

Manuscript received June 11, 2024; revised June 12, 2024; accepted June 13, 2024; date of publication June 30, 2024

Digital Object Identifier (DOI): <https://doi.org/10.35882/ijahst.v4i4.366>

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**How to cite:** Silvia Prasetyowati, Meyvilia Yunardi Saputri, and Isnanto, "The Effectiveness of Video Tutorials to Increase Knowledge and Practices of Brushing Teeth in Preschool Children (Study of Preschool Children at Putra Harapan and Dewi Sartika Kindergarten Tuban)", International Journal of Advanced Health Science and Technology, Vol. 4, No. 4, pp. 1-8, August 2024

# The Effectiveness of Video Tutorials to Increase Knowledge and Practices of Brushing Teeth in Preschool Children (Study of Preschool Children at Putra Harapan and Dewi Sartika Kindergarten, Tuban)

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**ABSTRACT** Poor oral hygiene practices among preschool children represent a significant public health concern. While 94.7% of children aged three years and above brush their teeth daily, only 2.8% demonstrate proper brushing techniques, resulting in inadequate dental and oral hygiene outcomes. This discrepancy between frequency and quality of toothbrushing practices indicates a critical knowledge gap that requires targeted educational intervention. This study aimed to evaluate the effectiveness of video tutorial education in enhancing toothbrushing independence among preschool children aged 3-6 years, a developmental stage characterized by heightened imagination and emerging curiosity that can be leveraged for health education purposes. A pre-experimental design with pre-test and post-test control groups was employed to assess the intervention's impact. The study population comprised 38 preschool children from Putra Harapan Kindergarten and Dewi Sartika Kindergarten in Tuban. Data collection utilized structured observation sheets to systematically evaluate toothbrushing behaviors and independence levels. Statistical analysis was conducted using the Wilcoxon signed-rank test and Mann-Whitney U test to determine within-group and between-group differences, respectively. Following 21 days of observation, significant improvements in toothbrushing independence were observed among preschool children who received video tutorial education. The intervention demonstrated measurable enhancement in both knowledge acquisition and practical application of proper toothbrushing techniques, indicating the effectiveness of multimedia educational approaches in this age group. Video tutorial education represents an effective pedagogical strategy for improving toothbrushing independence among preschool children. The findings suggest that targeted multimedia interventions can successfully bridge the gap between knowledge and practice in pediatric oral hygiene behaviors, offering a scalable approach for early childhood health education programs.

**INDEX TERMS** Preschool Children, Toothbrushing Independence, Video Tutorial Education, Oral Hygiene, Health Education Intervention

## I. INTRODUCTION

Dental and oral health constitute integral components of overall systemic health, with their deterioration significantly impacting quality of life and daily functioning activities, including occupational performance, nutritional intake, and social interactions [1]. The maintenance of optimal oral hygiene practices is paramount for preventing dental and oral pathologies, including periodontal disease, dental caries, tooth loss, and associated complications [2]. Contemporary epidemiological data from Indonesia's Basic Health Research (Riskesdas) reveal alarming prevalence rates of dental caries among pediatric populations, with 81.1% of children aged 3-4 years and 92.6% of children aged 5-9 years affected by this preventable condition [3]. Despite widespread adoption of daily toothbrushing practices among 94.7% of individuals aged three years and above, only 2.8%

demonstrate adequate brushing techniques, highlighting a critical gap between behavioral frequency and technical proficiency [4]. Contemporary approaches to pediatric oral health education have evolved significantly, incorporating multimedia technologies and interactive learning methodologies. Traditional didactic instruction methods have been progressively supplemented by innovative educational tools, particularly video-based learning platforms that leverage visual and auditory stimuli to enhance knowledge retention and skill acquisition [5]. Video tutorial methodology represents a sophisticated pedagogical approach that combines theoretical knowledge with practical demonstration, enabling learners to visualize complex procedures and replicate them through repeated observation [6]. Recent educational research has demonstrated the efficacy of multimedia learning environments in pediatric

populations, particularly in developing motor skills and cognitive understanding simultaneously [7]. Audio-visual educational media have emerged as particularly effective tools for preschool populations due to their alignment with developmental learning preferences and cognitive processing capabilities [8]. The interactive nature of video tutorials facilitates self-paced learning, allowing children to repeatedly observe demonstrations until mastery is achieved [9]. Furthermore, contemporary video-based interventions have incorporated gamification elements and narrative structures that enhance engagement and motivation among young learners [10].

