



Empowering Elementary School Students as Young Dental Health Cadres through the Senyumku Sehat Program

Pemberdayaan Siswa Sekolah Dasar sebagai Kader Kesehatan Gigi Cilik melalui Program Senyumku Sehat

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ABSTRACT

Oral health promotion among school-aged children requires approaches that improve knowledge while encouraging active participation. The Senyumku Sehat Program aimed to evaluate changes in oral health knowledge and establish Young Dental Health Cadres as a school-based empowerment mechanism. This community service program involved 176 students from Grades 1–4 at MI PSM Gempolan 2, Kediri Regency, Indonesia, using a one-group pre-test–post-test design. Knowledge was assessed using a ten-item questionnaire before and immediately after interactive oral health education. The overall median score increased from 45 to 65, with all participants achieving higher post-test scores ($Z = -12.047$, $p < 0.001$; $r = 0.91$). Significant improvements occurred in all grades (all $p < 0.001$). Knowledge gains differed significantly across grade levels ($H = 16.82$, $p < 0.001$), with Grade 4 demonstrating significantly greater gains than Grades 1–3. Eight students were established as Young Dental Health Cadres for one academic year under teacher supervision, supported by cadre pins, a rotating trophy, and a guidance book as planned continuity mechanisms. The program was associated with substantial immediate knowledge improvement while establishing a structured school-based cadre mechanism. Longitudinal evaluation is required to assess knowledge retention, cadre effectiveness, and program sustainability.

Keywords: dental health cadres; elementary school students; forensic odontology; oral health education; school-based health promotion.

Abstrak. Promosi kesehatan gigi dan mulut pada anak usia sekolah memerlukan pendekatan yang tidak hanya meningkatkan pengetahuan, tetapi juga mendorong partisipasi aktif. Program Senyumku Sehat bertujuan untuk mengevaluasi perubahan pengetahuan mengenai kesehatan gigi dan mulut serta membentuk Kader Kesehatan Gigi Cilik sebagai mekanisme pemberdayaan berbasis sekolah. Program pengabdian kepada masyarakat ini melibatkan 176 siswa kelas 1–4 di MI PSM Gempolan 2, Kabupaten Kediri, Indonesia, dengan menggunakan desain one-group pre-test–post-test. Pengetahuan diukur menggunakan kuesioner yang terdiri atas sepuluh butir sebelum dan segera setelah pemberian edukasi kesehatan gigi dan mulut secara interaktif. Skor median keseluruhan meningkat dari 45 menjadi 65, dengan seluruh peserta menunjukkan skor post-test yang lebih tinggi ($Z = -12,047$, $p < 0,001$; $r = 0,91$). Peningkatan yang signifikan terjadi pada seluruh tingkat kelas (semua $p < 0,001$). Peningkatan pengetahuan juga berbeda secara signifikan antarjenjang kelas ($H = 16,82$, $p < 0,001$), dengan siswa kelas 4 menunjukkan peningkatan yang secara signifikan lebih besar dibandingkan siswa kelas 1–3. Delapan siswa ditetapkan sebagai Kader Kesehatan Gigi Cilik selama satu tahun ajaran di bawah supervisi guru, dengan dukungan berupa pin kader, piala bergilir, dan buku panduan sebagai mekanisme keberlanjutan program yang telah direncanakan. Program ini berkaitan dengan peningkatan pengetahuan secara langsung yang substansial sekaligus berhasil membentuk mekanisme kader berbasis sekolah yang terstruktur. Evaluasi longitudinal diperlukan untuk menilai retensi pengetahuan, efektivitas kader, dan keberlanjutan program.

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Kata kunci: kader kesehatan gigi; siswa sekolah dasar; odontologi forensik; pendidikan kesehatan gigi dan mulut; promosi kesehatan berbasis sekolah.

INTRODUCTION

Oral health remains an important public health concern in Indonesia, particularly among children, as oral diseases can interfere with eating, speaking, learning activities, and overall quality of life. The 2023 Indonesian Health Survey reported that 56.9% of the Indonesian population aged three years and older experienced oral and dental health problems, indicating a substantial population-level burden (Health Development Policy Agency, 2024). These conditions highlight the importance of establishing preventive behaviors from childhood, when knowledge, attitudes, and daily oral hygiene habits are still developing. Oral health promotion during this period should therefore extend beyond the delivery of information by encouraging children to understand and practice appropriate oral health behaviors within their everyday environment (Nurmalasari et al., 2025; Sosiawan et al., 2022).

Schools provide a strategic setting for oral health promotion because health education can be integrated into an environment where children learn, interact, and develop habits together. Evidence from systematic reviews and meta-analyses indicates that school-based oral health interventions can improve oral health knowledge, attitudes, behaviors, and oral hygiene outcomes among children (Dadipoor et al., 2023; Gurav et al., 2022; Kim, 2024). Various educational methods, including demonstrations, visual materials, games, presentations, and interactive activities, have also been used to support oral health education among school-aged children (Setiawan et al., 2025a; Gurav et al., 2022; Khafid et al., 2025). However, improvements observed following short-term educational interventions may not necessarily persist over time. Kim, 2024 emphasized the importance of repetition, reinforcement, contextual adaptation, and sustainability when designing school-based oral health education. These considerations highlight the need for programs that extend beyond one-time educational activities by incorporating mechanisms intended to support continued student participation within the school environment.

