below 0.05 was considered statistically significant. Statistical analyses were performed using IBM SPSS Statistics.

Ethical clearance was obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Tasikmalaya. Parents or legal guardians provided written informed consent for their children's participation.

Results

A total of 90 preschool children participated in the study. Sixty participants (66.7%) were from TK Sejahtera 4, while 30 participants (33.3%) were from TK Al-Muttaqin II.

Table 1. Distribution of Participants by Research Location

Research location	n	%
TK Sejahtera 4	60	66.7
TK Al-Muttaqin II	30	33.3
Total	90	100.0

Most participants were from TK Sejahtera 4 (66.7%), while 33.3% were from TK Al-Muttaqin II.

Oral Health Knowledge Before and After the Intervention

Table 2. Distribution of Oral Health Knowledge Before and After the Intervention

Knowledge level	Pretest n (%)	Posttest n (%)
Good	20 (22.2)	67 (74.4)
Moderate	26 (28.9)	17 (18.9)
Poor	44 (48.9)	6 (6.7)
Total	90 (100.0)	90 (100.0)

Before the intervention, nearly half of the participants had poor oral health knowledge (48.9%), while only 22.2% had good knowledge.

Following the Dental Board Game intervention, the proportion of participants with good knowledge increased substantially to 74.4%. Meanwhile, the proportion with poor knowledge decreased from 48.9% to 6.7%.

This finding indicates a substantial shift in the distribution of oral health knowledge following the intervention.

Table 3. Descriptive Statistics of Oral Health Knowledge Scores

Knowledge score	n	Min	Max	Mean ± SD
Pretest	90	10	100	51.44 ± 22.81
Posttest	90	50	100	86.22 ± 13.87

The mean oral health knowledge score increased from 51.44 ± 22.81 before the intervention to 86.22 ± 13.87 after the intervention, representing an increase of 34.78 points.

The lower standard deviation observed in the posttest also indicates that the knowledge scores became more concentrated after the intervention.

Table 4. Comparison of Oral Health Knowledge Scores Before and After the Intervention

Comparison	Pretest Mean ± SD	Posttest Mean ± SD	Z	p-value
Oral health knowledge	51.44 ± 22.81	86.22 ± 13.87	−7.545	<0.001 *

The Shapiro–Wilk test was used to assess the distribution of the total oral health knowledge scores obtained from the pretest and posttest assessments. The results indicated that both pretest and posttest scores were not normally distributed ($p < 0.001$). Therefore, the Wilcoxon Signed-Rank Test was used to compare the paired pretest and posttest knowledge scores. The analysis showed a statistically significant difference in oral health knowledge scores between the two assessments ($Z = -7.545$; $p < 0.001$).

Discussion

The findings indicate that oral health knowledge increased following participation in the Dental Board Game. This change may be related to the interactive characteristics of the game, which provided children with opportunities to receive information through pictures, answer questions, respond to simple challenges, discuss the content, and receive feedback during the learning activity. These features may have made oral health information more concrete and easier for preschool children to engage with compared with learning approaches that rely primarily on passive information delivery. However, because this study used a one-group pretest-posttest design without a control group, the observed increase in knowledge cannot be attributed solely to the Dental Board Game. Other factors, such as repeated exposure to the questionnaire, interaction with teachers or researchers, or other learning experiences during the study period, may also have contributed to the observed change.

The findings of the present study are consistent with previous experimental studies examining game-based oral health education among children. Shi et al. (2023) evaluated a board game-based intervention, “Dental Truth or Dare,” among preschool children and reported improvements in oral health knowledge following the intervention. Similarly, Miko et al. (2024) reported the use of a dental board game as an educational approach to improve children's oral and dental health knowledge. These findings, together with the present results, suggest that game-based approaches can be used to deliver oral health information in a more interactive learning format for children. However, the specific Dental Board Game evaluated in the present study differs from the games used in previous studies, and its application in the present kindergarten setting had not previously been evaluated.

The improvement in oral health knowledge observed in the present study may be related to the interactive characteristics of the Dental Board Game. Unlike conventional health education approaches that may rely primarily on verbal explanations or passive information delivery, game-based learning allows children to actively participate in learning activities and interact with educational content. Previous research has suggested that game-based approaches may support children's engagement and learning during educational activities (Alotaibi, 2024). In the context of the present study, these interactive features may have contributed to the observed increase in oral health knowledge. However, attention, engagement, and memory were not directly measured in this study and therefore cannot be confirmed as mechanisms underlying the observed change.

The use of games may be particularly suitable for young children. Previous experimental studies have reported positive findings from game-

based oral health education among children. Shi et al. (2023), for example, evaluated a board game-based intervention among preschool children and reported improvements in oral health knowledge following the intervention. Similarly, Miko et al. (2024) reported that a dental board game could be used as an educational approach to improve children's oral and dental health knowledge. These findings provide empirical support for the use of game-based approaches to deliver oral health information to young children in an interactive learning environment.

Interaction and guidance from adults may have also supported the learning process. Skene et al. (2022), through a systematic review and meta-analysis, reported that guided play can support children's learning and development when appropriate adult guidance is provided. In the present study, researchers and teachers assisted the children during the game, explained questions when needed, and provided feedback on their responses. This support may have helped children better understand the oral health information presented during the activities.