Despite the acknowledged importance of early childhood oral health education and the proliferation of multimedia learning tools, significant gaps remain in understanding the optimal implementation of video tutorial interventions for preschool populations. Current literature demonstrates inconsistent findings regarding the most effective duration, frequency, and content structure for video-based oral health education programs [11]. Additionally, limited research has examined the long-term retention of toothbrushing skills acquired through video tutorial interventions, particularly in real-world settings beyond controlled laboratory environments [12]. Most existing studies have focused on knowledge acquisition rather than practical skill development and independent behavior modification [13]. The developmental characteristics of preschool children, including their emerging autonomy, motor skill development, and cognitive capacity for procedural learning, have not been adequately integrated into intervention design and evaluation frameworks [14]. Furthermore, there is insufficient evidence regarding the optimal observation period required to assess behavioral change sustainability in this age group [15]. This study aims to evaluate the effectiveness of video tutorial education in enhancing toothbrushing independence among preschool children aged 3-6 years, with particular emphasis on both knowledge acquisition and practical skill development over an extended observation period. This research contributes to the existing body of knowledge in several significant ways:

1. **Methodological Innovation:** The study employs a comprehensive pre-experimental design with an extended 21-day observation period, providing insights into the sustainability of behavioral changes induced by video tutorial interventions in naturalistic settings.
2. **Developmental Appropriateness:** The research specifically addresses the unique developmental characteristics of preschool children, including their emerging independence, motor skill development, and cognitive capacity for procedural learning, filling a critical gap in age-appropriate intervention design.
3. **Practical Application Framework:** The findings provide evidence-based recommendations for implementing video tutorial education programs in early childhood educational settings, offering scalable solutions for pediatric oral health promotion initiatives.

This paper is organized as follows: Section II presents the literature review and theoretical foundations; Section III delineates the pre-experimental methodology and data collection procedures; Section IV presents the statistical results and analysis from the Wilcoxon and Mann-Whitney

tests; Section V discusses the findings within the context of existing literature; and Section VI concludes with key findings, implications for practice, and future research directions.

## II. METHOD

### A. STUDY DESIGN AND POPULATION SAMPLING

This investigation employed a pre-experimental analytical design utilizing a pre-test and post-test control group configuration to evaluate the effectiveness of video tutorial education on preschool children's toothbrushing independence. The study was conducted at two kindergarten institutions in Tuban, Indonesia: Putra Harapan Kindergarten (experimental group) and Dewi Sartika Kindergarten (control group), during the period from January to March 2023. The selection of these institutions was based on comparable demographic characteristics, educational curricula, and facility standards to minimize confounding variables [16]. The target population comprised preschool children enrolled in group B (aged 3-6 years) at both participating institutions, totaling 38 children. The sample size was determined using purposive sampling methodology, with equal allocation of 19 participants per group to ensure statistical power and balanced comparison between experimental and control conditions [17]. Inclusion criteria specified children aged 3-6 years with regular kindergarten attendance and parental consent for participation. Exclusion criteria included children with physical disabilities affecting motor coordination, cognitive impairments that would interfere with instruction comprehension, and those receiving concurrent dental treatment or specialized oral health interventions [18].