One approach is to reposition students from passive recipients of health information into active participants in school-based health promotion. Peer-based health education provides opportunities for students to reinforce health messages within their social environment and participate in promoting healthy practices. A global systematic review has demonstrated the broad application of peer education within school health interventions (Dodd et al., 2022; Setiawan et al., 2026; Lukis et al., 2025), while a systematic review specifically addressing oral health reported the potential of student peer-led interventions to improve oral health outcomes among school children (Elsadek et al., 2023). Within this framework, Young Dental Health Cadres may serve as school-based peer agents who reinforce simple preventive messages, encourage appropriate oral hygiene practices, and communicate oral health concerns that require assistance from teachers, parents, or dental health professionals. Their role remains educational and supportive rather than clinical, thereby maintaining clear boundaries between student participation and professional dental care (Setiawan et al., 2026; Setiawan et al., 2025a).

The present community service initiative was implemented at MI PSM Gempolan 2, Gempolan Village, Gurah District, Kediri Regency, as part of the 2026 student community engagement program of Institut Ilmu Kesehatan Bhakti Wiyata. The school was located within the designated community service area and provided an appropriate setting for a school-based empowerment program involving students from multiple elementary grade levels. This setting enabled the delivery of a common oral health educational framework while allowing knowledge changes to be evaluated across different grade levels. Collaboration with the school also provided an opportunity to extend the program beyond a single educational session through the planned establishment of Young Dental Health Cadres and a school-based continuity mechanism. Thus, the school served as an operational setting in which oral health education, student empowerment, and planned cadre regeneration could be incorporated within a single community service model.

The concept of Young Dental Health Cadres may also provide an opportunity to introduce children to the responsible communication of oral health information. Within this program, children were positioned as peer agents rather than clinical examiners and were encouraged to communicate oral health concerns appropriately to teachers, parents, or dental health professionals when further

assistance was required. This approach does not transfer clinical or documentation responsibilities to children but may provide an early foundation for recognizing that oral health information has value and should be communicated responsibly.

This perspective may be conceptually related to dental information governance, although this aspect was not directly evaluated in the present program. Professional dental records contain longitudinal oral health information whose future usefulness depends on appropriate documentation, maintenance, and retrievability. Previous studies have highlighted the importance of dental record-keeping and the broader value of well-maintained dental information (Baqai et al., 2023; Prakosa et al., 2026; Setiawan et al., 2025b; Setiawan et al., 2026). In the context of the present program, however, dental information governance represents a broader professional perspective rather than an outcome of the school-based intervention.

The broader value of professionally documented dental information is also relevant to forensic odontology. Dental identification relies on the comparison of antemortem dental information with postmortem findings, and recorded characteristics such as dental charts, radiographs, restorations, missing teeth, and prosthetic treatments may provide valuable comparative information for human identification (Emam, 2024; Wood & Gardner, 2024). Thus, the potential forensic value of dental information depends partly on the availability and quality of records established before identification is required. However, forensic identification was not an outcome evaluated in the present program and is considered only as a broader downstream relevance of appropriately maintained dental information.

Within this broader perspective, forensic readiness may be considered a downstream conceptual implication of responsible dental information practices rather than an outcome of the present program. The Senyumku Sehat Program did not train students in forensic identification, clinical dental documentation, or odontogram interpretation; instead, its measurable focus remained on oral health knowledge and student empowerment. Early awareness of the value and responsible communication of oral health information may provide a foundation for appreciating dental information as part of an individual's health history, while its subsequent professional documentation and governance may contribute to its potential clinical, medico-legal, and forensic utility (Setiawan et al., 2026; Ruth et al., 2025; Setiawan et al., 2025a; Setiawan et al., 2025b).

Based on these considerations, the Senyumku Sehat Program was designed as a school-based student empowerment initiative that extended beyond conventional oral health counseling. The program integrated interactive oral health education, practical learning activities, and pre-test and post-test knowledge assessment with the establishment of Young Dental Health Cadres. Unlike a one-time educational activity, the cadre component incorporated a one-academic-year role, teacher supervision, a program guidance book, dedicated cadre pins, and a rotating trophy as planned mechanisms for cadre recognition and regeneration. This integrated model was designed to provide a structured pathway for continued student participation and school-led cadre regeneration after completion of the initial community service activity, while recognizing that its long-term sustainability requires further evaluation.

LITERATURE OR CONCEPTUAL REVIEW

School-based oral health promotion provides an important opportunity to develop oral health knowledge and preventive practices during a formative stage of childhood. Schools provide an environment in which oral health messages can be introduced and reinforced through interaction with teachers and peers. Evidence from systematic reviews and meta-analyses indicates that school-based oral health interventions can improve children's knowledge, attitudes, oral hygiene practices, and oral health outcomes (Dadipoor et al., 2023; Gurav et al., 2022; Kim, 2024). The potential benefits of these interventions may be strengthened when students actively participate in the learning process rather than receiving information passively. Educational approaches incorporating demonstrations,

practical activities, visual materials, and peer interaction may support children's understanding and application of oral health messages in their daily practices (Gurav et al., 2022).

