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Tree of Knowledge Media: An Innovative Approach to Improving Cariogenic Food Knowledge Among Elementary

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ABSTRACT

Cariogenic foods contain fermentable carbohydrates, particularly sugars, that may contribute to dental caries when consumed frequently. Elementary school children require appropriate health education to improve their understanding of cariogenic foods. Attractive and interactive educational media may facilitate children's understanding of health information. The Tree of Knowledge is a visual educational medium that can be used to support dental health education. This study aimed to describe the level of knowledge about cariogenic foods before and after counseling using Tree of Knowledge media among third-grade students at SDN Baktijaya 3 Depok in 2026. A pre-experimental study with a one-group pretest-posttest design was conducted in April 2026 involving 86 third-grade students selected through random sampling from a population of 110 students. Data were collected using a 15-item multiple-choice questionnaire administered before and seven days after counseling. The intervention was delivered using Tree of Knowledge media in three small groups. Data were analyzed descriptively and presented as frequency distributions and percentages. Before the intervention, 48 students (55.8%) had poor knowledge and 38 students (44.2%) had moderate knowledge, with no students categorized as having good knowledge. After the intervention, 84 students (97.7%) had good knowledge, while 2 students (2.3%) had moderate knowledge, and none had poor knowledge. The mean knowledge score increased from 8.03 out of 15 (53.57%) before the intervention to 13.58 out of 15 (90.54%) after the intervention, representing an increase of 36.98 percentage points. The findings suggest that Knowledge Tree Media may be an effective educational approach for improving elementary school students' knowledge about cariogenic foods.

INTRODUCTION

Dental caries is one of the common oral health problems among school-aged children. The consumption of sweet, sticky, and easily adherent foods is one of the factors associated with dental caries because such foods can remain on tooth surfaces and contribute to caries development (Andriani et al., 2024). In Indonesia, dental caries remains a public health concern, with the prevalence among children aged 10–14 years reaching 37.2% based on the 2023 Indonesian Health Survey (Kementerian Kesehatan Republik Indonesia, 2023)

Cariogenic foods contain sugars that can be fermented by oral bacteria and produce acids that contribute to tooth demineralization. The process may begin shortly after food consumption and can increase the risk of dental caries when cariogenic foods are consumed frequently (Sirat et al., 2025). Knowledge about cariogenic foods is therefore important for school-aged children as part of efforts to prevent dental caries. Previous research showed that children aged 6–12 years still had limited knowledge regarding cariogenic foods and their relationship with dental caries (Melinda et al., 2022).

Health education is one approach that can be used to improve children's knowledge about cariogenic foods. Previous research has shown that counseling using educational media can improve children's knowledge about cariogenic foods. The use of appropriate and attractive educational media is particularly important for elementary school children because it can make health information easier to understand (Andreastiti & Widodo, 2023).

Educational media that are visually attractive and interactive may increase students' attention and participation during the learning process. Several studies have investigated visual learning media for dental health education. Pop-up books, for example, have been reported as an educational medium for improving

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elementary school students' knowledge about cariogenic food consumption (Ananta et al., 2025). Scrapbook-based educational media have also been investigated for improving children's knowledge about cariogenic foods (Andreastiti & Widodo, 2023). These studies indicate that visual educational media can support dental health education through different formats.

The Tree of Knowledge is another visual educational medium that may complement these previously studied approaches. The medium uses a tree-shaped visual structure in which information can be organized around a central topic and related concepts. Unlike a book-based medium that is primarily organized through pages or a scrapbook that combines selected visual materials, the tree-based structure allows the main topic and supporting information to be presented within a single visual framework. Its use may therefore provide an alternative way of organizing educational information while incorporating an interactive learning activity. However, the present study did not directly compare Tree of Knowledge with pop-up books or scrapbooks; therefore, its effectiveness should not be interpreted as superior to those media.

The use of visual media is also relevant to the characteristics of elementary school children. Children at this age are generally in the concrete operational stage of cognitive development, in which concrete objects, visual representations, and direct experiences can help them understand information more easily (Marinda, 2020). Previous research has also shown that visual learning media can support students' understanding by presenting learning material in an attractive and structured form (Sumiadi et al., 2023). Therefore, Tree of Knowledge may provide an alternative approach to delivering information about cariogenic foods in an attractive and understandable manner.

