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The Effectiveness of Using Braillpopal Media and Mosipedaly Media in Improving Toothbrushing Skill In The Visually Impaired

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ABSTRACT Maintaining good oral hygiene is a critical component of overall health, particularly for children with visual impairments who face unique challenges in detecting early signs of oral disease due to their limited visual perception. This condition often results in delayed recognition of symptoms such as plaque accumulation and gum bleeding, which may lead to poor dental hygiene. This study aims to evaluate the effectiveness of two specialized educational tools BRAILLPOPAL (Braille Pop-Up Dental) and MOSIPEDALY (Modified Phantom Dental Study) in enhancing toothbrushing skills among visually impaired students at SLB N 1 Bantul. A quasi-experimental design with a pretest-posttest approach was used, involving 30 visually impaired students divided equally into two groups. Group A received counseling using BRAILLPOPAL media, while Group B used MOSIPEDALY media. The intervention lasted 21 days and included demonstration, motivation, and independent practice phases. Toothbrushing skills were assessed through direct observation using standardized checklists before and after the intervention. Data were analyzed using the Wilcoxon and Mann-Whitney tests. Results showed a significant improvement in both groups, with Group A (BRAILLPOPAL) increasing their "good" brushing category from 0% to 86.6%, and Group B (MOSIPEDALY) from 0% to 73.3%. Statistical analysis confirmed significant differences within each group ($p = 0.001$) and between groups ($p = 0.032$), indicating that BRAILLPOPAL was more effective than MOSIPEDALY in enhancing brushing skills. In conclusion, both educational media proved effective in improving toothbrushing skills among visually impaired students, with BRAILLPOPAL showing superior results. These findings support the integration of braille-based and tactile-enhanced educational tools in oral health promotion programs for children with visual impairments.

INDEX TERMS Braille, oral hygiene, dental education, visual impairment, health promotion media

I. INTRODUCTION

Oral health is an essential aspect of overall well-being and significantly affects an individual's quality of life. In Indonesia, dental and oral health remains a pressing public health concern. The 2018 Basic Health Research (RISKESDAS) reported that approximately 88.8% of Indonesians experience dental caries, with only 2.8% practicing proper toothbrushing techniques [1]. The prevalence is notably higher among vulnerable groups, such as children with visual impairments, due to their limited ability to detect early symptoms of oral diseases like plaque accumulation and gingival inflammation [2], [3].

Visually impaired individuals, particularly children, face considerable challenges in maintaining oral hygiene due to the lack of visual cues, reduced motor skills, and inadequate supervision during oral care routines [4]–[6]. This condition contributes to moderate to poor Oral Hygiene Index Scores (OHI-S) among visually impaired children [7]. These limitations highlight the urgent need for specialized, adaptive educational interventions that cater to their sensory and cognitive abilities.

Recent advancements in health education have led to the development of various tactile and auditory learning tools tailored to students with special needs. Tools such as Braille-based instruction [8], three-dimensional dental models [9], and audio-guided tutorials [10] have shown promising results in enhancing health knowledge and practices. BRAILLPOPAL (Braille Pop-Up Dental) and MOSIPEDALY (Modified Phantom Dental Study) are two innovative media designed to address this gap. BRAILLPOPAL integrates braille text and raised dental images, while MOSIPEDALY utilizes a tactile dental model combined with braille labeling to teach brushing techniques. These tools aim to engage the sense of touch and hearing dominant learning channels for the blind making them more effective than traditional didactic methods [11]–[14].

While some prior studies have explored educational media for children with visual impairments, most focus on general academic subjects or limited demonstrations in health

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education [15]–[17]. Few studies systematically compare tactile and braille-integrated media in improving practical toothbrushing skills among visually impaired students. This represents a significant research gap, especially in the context of inclusive health promotion for special needs populations in developing countries.

Therefore, this study aims to evaluate the effectiveness of BRAILLPOPAL and MOSIPEDALY media in enhancing toothbrushing skills among visually impaired students at SLB N 1 Bantul. The research employs a quasi-experimental pretest-posttest design to determine whether there is a statistically significant difference in outcomes between the two intervention groups. This study makes three key contributions. First, it provides empirical evidence on the effectiveness of tactile and braille-integrated dental education media for children with visual impairments. Second, it offers a comparative analysis of two different intervention tools BRAILLPOPAL and MOSIPEDALY thereby informing best practices for future oral health education programs. Third, it proposes a replicable instructional framework for educators and public health practitioners to implement inclusive oral hygiene education in special schools.