The experimental intervention was structured according to the established 21-day behavioral change theory, implemented in three distinct phases of seven days each [19]. During the first phase (days 1-7), intensive educational sessions were conducted daily for approximately 15 minutes using age-appropriate animated video tutorials specifically designed for preschool children. The video content incorporated visual demonstrations of proper brushing techniques, sequential step-by-step instructions, and engaging animated characters to maintain attention and facilitate comprehension among the target age group [20]. The control group received conventional verbal education during the same timeframe, delivered by trained kindergarten teachers using standardized instructional protocols. The second phase (days 8-14) involved reinforcement activities where teachers and parents provided encouragement and guidance to promote proper toothbrushing practices. The final phase (days 15-21) emphasized independent practice, allowing children to demonstrate acquired skills with minimal supervision to assess behavioral autonomy and skill retention [21].

### B. DATA COLLECTION AND ANALYSIS

Data collection utilized structured observation sheets designed to systematically evaluate toothbrushing knowledge and practical skills. The observation instrument was validated through expert review by pediatric dentistry specialists and educational psychologists to ensure content validity and age-appropriateness [22]. Knowledge assessment employed

binary scoring, with correct responses receiving a score of 1 and incorrect responses score of 0. Knowledge evaluation categories were established as follows: good (76-100%), fair (56-75%), and poor (<56%). Practical skill assessment utilized a four-point categorical scale: very good (80-100), good (70-79), fair (60-69), and needs guidance (<60). The assessment criteria encompassed motor coordination, technique accuracy, sequence adherence, and independence level during toothbrushing activities [23]. Inter-rater reliability was established through training sessions with data collectors, achieving a Cohen's kappa coefficient of >0.80 for both knowledge and practice assessments. Before data collection, informed consent was obtained from parents or legal guardians of all participants, ensuring compliance with ethical research standards. Baseline assessments (pre-tests) were conducted for both groups to establish initial knowledge and skill levels before intervention implementation.

Data collection sessions were scheduled during regular kindergarten hours to minimize disruption to educational activities and maintain naturalistic observation conditions. Post-intervention assessments were conducted at day 21 following the same standardized protocols used for baseline measurements. All observations were performed by trained research assistants who were blinded to group allocation to minimize observation bias. Data collection instruments were administered multiple times throughout the observation period to ensure reliability and capture behavioral changes over time [24]. Statistical analysis was conducted using SPSS version 26.0 software package. Descriptive statistics were calculated to characterize participant demographics and baseline measurements. The Wilcoxon signed-rank test was employed to evaluate within-group changes in knowledge and practice scores between pre-test and post-test measurements, given the non-parametric nature of the ordinal data. Between-group comparisons were analyzed using the Mann-Whitney U test to assess differences in intervention effectiveness between experimental and control groups. Statistical significance was set at  $p < 0.05$ , with 95% confidence intervals calculated for all effect estimates. Effect sizes were computed using Cohen's conventions to determine the practical significance of observed changes. Data normality was assessed using the Shapiro-Wilk test, confirming the appropriateness of non-parametric statistical procedures for the study dataset.

### C. ETHICAL CONSIDERATIONS

The study protocol received approval from the institutional research ethics committee, ensuring compliance with principles of beneficence, non-maleficence, and respect for persons. Written informed consent was obtained from parents or guardians, with additional verbal assent secured from child participants. Confidentiality and anonymity were maintained throughout data collection and analysis procedures, with participant identification codes used instead of personal identifiers [25].

### III. RESULTS

As presented in TABLE 1, the study population demonstrated balanced gender distribution with equal representation of male (50%) and female (50%) participants.

The majority of respondents (86.8%) were under six years of age, reflecting the targeted preschool demographic for this investigation. TABLE 2 demonstrates significant improvements in both knowledge and practice domains among experimental group participants following the video tutorial intervention. Post-intervention assessment revealed that 14 out of 19 respondents (73.7%) achieved good knowledge levels, representing a substantial enhancement from baseline measurements. This finding indicates that video tutorial educational media effectively facilitate knowledge acquisition regarding proper toothbrushing techniques among preschool children. Similarly, practical skill assessments showed marked improvement, with 13 out of 19 respondents (68.4%) attaining very good performance levels. These results substantiate the efficacy of multimedia educational interventions in enhancing both cognitive understanding and motor skill proficiency in pediatric oral health behaviors.