This perspective supports a shift from viewing students solely as recipients of health information toward positioning them as active participants in school-based health promotion. Peer-led approaches utilize existing social relationships among students to reinforce health messages and encourage participation in healthy practices. Dodd et al., 2022 demonstrated the potential of peer education across various school health interventions, while Elsadek et al., 2023 specifically identified the potential value of student peer-led approaches in promoting oral health among school children. Within this framework, Young Dental Health Cadres may function as peer agents who reinforce simple preventive messages, encourage appropriate oral hygiene practices, and encourage their peers to communicate oral health concerns to teachers, parents, or dental health professionals when necessary. Their role remains educational and supportive rather than clinical; children are not positioned as dental examiners, diagnosticians, or providers of treatment.

The potential contribution of a school-based cadre model should also be considered in relation to program continuity. Improvements following educational interventions may diminish when reinforcement is discontinued, making continued engagement an important consideration in school-based oral health programs (Kim, 2024). A cadre system may provide a mechanism for maintaining program visibility by embedding oral health promotion activities within the school environment rather than relying entirely on external facilitators. Recognition mechanisms may further support the visibility and identity of the cadre role. In the Senyumku Sehat Program, dedicated cadre pins and a rotating trophy were therefore incorporated as planned recognition mechanisms to support cadre continuity and regeneration across subsequent student cohorts. The rotating trophy was conceptualized not merely as an award but as a visible symbol of cadre recognition and planned regeneration within the school. However, these components represent planned continuity mechanisms rather than evidence of established long-term sustainability or cadre effectiveness, both of which require longitudinal evaluation.

The concept of student empowerment may also extend beyond preventive practices toward an early appreciation of oral health information. Oral health literacy includes the ability to obtain, understand, communicate, and appropriately use information related to oral health. Within a school-based cadre framework, this may involve recognizing oral health concerns, communicating them appropriately, and seeking assistance from responsible adults or health professionals when necessary. Such activities may introduce children to the principle that oral health information has value and should be communicated responsibly. This does not imply that elementary school students are responsible for creating or managing professional dental records, as these responsibilities remain within the scope of dental professionals. Rather, the cadre framework may provide an early educational foundation for recognizing oral health information as part of an individual's broader health history.

This perspective may be conceptually related to dental information governance, although this aspect lies beyond the outcomes directly evaluated in the present program. The long-term value of professional dental information depends on its completeness, accuracy, preservation, accessibility, and retrievability. Baqai et al., 2023 highlighted deficiencies in dental record-keeping practices despite practitioners' recognition of the importance of maintaining dental information. From this broader perspective, appropriate professional documentation and information governance contribute to preserving the clinical, legal, and potential secondary value of dental information.

The secondary value of professionally documented dental information is particularly relevant to forensic odontology. Dental identification relies on the comparison of antemortem dental information with postmortem findings, and its utility depends partly on the availability and quality of records established before an identification need arises. Recorded characteristics such as dental charts, radiographs, restorations, missing teeth, prostheses, and other distinctive dental features may provide valuable comparative information for individual identification (Emam, 2024; Wood & Gardner, 2024). Thus, the potential forensic value of dental information reinforces the broader importance of

appropriate professional documentation and preservation, although forensic identification itself was not evaluated as an outcome of the present program.

Within this broader framework, forensic readiness may be considered a downstream conceptual implication of responsible dental information practices rather than an outcome of the Senyumku Sehat Program. The program did not involve forensic identification, clinical dental documentation, or odontogram interpretation; its primary focus remained school-based oral health education and student empowerment through Young Dental Health Cadres. Early awareness of the value and responsible communication of oral health information may provide a foundation for appreciating dental information as part of an individual's health history, while its subsequent professional documentation, preservation, and governance determine its potential clinical, medico-legal, and forensic utility (Setiawan et al., 2026; Setiawan & Rosandi, 2025). Thus, forensic readiness is positioned only as a broader downstream relevance of professionally managed dental information and was not directly evaluated in the present program.

MATERIAL AND METHODS

The Senyumku Sehat Program was conducted as a school-based community service program using a one-group pre-test–post-test evaluation design to assess changes in students' oral health knowledge following the educational intervention. The program was implemented on August 10, 2026, at MI PSM Gempolan 2, Gempolan Village, Gurah District, Kediri Regency, East Java, Indonesia, as part of the 2026 student community engagement program of Institut Ilmu Kesehatan Bhakti Wiyata. A total of 176 students from grades one to four participated in the program, comprising 36 students from grade one, 52 from grade two, 52 from grade three, and 36 from grade four. The program was supervised by faculty supervisors and implemented with the involvement of students participating in the community engagement program.

This activity was conducted as a school-based community service and program evaluation rather than as a clinical research study. No clinical examination, invasive procedure, diagnosis, or treatment was performed as part of the evaluation. The activity was implemented with permission from the participating school, and the pre-test and post-test data were used to evaluate the educational program and analyzed without reporting personally identifiable information. Formal ethical clearance was not obtained for this community service activity.