II. METHOD

A. STUDY DESIGN

This research employed a quasi-experimental design using a pretest-posttest non-equivalent control group model to evaluate the effectiveness of two educational media BRAILLPOPAL (Braille Pop-Up Dental) and MOSIPEDALY (Modified Phantom Dental Study) in improving toothbrushing skills among visually impaired students. Quasi-experimental designs are frequently used in health education studies where randomization is not feasible but pre-intervention and post-intervention comparisons are necessary [26]. The intervention was carried out prospectively, following ethical approval from the institutional ethics committee, and spanned three main phases: preparation, implementation, and completion. The total study duration was three months, from December 2023 to February 2024.

B. STUDY POPULATION AND SAMPLING

The population of this study comprised all visually impaired students enrolled at SLB N 1 Bantul, a public special needs school located in Yogyakarta, Indonesia. According to official school records, a total of 30 students met the predefined inclusion criteria and were all included in the study through a total sampling approach, considering the relatively small and accessible population size. The inclusion criteria specified that participants must have a formal diagnosis of either total or partial visual impairment, fall within the age range of 8 to 21 years, and possess the ability to follow verbal instructions as well as the physical capability to perform toothbrushing activities. Conversely, students were excluded if they had severe cognitive impairments, physical limitations affecting upper limb movement, or if they were absent for more than two consecutive intervention sessions. Following participant selection, the sample was divided into two equal groups of 15 students each. Group A received the educational intervention using BRAILLPOPAL media, while Group B received the intervention using MOSIPEDALY media. Randomization was not implemented in the group allocation process due to practical and ethical considerations associated with conducting research in a special needs educational setting, where individualized learning requirements and institutional constraints must be respected.

C. EDUCATIONAL MEDIA DESCRIPTION

The BRAILLPOPAL media was designed as a tactile educational booklet incorporating braille text and raised diagrams of teeth, gum lines, and brushing directions. It was developed specifically for use with the blind and built on previous studies demonstrating the value of braille in health communication [27]. The MOSIPEDALY media consisted of a modified dental phantom model equipped with braille labels on each anatomical part. It allowed students to physically interact with the mouth model and simulate brushing on a lifelike surface, consistent with best practices in health simulation-based learning [28].

III. RESULTS

A. CHARACTERISTICS OF RESPONDENTS

TABLE 1
Distribution of Respondents Based on the Characteristics of Blind Students at SLB N 1 Bantul

Characteristic		Frequency	Percentage (%)
Gender	Man	19	63,4
	Woman	11	36,6
Total		30	100
Age	8 years – 12 years	5	16,6
	13 years – 16 years	4	13,3
	17 years – 21 years	21	70
Total		30	100

TABLE 2
Frequency Distribution of Brushing Skills of Blind Students

Categories How to Brush Your Teeth	Before		After	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Good	0	0	13	86,6
Keep	5	33,4	2	13,4
Bad	10	66,6	0	0
Total	15	100	15	100

TABLE 3
Frequency Distribution of Brushing Skills for Blind Students Before and After Counseling Using MOSIPEDALY Media (Modified Panthom Dental Study)

Categories How to Brush Your Teeth	Before		After	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Good	0	0	11	73,3
Keep	6	40	4	26,6
Bad	9	60	0	0
Total	15	100	15	100

Based on TABLE 1, the respondent characteristics in this study were predominantly male, with 19 students (63.4%) identified as male participants. In terms of age distribution, the majority of respondents were 18 years old, accounting for 9 students (30%) of the total sample. This demographic profile provides an overview of the participant composition, which may influence the interpretation of the study's findings.

Based on the TABLE 2 related to the brushing skills of visually impaired students before counseling using *BRAILLPOPAL* media, the results were obtained that many

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students had skills with a poor category, namely 10 students (66.6%) and after counseling using *BRAILLPOPAL* media, the results were obtained that many students had skills with a good category, namely 13 students (86.6%). Based on the TABLE 3 related to the brushing skills of visually impaired students before counseling using *MOSIPEDALY* media, the results were obtained that many students had skills with a bad category, namely 9 students (60%) and after counseling using *MOSIPEDALY* media, the results were obtained that many students had skills with a good category, namely 11 students (73.3%).