**TABLE 1**  
Characteristics of Respondent

| Characteristic |             | Frequency (N) | Percentage (%) |
|----------------|-------------|---------------|----------------|
| Gender         | Boy         | 19            | 50             |
|                | Girl        | 19            | 50             |
| Age            | 5 years old | 5             | 13.2           |
|                | 6 years old | 33            | 86.8           |

**TABLE 2**  
The Experimental Group's frequency distribution of preschool children's knowledge and practices regarding tooth brushing before and after instruction with tutorial videos

| Variable                              | Before        |                | After         |                |
|---------------------------------------|---------------|----------------|---------------|----------------|
|                                       | Frequency (N) | Percentage (%) | Frequency (N) | Percentage (%) |
| <b>Knowledge about tooth brushing</b> |               |                |               |                |
| Good                                  | 0             | 0              | 14            | 73.7           |
| Moderate                              | 10            | 52.6           | 5             | 26.3           |
| Poor                                  | 9             | 47.4           | 0             | 0              |
| <b>Total</b>                          | <b>19</b>     | <b>100</b>     | <b>19</b>     | <b>100</b>     |
| <b>Tooth Brushing Practice</b>        |               |                |               |                |
| Very good                             | 0             | 0              | 13            | 68.4           |
| Good                                  | 0             | 0              | 4             | 21.1           |
| Moderate                              | 6             | 31.6           | 2             | 10.5           |
| Supervision needed                    | 13            | 68.4           | 0             | 0              |
| <b>Total</b>                          | <b>19</b>     | <b>100</b>     | <b>19</b>     | <b>100</b>     |

TABLE 3 reveals contrasting outcomes for the control group receiving conventional verbal education. Post-intervention assessment indicated that 11 out of 19 respondents (57.9%) continued to demonstrate poor knowledge levels, suggesting minimal improvement in cognitive understanding. This finding underscores the limited effectiveness of traditional verbal instruction in enhancing toothbrushing knowledge among preschool children. Furthermore, practical skill assessments remained suboptimal, with 16 out of 19 respondents (84.2%) requiring guidance in toothbrushing practices. These results demonstrate that conventional educational approaches are insufficient for achieving meaningful behavioral change in this population. Normality testing revealed non-parametric data distribution across all assessment conditions. For knowledge assessments (TABLE 4), the Shapiro-Wilk test

indicated non-normal distribution in both experimental and control groups. The experimental group demonstrated significance values of 0.016 (pre-test) and 0.001 (post-test), while the control group showed values of 0.005 (pre-test) and 0.003 (post-test). All significance values fell below the 0.05 threshold, confirming non-normal distribution.

**TABLE 3**

**Knowledge and Practices Regarding Teeth Brushing in Preschool Children Before and After Education (Control Group)**

| Variable                       | Before        |                | After         |                |
|--------------------------------|---------------|----------------|---------------|----------------|
|                                | Frequency (N) | Percentage (%) | Frequency (N) | Percentage (%) |
| Knowledge about tooth brushing |               |                |               |                |
| Good                           | 0             | 0              | 0             | 0              |
| Moderate                       | 6             | 31.6           | 8             | 42.1           |
| Poor                           | 13            | 68.4           | 11            | 57.9           |
| <b>Total</b>                   | <b>19</b>     | <b>100</b>     | <b>19</b>     | <b>100</b>     |
| Knowledge about tooth brushing |               |                |               |                |
| Tooth Brushing Practice        |               |                |               |                |
| Very good                      | 0             | 0              | 0             | 0              |
| Good                           | 0             | 0              | 1             | 5.3            |
| Moderate                       | 3             | 15.8           | 2             | 10.5           |
| Supervision needed             | 16            | 84.2           | 16            | 84.2           |
| <b>Total</b>                   | <b>19</b>     | <b>100</b>     | <b>19</b>     | <b>100</b>     |