The intervention was delivered through the Senyumku Sehat Program, which combined interactive oral health education with practical learning activities appropriate for elementary school students. Educational content included basic oral and dental hygiene, appropriate toothbrushing practices, healthy dietary habits related to dental health, recognition of common oral health problems, and appropriate actions when dental problems occur. Educational delivery incorporated simple explanations, visual learning materials, interactive communication, and practical demonstrations to encourage active student participation. The program positioned children not only as recipients of oral health information but also as potential peer agents capable of reinforcing simple preventive messages within the school environment. The role introduced to students remained educational and supportive and did not include clinical examination, diagnosis, treatment, or other professional dental procedures.

Students' oral health knowledge was evaluated immediately before and after the educational activities using a ten-item questionnaire developed by the program team based on the educational content delivered in the Senyumku Sehat Program. The questionnaire covered the principal knowledge domains addressed during the intervention, including oral and dental hygiene, appropriate toothbrushing practices, dietary habits related to dental health, recognition of common oral health problems, and appropriate actions when dental problems occur. The questionnaire was developed specifically as a program-evaluation instrument to assess immediate changes in knowledge following the educational intervention. Formal psychometric validation and reliability testing of the

questionnaire had not been conducted prior to its use; therefore, the instrument should be interpreted as a program-specific knowledge assessment rather than a previously validated standardized questionnaire. Each correct response was assigned a score of 10, while an incorrect response received a score of 0, resulting in a total knowledge score ranging from 0 to 100. Higher scores indicated greater oral health knowledge. The same questionnaire and scoring procedure were used for the pre-test and post-test to allow paired comparison of individual scores before and after the intervention. Pre-test scores represented baseline knowledge before receiving the educational material, whereas post-test scores represented knowledge immediately following completion of the educational activities. The evaluation was conducted for all participating students, allowing changes in knowledge to be assessed both for the overall participant group and according to grade level.

Student empowerment was further implemented through the establishment of Young Dental Health Cadres. Following completion of the educational and evaluation activities, eight students were randomly selected from the participating students to serve as Young Dental Health Cadres. Random selection was used to provide participating students with an equal opportunity to be appointed as cadres rather than selecting them solely on the basis of their post-test performance. The selected cadres were introduced as peer agents with educational and supportive roles, including reinforcing simple oral health messages, encouraging appropriate toothbrushing and oral hygiene practices, and communicating oral health concerns to teachers, parents, or dental health professionals when necessary. Their role did not include clinical examination, diagnosis, treatment, or professional dental documentation. The cadres were assigned to serve for one academic year under the supervision of school teachers, particularly the teacher responsible for the School Health Unit (UKS). Cadre recognition was symbolized through dedicated cadre pins, while a rotating trophy was provided as a school-level recognition mechanism intended to support cadre regeneration across subsequent student cohorts. At the end of the cadre period, the school is expected to select a new group of cadres using the program guidance book as a reference. The cadre pins, rotating trophy, and planned annual regeneration were therefore incorporated as continuity mechanisms rather than as evidence of established long-term program sustainability.

Quantitative data from the pre-test and post-test assessments were analyzed descriptively and inferentially. Continuous scores were summarized using measures of central tendency and dispersion. The distribution of the paired score differences was assessed for normality using the Shapiro–Wilk test. Because the data did not meet the assumption of normality, differences between pre-test and post-test scores were analyzed using the Wilcoxon signed-rank test. The analysis was initially performed for all 176 participants and subsequently stratified by grade level to determine whether significant knowledge improvement occurred in grades one, two, three, and four. The effect size for the overall pre-test–post-test comparison was calculated as $r = |Z|/\sqrt{N}$. Changes in scores were calculated as the difference between individual post-test and pre-test scores, and differences in knowledge gains across the four independent grade groups were evaluated using the Kruskal–Wallis test. When the Kruskal–Wallis test indicated a statistically significant difference, post-hoc pairwise comparisons between grade levels were performed using Dunn’s test with Bonferroni correction for multiple comparisons. Statistical significance was established at $p < 0.05$. All statistical analyses were performed using International Business Machines Corporation Statistical Package for the Social Sciences (IBM SPSS) Statistics version 25.0 (IBM Corp., Armonk, NY, USA).

RESULTS

Participant Characteristics

A total of 176 students from grades one to four at MI PSM Gempolan 2 participated in the Senyumku Sehat Program and completed both the pre-test and post-test assessments. Participants consisted of 36 students from grade one, 52 students from grade two, 52 students from grade three,

and 36 students from grade four. Thus, grades two and three represented the largest groups, each accounting for 29.5 percent of the participants, while grades one and four each accounted for 20.5 percent. All paired pre-test and post-test data were included in the analysis. The distribution of participants according to grade level is presented in Table 1.