METHOD

This study used a pre-experimental design with a one-group pretest-posttest approach. The study was conducted at SDN Baktijaya 3, Depok, in April 2026. The population consisted of 110 third-grade students from classes III A, III B, III C, and III D. A total of 86 students were selected as the research sample using random sampling based on the Slovin formula. The selection of respondents was conducted randomly using a spin wheel application by entering the names of all third-grade students until the required number of respondents was obtained.

The research instrument consisted of an informed consent form and a questionnaire containing 15 multiple-choice questions about cariogenic foods. The questionnaire was used to measure students' knowledge before and after the intervention. The knowledge score was calculated by dividing the number of correct answers by the total number of questions and multiplying the result by 100%. Knowledge was categorized as good for scores of 76–100%, moderate for scores of 56–75%, and poor for scores of $\leq$ 55% (Arikunto, 2017).

The Tree of Knowledge is a visual educational medium designed in the form of a tree, consisting of a trunk, branches, and leaf components made from thick cardboard. The medium measures approximately 100 × 60 cm and presents illustrated information about cariogenic foods, examples of foods associated with dental caries, and foods that support dental health, with the branches used to organize the material into related subtopics. The use of images and colors was intended to make the educational material more visually accessible to elementary school students, while the interactive component involved students selecting and attaching pictures of cariogenic foods to the Tree of Knowledge.

The intervention was conducted once and delivered in three small groups consisting of 29, 29, and 28 students, respectively. The researcher was assisted by sixth-semester dental health students who had received standardized instructions regarding the research procedures. Each group received the same counseling material about cariogenic foods using the Tree of Knowledge media.

During the first visit, the selected students completed the 15-item pretest within 10 minutes. This was followed by approximately 20 minutes of counseling on cariogenic foods using the Tree of Knowledge. The counseling covered the definition and characteristics of cariogenic foods, types and examples of cariogenic foods, and their potential effects on dental health. At the end of the counseling session, an interactive quiz was conducted, followed by an activity in which students selected and attached pictures of cariogenic foods to the Tree of Knowledge. Students were also encouraged to ask and answer questions during the counseling session.

The posttest was administered during the second visit, seven days after the intervention, using the same questionnaire. Students were given 10 minutes to complete the posttest. After data collection, the researcher checked the completeness of the questionnaires, recorded the responses, and prepared the data for analysis. The collected data were analyzed descriptively and presented as frequency distributions, percentages, and mean knowledge scores to describe changes in students' knowledge before and after counseling using the Tree of Knowledge media.

RESULT

A total of 86 third-grade students participated in the study. Students' knowledge about cariogenic foods was assessed before and seven days after counseling using Tree of Knowledge media. The results are presented in Table 1 and Table 2.

Table 1. Comparison of Students' Knowledge about Cariogenic Foods Before and After Counseling Using Tree of Knowledge

Knowledge category	Before counseling, n (%)	After counseling, n (%)
Good	0 (0.0)	84 (97.7)
Moderate	38 (44.2)	2 (2.3)
Poor	48 (55.8)	0 (0.0)
Total	86 (100)	86 (100)

Before the counseling intervention, most students had poor knowledge about cariogenic foods. As shown in Table 1, 48 students (55.8%) were categorized as having poor knowledge, while 38 students (44.2%) had moderate knowledge. None of the students were categorized as having good knowledge. The mean knowledge score was 8.03 out of 15, corresponding to a mean percentage of 53.57% (Table 2).

Table 2. Mean Knowledge Score and Percentage Before and After Counseling

Knowledge score	Pretest	Posttest
Mean score	8.03	13.58

Following counseling using Tree of Knowledge media, the mean knowledge score increased from 8.03 in the pretest to 13.58 in the posttest. This represented an increase of 5.55 points in the mean knowledge score, indicating an improvement in students' knowledge about cariogenic foods following the counseling intervention.

DISCUSSION

The results showed that before counseling, most third-grade students at SDN Baktijaya 3 Depok had poor knowledge about cariogenic foods. Of the 86 respondents, 48 students (55.8%) were categorized as having poor knowledge, while 38 students (44.2%) had moderate knowledge. None of the students had good knowledge. This finding indicated that the students had limited understanding of cariogenic foods before receiving the educational intervention. Limited knowledge may affect children's ability to recognize foods that can contribute to dental caries and understand the importance of choosing foods that support dental health (Melinda et al., 2022).