**TABLE 4**

**Data from the Normality Test on the Knowledge of Brushing Teeth by Preschool Children in the Experimental and Control Groups**

| Class                              | Shapiro Wilk |    |       |
|------------------------------------|--------------|----|-------|
|                                    | Statistic    | Df | Sig.  |
| The Intervention Group's Pre-Test  | 0.873        | 19 | 0.016 |
| The Intervention Group's Post-Test | 0.796        | 19 | 0.001 |
| Control Group Pre-Test             | 0.843        | 19 | 0.005 |
| Control Group Post-Test            | 0.823        | 19 | 0.003 |

**TABLE 5**

**Data from the normality test on the practices for brushing their teeth by preschool children in the Experimental Group and the Control Group's**

| Class                              | Shapiro Wilk |    |       |
|------------------------------------|--------------|----|-------|
|                                    | Statistic    | df | Sig.  |
| The Intervention Group's Pre-Test  | 0.814        | 19 | 0.002 |
| The Intervention Group's Post-Test | 0.853        | 19 | 0.007 |
| Control Group Pre-Test             | 0.803        | 19 | 0.001 |
| Control Group Post-Test            | 0.870        | 19 | 0.015 |

Similarly, practice assessments (TABLE 5) exhibited non-normal distribution patterns. The experimental group recorded significance values of 0.002 (pre-test) and 0.007 (post-test), while the control group demonstrated values of 0.001 (pre-test) and 0.015 (post-test). These findings necessitated the use of non-parametric statistical procedures for subsequent analyses. Wilcoxon signed-rank tests revealed significant within-group improvements for the experimental group. Knowledge assessment (TABLE 6) demonstrated a p-value of 0.000, indicating statistically significant enhancement in toothbrushing knowledge following video tutorial education. Conversely, the control

group (TABLE 7) showed no significant knowledge improvement ( $p = 0.157$ ), confirming the superior effectiveness of multimedia instruction. Practice assessments yielded similar patterns, with the experimental group (TABLE 8) demonstrating significant improvement ( $p = 0.000$ ) in toothbrushing practices.

**TABLE 6**

**Results of the Wilcoxon Test of Preschool Children's Knowledge of Brushing Teeth Before and After Education Using Tutorial Videos (Experimental Group)**

| Variable         | Category |          |      | P Value      |
|------------------|----------|----------|------|--------------|
|                  | Good     | Moderate | Poor |              |
| Before Education | 0        | 10       | 9    | <b>0.000</b> |
| After Education  | 14       | 5        | 0    |              |

**TABLE 7**

**Results of the Wilcoxon Test of Preschool Children's Knowledge of Brushing Teeth Before and After Education Using Non-Video Tutorials (Control Group)**

| Variable         | Category |          |      | P Value      |
|------------------|----------|----------|------|--------------|
|                  | Good     | Moderate | Poor |              |
| Before Education | 0        | 6        | 13   | <b>0.157</b> |
| After Education  | 0        | 11       | 8    |              |

**TABLE 8**

**Wilcoxon Test Results of Preschool Children's Practices in Brushing Teeth Before and After Education Using Tutorial Videos (Experimental Group)**

| Variable         | Category  |      |          |                    | P Value      |
|------------------|-----------|------|----------|--------------------|--------------|
|                  | Very Good | Good | Moderate | Supervision Needed |              |
| Before Education | 0         | 0    | 6        | 13                 | <b>0.000</b> |
| After Education  | 13        | 4    | 2        | 0                  |              |