Table 1. Distribution of participants by grade level (n=176)

Grade level	n	%
Grade 1	36	20.5
Grade 2	52	29.5
Grade 3	52	29.5
Grade 4	36	20.5
Total	176	100.0

Overall Improvement in Oral Health Knowledge

The Senyumku Sehat Program produced a clear improvement in students' oral health knowledge. The overall median pre-test score was 45, with an interquartile range of 40–50, and increased to 65, with an interquartile range of 60–70, following the educational intervention. Notably, all 176 participants achieved higher post-test scores than their corresponding pre-test scores; no participant had an unchanged or decreased score. Because the score distribution did not meet the assumption of normality, differences between paired pre-test and post-test scores were evaluated using the Wilcoxon signed-rank test. The analysis demonstrated a statistically significant increase in oral health knowledge following participation in the program ($Z = -12.047$, $p < 0.001$), with a large effect size ($r = 0.91$). The distribution of positive, negative, and tied ranks further demonstrated the consistency of the improvement, with 176 positive ranks, no negative ranks, and no ties (see Table 2).

Table 2. Overall pre-test and post-test oral health knowledge scores

Measurement	n	Median	IQR	Minimum–Maximum
Pre-test	176*	45	40–50	20–70
Post-test	176*	65	60–70	30–100

Note: Wilcoxon signed-rank test: $Z = -12.047$; $p < 0.001$; effect size $r = 0.91$.

The overall improvement in knowledge is visually presented in Figure 1A. It illustrates the upward shift in students' knowledge scores following the educational intervention from 46.36 ± 11.13 to 66.82 ± 13.82 .

Knowledge Improvement Across Grade Levels

When the analysis was stratified by grade level, improvements in oral health knowledge were consistently observed across all four groups. In Grade 1, the median score increased from 40 to 60, while the mean $\pm$ SD increased from 43.33 ± 9.56 to 62.22 ± 9.29 . In Grade 2, the median score increased from 40 to 60, with the mean $\pm$ SD increasing from 46.15 ± 10.13 to 66.15 ± 11.57 . In Grade 3, the median score increased from 40 to 60, with the mean $\pm$ SD increasing from 46.15 ± 9.32 to 65.38 ± 8.51 . In Grade 4, the median score increased from 50 to 70, while the mean $\pm$ SD increased from 50.00 ± 15.12 to 74.44 ± 21.97 . Wilcoxon signed-rank tests demonstrated statistically significant improvements between pre-test and post-test scores within all four grade levels (all $p < 0.001$). The mean knowledge gains were 18.89 points in Grade 1, 20.00 points in Grade 2, 19.23 points in Grade

3, and 24.44 points in Grade 4. Thus, Grade 4 showed the greatest mean numerical improvement following the intervention. The grade-specific results are summarized in Table 3 and Figure 1B–C.

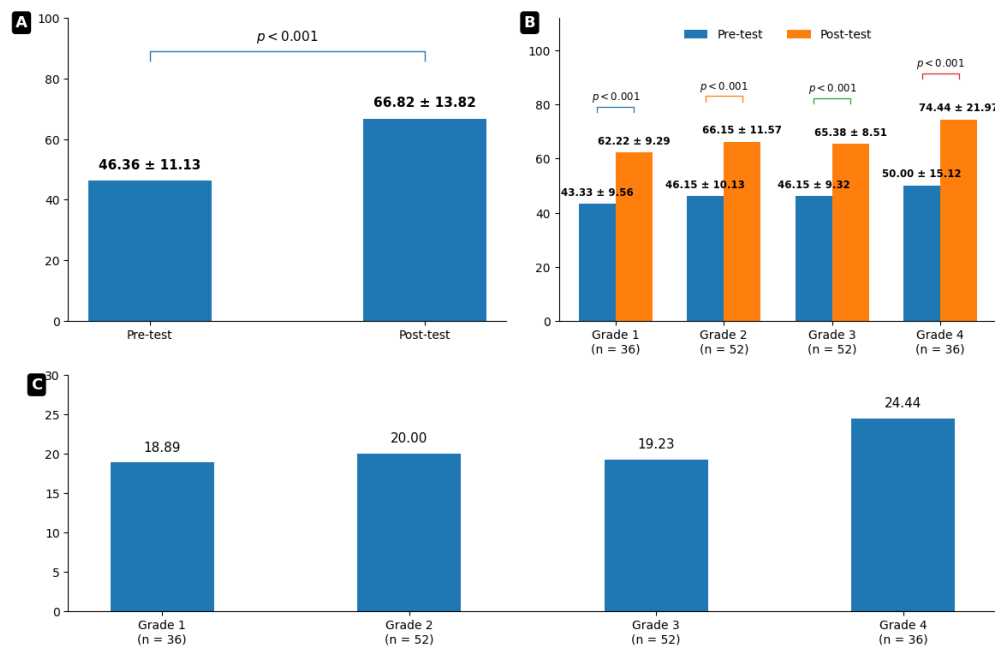


Figure 1. Changes in oral health knowledge scores following the Senyumku Sehat Program: (A) overall pre-test and post-test mean scores; (B) pre-test and post-test mean scores according to grade level; and (C) mean changes in knowledge scores across grade levels. Values in panels A and B are presented as mean ± standard deviation. Paired pre-test–post-test comparisons were analyzed using the Wilcoxon signed-rank test, while differences in change scores across grade levels were evaluated using the Kruskal–Wallis test followed by Dunn post-hoc comparisons.