The low level of knowledge observed before the intervention also indicated the importance of providing dental health education to elementary school children. Children may not fully understand the relationship between food consumption and dental caries without adequate information. Cariogenic foods, particularly sweet and sticky foods, may remain on tooth surfaces and contribute to the development of dental caries (Andriani et al., 2024). Therefore, providing appropriate information about cariogenic foods is an important part of preventive dental health education for school-aged children.

After counseling using Tree of Knowledge media, an increase in the proportion of students with good knowledge was observed. The number of students categorized as having good knowledge increased from 0 before counseling to 84 students (97.7%) after counseling. Meanwhile, the number of students with poor knowledge decreased from 48 students (55.8%) to none. This finding indicated that the students demonstrated a substantially higher level of knowledge after receiving the counseling intervention.

The observed increase was consistent with previous research on cariogenic food education among elementary school students. Ngatemi et al. reported an increase in students' knowledge following education about cariogenic foods as an effort to prevent dental caries. Their findings showed that the proportion of students with good knowledge increased after the educational intervention (Ngatemi et al., 2022). The similarity between the findings suggests that health education can be an important approach to improving children's understanding of cariogenic foods.

The use of Tree of Knowledge media may have contributed to the observed improvement in knowledge. The medium presented educational information through a visual and structured format, which may help students connect the educational content with examples that are familiar to them. Visual educational media may be particularly relevant for elementary school children because information

presented through concrete and visual representations can facilitate understanding during the learning process (Marinda, 2020).

The interactive component of the intervention may also have contributed to students' engagement with the material. During the counseling session, students participated in a quiz, answered questions, and selected and attached pictures of cariogenic foods to the Tree of Knowledge. These activities provided opportunities for students to actively process the information rather than only receive verbal explanations. Previous research has also reported that visual educational media using images can facilitate students' understanding of learning materials (Sumiadi et al., 2023).

The present finding can also be considered in relation to previously studied educational media. Pop-up books have been used to improve knowledge about cariogenic food consumption among elementary school students (Ananta et al., 2025) and recent research has also demonstrated the usefulness of pop-up books for improving dental caries knowledge (Faradiza et al., 2025). Scrapbook-based educational media have likewise been investigated in relation to children's knowledge about cariogenic foods (Andreastiti & Widodo, 2023). These findings indicate that visual media can support dental health education through different formats.

The Tree of Knowledge may complement these existing approaches because its visual organization allows educational information to be arranged around a central topic and related concepts within a single visual structure. Unlike book-based media that primarily present information sequentially through pages, the tree-based structure provides a visual relationship between the main topic and its supporting information. This type of visual organization may facilitate students' understanding of relationships among concepts (Yoo & Rha, 2015). However, the present study did not directly compare Tree of Knowledge with pop-up books or scrapbooks. Therefore, the findings should not be interpreted as evidence that Tree of Knowledge is superior to these media. Rather, the findings support its potential as an alternative visual medium for dental health education.

Another important consideration is the distinction between knowledge improvement and behavioral change. The present study measured knowledge using a questionnaire seven days after counseling; it did not measure changes in actual dietary intake, frequency of cariogenic food consumption, oral health practices, or dental caries incidence. Therefore, the substantial increase in knowledge observed in this study should not be interpreted as proof that students subsequently changed their dietary habits or experienced reduced caries risk. Previous evidence indicates that school-based oral health education can improve students' knowledge, attitudes, and behaviors, but evidence regarding improvements in dental caries remains inconclusive, particularly beyond the short term (Das et al., 2025). Longer follow-up is therefore needed to determine whether improvements in knowledge are sustained and translated into dietary and oral health behavior changes and, ultimately, improved oral health outcomes.

CONCLUSION

Tree of Knowledge media can be considered an alternative visual and interactive medium for delivering dental health education to elementary school students. Schools are encouraged to provide dental health education regularly using age-appropriate educational media, while future studies are recommended to use a control group and inferential statistical analysis to further evaluate the effect of Tree of Knowledge media on students' knowledge.

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