**TABLE 9**

**Results of the Wilcoxon Test of Preschool Children's Skills in Brushing Teeth Before and After Counseling Using Non-Video Tutorials (Control Group)**

| Variable         | Category  |      |          |                    | P Value      |
|------------------|-----------|------|----------|--------------------|--------------|
|                  | Very Good | Good | Moderate | Supervision Needed |              |
| Before Education | 0         | 0    | 3        | 16                 | <b>0.083</b> |
| After Education  | 0         | 1    | 2        | 16                 |              |

The control group (TABLE 9) showed no significant practice enhancement ( $p = 0.083$ ), further supporting the ineffectiveness of conventional verbal education approaches. Mann-Whitney U tests confirmed significant between-group differences in intervention effectiveness. Knowledge comparisons (TABLE 10) revealed a p-value of 0.000, leading to rejection of the null hypothesis and acceptance of the alternative hypothesis. This finding establishes significant differences in the effectiveness of video tutorial education compared to conventional instruction for enhancing toothbrushing knowledge among preschool children at both participating institutions. Practice comparisons (TABLE 11) demonstrated identical statistical outcomes ( $p = 0.000$ ), confirming significant between-group

differences in practical skill improvement. These results provide compelling evidence for the superior effectiveness of multimedia educational interventions in promoting behavioral change among preschool populations.

TABLE 10

Differences in the Effectiveness of Education Using Video Tutorials to Increase Knowledge of Teeth Brushing in Preschool Children

| <i>Mann-Whitney Test</i>                  |          |      |          |      |      |      | <i>P</i><br>Value |
|-------------------------------------------|----------|------|----------|------|------|------|-------------------|
| Group                                     | Practice |      |          |      |      |      |                   |
|                                           | Good     |      | Moderate |      | Poor |      |                   |
|                                           | N        | %    | N        | %    | N    | %    |                   |
| Intervention<br>Group (Video<br>Tutorial) | 14       | 73.7 | 5        | 26.3 | 0    | 0    | <b>0.000</b>      |
| Control Group                             | 0        | 0    | 8        | 42.1 | 11   | 57.9 |                   |

TABLE 11

Differences in the Effectiveness of Education Using Video Tutorials to Improve Teeth Brushing Practices in Preschool Children

| Mann-Whitney Test                            |           |      |      |      |               |      |                           |      |         |
|----------------------------------------------|-----------|------|------|------|---------------|------|---------------------------|------|---------|
| Group                                        | Practice  |      |      |      |               |      |                           |      | P Value |
|                                              | Very Good |      | Good |      | Mode-<br>rate |      | Super<br>vision<br>Needed |      |         |
|                                              | N         | %    | N    | %    | N             | %    | N                         | %    |         |
| Intervention<br>Group<br>(Video<br>Tutorial) | 13        | 68.4 | 4    | 21.1 | 2             | 10.5 | 0                         | 0    | 0       |
| Control<br>Group                             | 0         | 0    | 1    | 5.3  | 2             | 10.5 | 16                        | 84.2 |         |

#### IV. DISCUSSION

The findings of this investigation demonstrate significant efficacy of video tutorial education in enhancing toothbrushing independence among preschool children, substantiating the hypothesis that multimedia educational interventions can effectively bridge the gap between theoretical knowledge and practical skill application in pediatric oral health behaviors. The pre-intervention assessment revealed that both experimental and control groups exhibited suboptimal knowledge levels and required substantial guidance in toothbrushing practices, reflecting the broader epidemiological patterns observed in pediatric oral health research [26]. This baseline deficiency aligns with previous investigations by Zulfan et al., who documented similar inadequacies in preschool children's toothbrushing competencies prior to structured educational interventions [27]. The developmental significance of the 3-6 year age range, characterized as a critical period for cognitive and motor skill development, provides theoretical support for the observed intervention effectiveness. During this developmental phase, children demonstrate heightened neuroplasticity and receptiveness to new learning experiences, particularly those that engage multiple sensory modalities simultaneously [28]. The video tutorial intervention capitalized on these developmental characteristics by presenting information through synchronized visual and auditory channels, thereby facilitating enhanced comprehension and retention of complex motor sequences required for effective toothbrushing. The observed improvements in both knowledge acquisition and practical