Table 3. Changes in oral health knowledge scores according to grade level

Grade	n	Pre-test Median (IQR)	Post-test Median (IQR)	Median change	Mean change	p-value*
Grade 1	36	40 (40–50)	60 (60–70)	20	18.89	<0.001*
Grade 2	52	40 (40–50)	60 (60–70)	20	20.00	<0.001*
Grade 3	52	40 (40–50)	60 (60–70)	20	19.23	<0.001*
Grade 4	36	50 (40–60)	70 (70–100)	20	24.44	<0.001*

Note: * Wilcoxon signed-rank test comparing pre-test and post-test scores within each grade. Differences in change scores across grade levels were evaluated using the Kruskal–Wallis test ($H = 16.82$, $p < 0.001$), followed by Dunn post-hoc comparisons.

Comparison of Knowledge Gains Across Grade Levels

To determine whether the magnitude of knowledge improvement differed according to grade level, change scores were calculated as the difference between individual post-test and pre-test scores. Because the change scores were not normally distributed and the four grade groups were independent, differences in knowledge gains were evaluated using the Kruskal–Wallis test. The analysis demonstrated a statistically significant difference in knowledge gains across grade levels ($H = 16.82$, $p < 0.001$). Post-hoc pairwise comparisons using Dunn’s test with Bonferroni correction showed that Grade 4 had significantly greater knowledge gains than Grade 1 (adjusted $p = 0.002$), Grade 2 (adjusted $p = 0.019$), and Grade 3 (adjusted $p = 0.002$). No statistically significant differences were observed among Grades 1, 2, and 3 (all adjusted $p > 0.05$). Grade 4 also demonstrated the highest mean knowledge gain at 24.44 points, compared with 18.89 points in Grade 1, 20.00 points in Grade 2, and 19.23 points in Grade 3 (Figure 1C). These findings indicate that although significant knowledge improvement occurred in all grade levels, Grade 4 demonstrated a significantly greater magnitude of improvement than the other three grades.

Establishment of Young Dental Health Cadres

Beyond knowledge improvement, the program incorporated student empowerment through the establishment of Young Dental Health Cadres. Following the educational and evaluation activities, eight students were randomly selected from the participants to serve as cadres for one academic year. The selected students were introduced as peer agents with educational and supportive roles in reinforcing simple oral health messages and encouraging appropriate oral hygiene practices within the school environment. Their activities were planned to be supervised by school teachers, particularly the teacher responsible for the School Health Unit (UKS). Cadre recognition included dedicated cadre pins and a rotating trophy, providing a visible identity and recognition mechanism for the selected students (Figure 2). The rotating trophy was intended to support annual cadre regeneration, with the school expected to select a new group of cadres for subsequent cohorts using the program guidance book as a reference. Thus, while the present evaluation assessed immediate changes in oral health knowledge, the cadre system, supervision, recognition, and planned regeneration were incorporated as continuity mechanisms for school-based oral health promotion rather than as evidence of established long-term program sustainability.



Figure 2. Recognition of selected students as young dental health cadres through the Senyumku Sehat Program.

Program Implementation and Student Engagement

The educational activities were implemented through interactive learning that combined oral health education, practical demonstrations, and direct engagement between facilitators and students. The educational content covered appropriate toothbrushing practices, healthy food choices, oral and dental hygiene, recognition of common dental problems, and appropriate dental care-seeking behavior. These educational domains corresponded to the topics assessed through the ten-item pre-test and post-test questionnaire. Students actively participated in both classroom-based learning and practical activities, including guided toothbrushing demonstrations. The integration of education, practical learning, and student participation provided an interactive learning environment designed to reinforce the oral health messages delivered during the program (Figure 3).

DISCUSSION

The findings demonstrate that the Senyumku Sehat Program was associated with a significant improvement in oral health knowledge among elementary school students. The overall median knowledge score increased from 45 before the intervention to 65 after the intervention, and all 176 participants achieved higher post-test scores, with no unchanged or decreased scores. The Wilcoxon signed-rank test confirmed a statistically significant improvement ($Z = -12.047$, $p < 0.001$), with a large effect size ($r = 0.91$). This finding indicates that the observed improvement was not only statistically significant but also substantial in magnitude within the evaluated participant group. The improvement may reflect the interactive school-based educational approach, which combined simple explanations, visual materials, demonstrations, and practical learning activities. Similar findings have

been reported in previous studies demonstrating that school-based oral health education can improve children's knowledge, attitudes, oral hygiene practices, and preventive behaviors, particularly when educational activities are adapted to the developmental characteristics of school-aged children (Sosiawan et al., 2022; Dadipoor et al., 2023; Gurav et al., 2022; Kim, 2024).



Figure 3. Implementation of interactive oral health education and student participation during the Senyumku Sehat Program at MI PSM Gempolan 2.

The improvement was not limited to the overall participant group but was observed consistently across all four grade levels. Students in Grades 1, 2, 3, and 4 demonstrated significant pre-test to post-test improvements (all $p < 0.001$), indicating that knowledge gains occurred across different elementary grade levels. The mean knowledge gains were 18.89 points in Grade 1, 20.00 points in Grade 2, 19.23 points in Grade 3, and 24.44 points in Grade 4. The Kruskal–Wallis test demonstrated a statistically significant difference in knowledge gains across grade levels ($H = 16.82$, $p < 0.001$). Subsequent Dunn's post-hoc test with Bonferroni correction showed that Grade 4 achieved significantly greater knowledge gains than Grade 1 (adjusted $p = 0.002$), Grade 2 (adjusted $p = 0.019$), and Grade 3 (adjusted $p = 0.002$), whereas no significant differences were observed among Grades 1, 2, and 3. These findings suggest that although the educational intervention was associated with improved knowledge across all grade levels, the magnitude of improvement was greater among Grade 4 students.