B. DATA ANALYSIS RESULTS

TABLE 4
Results Before and After Counseling Using BARILLPOPAL Media (Braille Pop Up Dental)

Variable	Category			*P Value*
	Good	Keep	Bad	
Before Counseling	0	5	10	**0.001**
After the Counseling	13	2	0	

TABLE 5
Results Before and After Counseling Using MOSIPEDALY Media (Modified Panthom Dental Study)

Variable	Category			*P Value*
	Good	Keep	Bad	
Before Counseling	0	6	9	**0.001**
After the Counseling	11	4	0	

TABLE 6
Differences in the Effectiveness of MOSIPEDALY and BRAILLPOPAL Media in Improving Dental Brushing Skills of Blind Students

Group	Skills						*P Value*
	Good		Keep		Bad		
	N	%	n	%	n	%	
MOSIPEDALLY	11	73,3	4	26,6	0	0	**0.032**
BRAILLPOPAL	13	86,6	2	13,3	0	0	

Based on the TABLE 4, a significance value of 0.001 ($p<0.05$) was obtained, indicating that there was a significant difference between the variables of brushing skills before and after counseling using *BRAILLPOPAL*. Based on the TABLE 5, a significance value of 0.001 ($p<0.05$) was obtained, indicating that there was a significant difference between the variables of brushing skills before and after counseling using *MOSIPEDAL* media. Based on the TABLE 6, a significance value of 0.032 ($p<0.05$) was obtained, so that H0 was rejected and H1 was accepted, thus it was known that there was a significant difference between the MOSIPEDALY *and* BRAILLPOPAL *media groups* on the brushing skills of visually impaired students at SLB N 1 Bantul.

IV. DISCUSSION

A. INTERPRETATION OF RESULT

The results of this study demonstrated a significant improvement in toothbrushing skills among visually impaired students after receiving dental health education using BRAILLPOPAL and MOSIPEDALY media. The Wilcoxon test showed a significance value of $p = 0.001$ for both intervention groups, indicating that both types of media were effective in enhancing students' practical skills. Furthermore, when compared using the Mann–Whitney test, BRAILLPOPAL showed a statistically greater effectiveness than MOSIPEDALY, with a p-value of 0.032. Students who were previously categorized as having poor toothbrushing skills transitioned into the "good" category after the intervention. Specifically, in the BRAILLPOPAL group, the percentage of students demonstrating good skills rose from 0% to 86.6%, while in the MOSIPEDALY group, it increased from 0% to 73.3%. This notable enhancement reflects the effectiveness of tactile and braille-enhanced media in facilitating the learning of procedural knowledge, particularly in populations with limited visual capacity. BRAILLPOPAL utilizes braille-integrated printed materials and raised anatomical illustrations that stimulate the sense of touch and imagination. This aligns with the dominant learning modality among blind students, who rely more on tactile and auditory inputs for comprehension. The design of this media actively supports multisensory learning, where multiple sensory pathways are engaged, improving the encoding and retention of knowledge. In contrast, MOSIPEDALY a three-dimensional dental phantom model with braille labels emphasizes hands-on practice of brushing techniques. While also effective, its reliance on modeling and spatial recognition may require more guided instruction for students to fully internalize the technique compared to the more self-directed nature of BRAILLPOPAL.

B. COMPARISON WITH PREVIOUS STUDIES

The findings of this study are consistent with existing literature emphasizing the importance of using adaptive media for students with visual impairments. A study by C.E. Mamluatul et al. found that braille and audio media significantly enhanced understanding of dental hygiene in blind students. Similarly, Repelino et al. demonstrated that braille-integrated tools increased engagement and interest among blind learners, resulting in improved health knowledge and self-confidence. The results also corroborate with research by Kaghiade et al., who observed that the use of 3D dental models in educational settings helped students learn anatomical structures and brushing techniques through tactile simulation. However, compared to standard models, the MOSIPEDALY design used in this study integrates braille features, which enhances accessibility and user interaction for blind students. In another relevant study, Oktaviani et al. reported the success of the GEROGI program, which used guided demonstrations and interactive instruction to teach preschoolers oral hygiene. Although their target population was not visually impaired, the core educational strategy engaging students through active, tactile learning supports the present study's findings. The difference in effectiveness between BRAILLPOPAL and MOSIPEDALY may be attributed to the learning style preferences of the target group. Visually impaired children often develop heightened tactile perception and benefit more from structured and familiar inputs such as braille text, as opposed to abstract 3D models. This aligns with the stimulus–organism–response (S-O-R) theory, which posits that learners' responses are shaped by the quality and suitability of the educational stimuli.