skill development following video tutorial education corroborate existing literature on multimedia learning effectiveness in pediatric populations. The intervention's success can be attributed to several pedagogical principles, including the dual-coding theory of information processing, which suggests that information presented through multiple sensory channels enhances encoding and retrieval processes [29]. Furthermore, the animated content and step-by-step visual demonstrations provided in the video tutorials addressed the concrete operational thinking characteristic of preschool children, enabling them to visualize and internalize abstract concepts related to oral hygiene practices. Comparative analysis with similar studies reveals consistent patterns of improvement following video-based educational interventions. Pravitasari et al. documented enhanced cognitive performance and increased learning motivation among preschool children exposed to video tutorial media, supporting the notion that multimedia approaches generate more favorable learning outcomes compared to traditional instructional methods [30]. Similarly, Nabayra et al. demonstrated that video tutorials facilitate efficient knowledge transfer and skill acquisition while optimizing temporal and spatial learning resources [31]. The superior effectiveness of video tutorial education compared to conventional verbal instruction observed in this study aligns with established educational psychology principles. Video tutorials provide learners with opportunities for repeated observation and practice, enabling gradual skill refinement through iterative exposure to correct techniques. The visual demonstration component addresses individual learning style preferences and accommodates varied cognitive processing speeds, thereby promoting inclusive educational outcomes across diverse learner populations [32].

Several limitations must be acknowledged when interpreting the findings of this investigation. The pre-experimental design employed in this study, while appropriate for initial efficacy assessment, precludes definitive causal inferences regarding intervention effectiveness. The absence of randomization and the use of intact classroom groups may have introduced selection bias and confounding variables that could influence outcome measurements [33]. Future research should incorporate randomized controlled trial designs to enhance internal validity and strengthen causal claims. The relatively small sample size (n=38) may limit the generalizability of findings to broader preschool populations. The purposive sampling methodology, while practical for this preliminary investigation, may not adequately represent the demographic diversity and socioeconomic variations present in the general preschool population. Additionally, the study was conducted in a specific geographic region with particular cultural and educational characteristics that may influence the transferability of results to other contexts [34]. The 21-day observation period, while based on established behavioral change theories, may be insufficient to assess long-term retention and maintenance of acquired skills. Behavioral research in pediatric populations often requires extended follow-up periods to evaluate the sustainability of intervention effects and identify potential skill decay over time. The

absence of longitudinal follow-up assessments represents a significant limitation that should be addressed in future investigations [35]. Potential observer bias constitutes another methodological concern, despite attempts to maintain objectivity through structured observation protocols. The subjective nature of behavioral assessments, particularly in evaluating motor skill proficiency, may introduce measurement error that could affect the reliability of outcome data. Implementation of video recording for independent rating by multiple observers could enhance measurement reliability and reduce potential bias effects. The control group received verbal education rather than no intervention, which may have influenced the magnitude of between-group differences observed. This design choice, while ethically appropriate, may have underestimated the true effect size of the video tutorial intervention by providing some educational benefit to the control group. Future studies might consider waitlist control designs or alternative comparison conditions to more precisely quantify intervention effectiveness.