Although significant knowledge improvement occurred across all grade levels, Grade 4 demonstrated a significantly greater knowledge gain than Grades 1, 2, and 3. This pattern may be interpreted through Cognitive Load Theory, which emphasizes the limited capacity of working memory when processing new information. Students at higher grade levels may have greater cognitive maturity and accumulated learning experience, enabling them to organize newly presented information and integrate it more effectively with prior knowledge (Setiawan et al., 2026; Sweller, 1988). This developmental advantage may provide one possible explanation for the greater knowledge gain observed among Grade 4 students following the same educational intervention. However, the pattern should not be interpreted as a linear increase across grade levels, as the mean gains were 18.89, 20.00, 19.23, and 24.44 points in Grades 1 to 4, respectively, with no significant differences observed among Grades 1, 2, and 3. Furthermore, cognitive load was not directly measured in the present program. Cognitive Load Theory should therefore be regarded as an explanatory framework for interpreting the observed Grade 4 pattern rather than as a mechanism or variable directly tested in this evaluation.

The findings also support the relevance of interactive approaches rather than relying exclusively on one-way health counseling. The Senyumku Sehat Program combined simple oral health information with visual communication, practical activities, demonstrations, and direct interaction

with students. Such approaches may facilitate understanding by presenting oral health information through multiple forms of learning rather than verbal explanation alone. Gurav et al., 2022 reported that various school-based oral health educational methods can improve children's oral health outcomes, while Dadipoor et al., 2023 demonstrated an overall positive effect of educational interventions on students' oral health. In the present program, the significant knowledge improvement observed across all four grade levels suggests that an interactive educational approach can be feasibly implemented among students at different elementary grade levels within the same school environment.

Nevertheless, immediate knowledge improvement does not necessarily translate into sustained oral health knowledge or behavior. School-based interventions may face challenges in maintaining student engagement after external facilitators have completed their activities. Kim, 2024 emphasized the importance of reinforcement and sustainability in school-based oral health interventions. This issue is particularly relevant to community service programs conducted within a limited implementation period. Although the significant post-test improvement observed in the present program demonstrates immediate knowledge gain, it does not establish long-term knowledge retention or behavioral change. Therefore, an internal school-based continuation mechanism is important to reduce the likelihood that the program remains a one-time educational activity.

For this reason, the Senyumku Sehat Program incorporated Young Dental Health Cadres as a student empowerment strategy. Peer-based health promotion may shift students from passive recipients of information toward active participants who can reinforce simple health messages within their social environment. Previous evidence indicates that peer-led school health interventions can support health promotion, while peer-led oral health programs have shown potential benefits for both participating students and peer leaders (Dodd et al., 2022; Elsadek et al., 2023). In the present program, eight students were randomly selected as Young Dental Health Cadres and assigned to serve for one academic year under the supervision of school teachers, particularly the teacher responsible for the School Health Unit (UKS). Their role was intentionally limited to educational and supportive functions. The cadres were not positioned to diagnose oral diseases or perform clinical procedures; rather, they were introduced as student role models who could reinforce simple oral health messages, encourage appropriate oral hygiene practices, and encourage peers to communicate oral health concerns to teachers, parents, or dental professionals when necessary.

The use of cadre pins and a rotating trophy adds a recognition component to the student empowerment model. Rather than functioning solely as ceremonial rewards, these elements were designed to provide a visible identity for Young Dental Health Cadres and to reinforce their role within the school environment. The rotating trophy, in particular, was intended to remain within the school and to be transferred to subsequent student cohorts as part of the planned cadre regeneration mechanism. Together with teacher supervision and the one-academic-year cadre period, this recognition system was designed to support continuity of the program after completion of the initial community service activity. However, the present evaluation did not assess whether the cadre system, rotating trophy, or other continuation mechanisms were maintained over time. These components should therefore be interpreted as planned continuity mechanisms rather than evidence of established long-term sustainability. Future follow-up is required to determine whether subsequent cohorts continue the cadre system and whether the program contributes to sustained oral health knowledge and behavior.

As a follow-up plan, the school is expected to continue the Young Dental Health Cadre mechanism after completion of the initial program. Following the one-academic-year cadre period, the school is expected to select a new group of cadres, with the program guidance book serving as a reference for cadre roles, educational activities, and implementation procedures (Figure 4). The cadre pins and rotating trophy are intended to support this regeneration process by maintaining the visibility and identity of the cadre program across successive student cohorts. School teachers, particularly the teacher responsible for the School Health Unit (UKS), are expected to facilitate this school-led continuation. Thus, the follow-up strategy was designed to reduce dependence on the original community service team and provide a structured pathway toward school-led implementation.

However, the actual implementation and effectiveness of this regeneration mechanism require evaluation in subsequent academic years.