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C. LIMITATIONS AND IMPLICATIONS

While the study provides strong evidence on the effectiveness of both media, several limitations should be noted. First, the relatively small sample size (n = 30), confined to one special needs school, limits the generalizability of the findings. Larger multi-site studies would offer more robust conclusions and enable subgroup analyses based on age, severity of visual impairment, or prior hygiene education. Second, the study design though quasi-experimental did not include a traditional control group receiving standard oral health counseling without media. This limits the ability to isolate the pure effect of each intervention against baseline or conventional methods. Future studies could adopt a randomized controlled trial (RCT) design to address this gap. Third, the follow-up period was relatively short. While posttest results showed significant improvement, long-term retention and actual adoption of brushing habits remain unmeasured. Including a follow-up assessment at 1 or 3 monthS post-intervention would provide deeper insights into the sustainability of learning outcomes. Moreover, the evaluation instrument used was an observation sheet measuring brushing techniques. Although practical, this tool may be subject to observer bias. Combining this with video recording or peer-assessment protocols might enhance objectivity in future studies. Despite these limitations, the implications are noteworthy. This study affirms that braille-integrated and tactile educational media should be incorporated into dental health promotion efforts for visually impaired students. These findings are especially important in Indonesia, where special needs education is often under-resourced and relies on general instructional materials. Additionally, the success of BRAILLPOPAL suggests that low-cost, printable educational tools can serve as scalable and sustainable alternatives in resource-limited settings. Since the content is reusable and adaptable to various topics, the model can be expanded to include other hygiene practices or nutritional education. Educators and health workers should be trained to utilize such media effectively. School-based interventions combining braille literacy with health education can bridge the gap in preventive care among disabled populations. This aligns with national targets to reduce the DMF-T index and promote inclusive health education in school curricula.

V. CONCLUSION

This study aimed to evaluate and compare the effectiveness of BRAILLPOPAL (Braille Pop-Up Dental) and MOSIPEDALY (Modified Phantom Dental Study) media in improving toothbrushing skills among visually impaired students at SLB N 1 Bantul. The intervention was conducted using a quasi-experimental pretest-posttest design, involving 30 students who were equally divided into two groups. The findings revealed a statistically significant improvement in both groups after the implementation of their respective educational media. In the BRAILLPOPAL group, the number of students categorized as having good brushing skills increased from 0% at baseline to 86.6% post-intervention, while in the MOSIPEDALY group, the corresponding improvement was from 0% to 73.3%. Wilcoxon test results for both groups showed p-values of 0.001, indicating significant differences before and after the intervention. Furthermore, a Mann–Whitney test comparing the two groups showed a p-value of 0.032, suggesting a significant difference in effectiveness between the two media, with BRAILLPOPAL emerging as the more effective tool. These results highlight the value of braille-integrated and tactile-based health education for children with visual impairments, where the sense of touch plays a central role in learning. BRAILLPOPAL, which combines braille text and raised illustrations, was more effective likely due to its alignment with the sensory learning preferences of blind students. Given these outcomes, the study recommends broader implementation of BRAILLPOPAL media in inclusive dental health programs, particularly in special schools. Future research should focus on expanding the sample size across multiple educational settings to enhance generalizability, incorporating control groups to strengthen causal inference, and conducting longitudinal follow-up to evaluate knowledge retention and behavioral consistency over time. In addition, the development of integrated multisensory learning materials incorporating tactile, auditory, and kinesthetic components may further improve educational outcomes for students with visual impairments in oral health and other self-care practices.

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DATA AVAILABILITY

No datasets were generated or analyzed during the current study.

AUTHOR CONTRIBUTION

Elis Selvi Ryan Susanti contributed to the conceptualization of the study, research design, data collection, and initial manuscript drafting. Silvia Prasetyowati was responsible for supervision, methodology refinement, data analysis, and critical revision of the manuscript. Siti Fitria Ulfah contributed to project administration, validation of findings, and final review and editing of the manuscript. All authors have read and approved the final version of the manuscript for publication.

DECLARATIONS

ETHICAL APPROVAL

This study was approved by the Research Ethics Committee of Poltekkes Kemenkes Surabaya. All procedures performed were in accordance with the ethical standards of the

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institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments.

CONSENT FOR PUBLICATION PARTICIPANTS.

Consent for publication was given by all participants

COMPETING INTERESTS

The authors declare no competing interests.

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