These findings are consistent with previous experimental studies showing that game-based oral health education can improve children's oral health knowledge. Shi et al. (2023) reported improved oral health knowledge among preschool children following a board game-based intervention. Similarly, Miko et al. (2024) found that a dental board game could be used as an educational approach to improve children's oral and dental health knowledge. The consistency between these findings and the present study suggests that interactive game-based approaches may provide a useful format for delivering oral health information to young children.

Overall, the findings of this study indicate that oral health knowledge increased following participation in the Dental Board Game. The interactive features of the intervention, including visual materials, questions, play activities, and feedback, provided opportunities for children to participate actively during the learning session. However, because this study used a one-group pretest-posttest design without a comparison group, the observed increase in knowledge cannot be attributed solely to the Dental Board Game. Other factors, such as repeated exposure to the questionnaire, interaction with teachers or researchers, or other learning experiences during the study period, may also have contributed to the observed change. Therefore, the findings should be interpreted as an increase in knowledge following the intervention rather than definitive evidence of the effectiveness of the Dental Board Game.

The present findings therefore extend previous evidence by demonstrating a significant short-term improvement in oral health knowledge following the implementation of a Dental Board Game among preschool children aged 3–5 years. This is relevant because preschool children represent an important target population for oral health promotion. School and kindergarten settings provide opportunities to introduce preventive oral health messages before unhealthy habits become established, and systematic reviews have shown that school-based oral health promotion can produce positive effects across knowledge, behavior, and selected oral health outcomes (Bhadauria et al., 2024; Das et al., 2025).

The findings may be related to the interactive features of the Dental Board Game, which included visual materials, questions, simple challenges, discussion, and feedback during the learning session. These features provided opportunities for children to actively participate while receiving and responding to oral health information. Similar findings have been reported in previous experimental studies using game-based oral health education among children (Shi et al., 2023; Miko et al., 2024). However, the present study did not directly measure children's engagement, attention, or other learning processes; therefore, these factors should be considered possible explanations rather than confirmed mechanisms for the observed increase in knowledge.

The findings also have implications for school-based oral health promotion in Indonesia. Previous research among Indonesian preschool children has demonstrated a high burden of early childhood caries and identified relationships between oral health practices, cariogenic food consumption, ECC, and oral health-related quality of life (Ramadhani et al., 2021). This reinforces the importance of preventive oral health education during the preschool period. The use of engaging educational media such as the Dental Board Game may complement existing school-based oral health promotion activities by providing an age-appropriate approach to introducing basic oral health concepts.

This study has several limitations that should be considered when interpreting the findings. First, the use of a one-group pretest–posttest design without a control group limits the ability to determine whether the observed improvement in knowledge was solely attributable to the Dental Board Game. During the study period, children may also have been exposed to oral health information from teachers, parents, or other sources. Therefore, a causal relationship between the intervention and the increase in knowledge cannot be established with certainty.

Second, the posttest assessment was administered immediately after the intervention. Consequently, the study primarily evaluated short-term changes in oral health knowledge and did not assess whether the improvement was sustained over time. Future studies should consider conducting follow-up assessments to examine the long-term retention of knowledge.

Third, the study involved children from only two kindergartens in Tasikmalaya City. The relatively limited study setting may reduce the generalizability of the findings to preschool children in other geographical areas or educational settings. Further research involving a larger and more diverse sample, preferably with a control or comparison group, is therefore warranted.

Fourth, the outcome measured in this study was oral health knowledge rather than behavioral or clinical outcomes. Improvement in knowledge does not necessarily translate directly into improved toothbrushing practices, dietary behavior, plaque control, or reduced dental caries. Evidence from school-based oral health programs indicates that educational interventions may improve knowledge and behavior, but the effects on clinical outcomes such as dental caries are less consistent (Bhadauria et al., 2024; Das et al., 2025). Despite this limitation, the findings have practical implications for school-based oral health promotion. The Dental Board Game may serve as an additional educational medium to complement conventional oral health education in kindergarten settings by providing an interactive approach to introducing basic oral health concepts. Its use should be accompanied by reinforcement from teachers, parents, and dental health professionals to support the translation of knowledge into daily oral health behaviors. Therefore, future studies should assess whether knowledge improvement following Dental Board Game exposure is accompanied by sustained behavioral changes and measurable improvements in oral health status.

Future studies should use randomized controlled trials or controlled quasi-experimental designs involving larger and more diverse populations. Longer follow-up periods are also needed to assess whether the improvement in knowledge is maintained over time. In addition, future research should examine whether increased knowledge is followed by changes in oral health behaviors, such as toothbrushing and dietary practices, as well as clinical outcomes such as plaque accumulation and dental caries. These approaches would provide stronger evidence regarding the long-term value of the Dental Board Game in preschool oral health promotion.

Conclusions and Recommendations

The Dental Board Game was associated with a significant improvement in oral health knowledge among preschool children. The interactive approach may provide an engaging way to introduce basic oral health information in kindergarten settings.

The Dental Board Game may therefore be considered as an alternative educational medium for school-based oral health promotion. Further research using comparison groups and longer follow-up periods is recommended to assess knowledge retention and determine whether improvements in knowledge are accompanied by changes in children's oral health behaviors.

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