Figure 4. Young Dental Health Cadre Training Module developed to support the implementation and planned continuity of the Senyumku Sehat Program.

Beyond immediate oral health promotion, the cadre concept may also provide an opportunity to introduce children to the importance of communicating oral health information responsibly. Learning to recognize dental problems, communicate oral health concerns, and seek appropriate professional assistance may help children understand that information about their oral health forms part of their broader health history. This interpretation does not imply that Young Dental Health Cadres should create clinical records or perform professional documentation, as these responsibilities remain within the scope of dental professionals. Rather, the cadre-based educational process may provide an early foundation for appreciating the value of oral health information and its appropriate communication.

This broader perspective provides a conceptual connection to dental information governance, although this aspect was not directly evaluated in the present program. Dental information acquires long-term value when it is accurately documented, preserved, accessible, and retrievable. Professional dental records may contain odontograms, treatment histories, restorations, missing teeth, prostheses, radiographs, photographs, and other individual dental characteristics that contribute to the longitudinal value of dental information (Setiawan et al., 2025b; Setiawan et al., 2026). Baqai et al., 2023 highlighted the importance of dental record maintenance and noted that limitations in record-keeping practices may restrict the broader usefulness of dental information. In this context, dental information governance represents a broader professional perspective rather than an outcome measured by the Senyumku Sehat Program.

The secondary value of professionally documented dental information is particularly relevant to forensic odontology. Dental identification relies on the availability and quality of antemortem records containing characteristics such as restorations, missing teeth, prostheses, radiographic patterns, and other distinctive dental features that may be compared with postmortem findings (Emam, 2024; Wood & Gardner, 2024). Thus, the potential forensic value of dental information is established through appropriate professional documentation long before such records may be required for identification purposes. However, this forensic relevance represents a broader downstream implication and was not directly evaluated in the present program.

Within this broader framework, the Senyumku Sehat Program may be conceptually linked to forensic readiness only as a downstream implication. The program did not assess forensic competence, dental record quality, or forensic readiness; therefore, no direct effect on these outcomes

can be inferred. Rather, school-based oral health education and student empowerment may provide an early foundation for appreciating the value of oral health information, while its subsequent professional documentation and governance determine its potential clinical, legal, and forensic utility.

Several limitations should be considered. First, the program used a one-group pre-test–post-test design without a comparison group, limiting causal attribution of the observed knowledge improvement exclusively to the intervention. Second, the post-test was administered immediately after the educational activities; therefore, the findings primarily represent immediate knowledge acquisition rather than long-term retention or behavioral change. Third, the ten-item knowledge questionnaire was developed specifically for program evaluation and had not undergone formal psychometric validation or reliability testing; therefore, the findings should be interpreted as changes in program-specific knowledge rather than scores derived from a standardized validated instrument. Fourth, the collective toothbrushing activity presented an operational challenge because elementary school students were prone to distraction, joking, and peer interaction during the activity, requiring closer supervision to maintain procedural consistency. Fifth, Cognitive Load Theory was used only as an explanatory framework, and cognitive load was not directly measured. Finally, the effectiveness and continuity of the Young Dental Health Cadre system, including teacher supervision, future school-led cadre selection using the guidance book, and the rotating trophy mechanism, have not yet been evaluated longitudinally. Future evaluations should therefore examine knowledge retention, oral health behavior, cadre effectiveness, cadre regeneration, and the continuity of the school-led program across subsequent cohorts (Setiawan et al., 2026).

Despite these limitations, the Senyumku Sehat Program demonstrates the feasibility of combining oral health education with student empowerment within a school-based community service setting. The significant knowledge improvement observed across all grade levels, together with the large overall effect size, supports the educational component of the program, while the Young Dental Health Cadre model, teacher supervision, guidance book, and rotating recognition system provide a structured mechanism for planned program continuity. These continuity mechanisms require longitudinal evaluation before their sustainability can be established. More broadly, introducing children to the responsible communication and value of oral health information may provide an early foundation for appreciating dental information as part of their broader health history. Its potential relevance to dental information governance and forensic odontology should therefore be regarded as a downstream conceptual implication rather than an outcome demonstrated by the present program.

CONCLUSION

The Senyumku Sehat Program was associated with a significant improvement in oral health knowledge among 176 elementary school students at MI PSM Gempolan 2, with a large overall effect size. Significant knowledge gains were observed across all grade levels, with Grade 4 demonstrating significantly greater improvement than Grades 1, 2, and 3. Beyond immediate knowledge improvement, the program established eight Young Dental Health Cadres who were assigned to serve for one academic year under teacher supervision, supported by cadre pins, a rotating trophy, and a program guidance book as planned continuity mechanisms. These mechanisms provide a structured basis for school-led cadre regeneration but should not be interpreted as evidence of established long-term sustainability. More broadly, the program may provide an early foundation for appreciating the value and responsible communication of oral health information, while its potential relevance to dental information governance and forensic odontology remains a downstream conceptual implication rather than an outcome directly evaluated in this program. Future studies should assess knowledge retention, behavioral change, cadre effectiveness, cadre regeneration, and program continuity longitudinally.

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Conflict of Interests

The authors declare that there are no conflicts of interest regarding the publication of this article.

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