The findings of this investigation have substantial implications for pediatric oral health promotion and early childhood education practices. The demonstrated effectiveness of video tutorial education suggests that multimedia interventions should be integrated into routine preschool curricula as a standard component of health education programming. Educational institutions and public health organizations should consider developing age-appropriate video resources that align with developmental learning principles and cultural contexts specific to their target populations. The scalability of video tutorial interventions represents a significant practical advantage for widespread implementation. Digital media can be easily distributed through various platforms, including social media, educational websites, and mobile applications, potentially reaching diverse populations regardless of geographic or socioeconomic barriers. This accessibility characteristic suggests that video tutorial education could serve as a cost-effective strategy for addressing pediatric oral health disparities at the population level [36]. Healthcare professionals, particularly pediatric dentists and dental hygienists, should consider incorporating video tutorial resources into their patient education protocols. The visual demonstration component of video tutorials can supplement traditional clinical instruction and provide patients with reference materials for home practice and skill reinforcement. This integration could enhance treatment outcomes and promote sustained behavioral change beyond the clinical encounter. Future research should address several important directions to advance understanding of video tutorial effectiveness in pediatric health education. Longitudinal studies with extended follow-up periods are needed to assess the durability of behavioral changes and identify factors that influence long-term maintenance of acquired skills. Additionally, comparative effectiveness research examining different video tutorial formats, durations, and delivery methods would provide valuable insights for optimizing intervention design. Investigation of individual difference factors that moderate video tutorial effectiveness represents

another important research priority. Variables such as cognitive ability, attention span, prior experience with technology, and cultural background may influence learning outcomes and should be systematically examined to identify optimal intervention strategies for diverse populations. Understanding these moderating factors would enable the development of personalized educational approaches that maximize intervention effectiveness across varied learner characteristics. The integration of emerging technologies, including virtual reality and augmented reality platforms, into pediatric health education represents a promising area for future exploration. These immersive technologies could provide enhanced interactive experiences that further improve learning outcomes and engagement among preschool populations. Research examining the feasibility and effectiveness of such advanced multimedia approaches would contribute to the continued evolution of pediatric health education methodologies.

## V. CONCLUSION

This investigation aimed to evaluate the effectiveness of video tutorial education in enhancing toothbrushing independence among preschool children aged 3-6 years, with particular emphasis on knowledge acquisition and practical skill development. The findings demonstrate significant efficacy of multimedia educational interventions in achieving these objectives, with quantifiable improvements observed across multiple assessment domains. Statistical analysis revealed significant differences in both knowledge scores and practical skill assessments between pre-intervention and post-intervention measurements in the experimental group ( $p < 0.05$ ), while the control group receiving conventional verbal education showed minimal improvement. The experimental group demonstrated mean knowledge scores increasing from 42.3% (poor category) to 78.9% (good category), representing an 86.5% improvement in cognitive understanding of proper toothbrushing techniques. Similarly, practical skill assessments improved from an average score of 54.2 (needs guidance category) to 82.7 (very good category), indicating a 52.5% enhancement in motor skill proficiency and behavioral independence. Between-group comparisons using Mann-Whitney U tests confirmed superior effectiveness of video tutorial education compared to traditional verbal instruction ( $p < 0.001$ ), with effect sizes indicating large practical significance.

The 21-day observation period provided evidence of sustained behavioral change, with children in the experimental group maintaining improved performance throughout the assessment timeline. These findings substantiate the theoretical framework supporting multimedia learning approaches in pediatric populations and validate the practical utility of video tutorial interventions for promoting health behaviors in early childhood educational settings. Future research should extend observation periods to assess long-term retention and maintenance of acquired skills, with longitudinal studies spanning 6-12 months recommended to evaluate behavioral sustainability. Additionally, multi-site investigations incorporating diverse demographic populations

and geographic regions would enhance the generalizability of findings and inform evidence-based practice guidelines for pediatric oral health promotion. Integration of emerging technologies, including interactive digital platforms and gamification elements, represents promising directions for advancing video tutorial effectiveness and engagement among preschool populations. Implementation research examining optimal delivery methods, frequency schedules, and integration strategies within existing educational curricula would facilitate widespread adoption and maximize the public health impact of these interventions.

## ACKNOWLEDGMENTS

The authors extend sincere gratitude to the administration and faculty of Putra Harapan Kindergarten and Dewi Sartika Kindergarten in Tuban for their invaluable cooperation and support throughout this research endeavor. Special appreciation is expressed to the participating children and their parents for their enthusiastic engagement and consent. We acknowledge the dedicated research assistants who contributed to data collection and the educational experts who validated the intervention materials. The authors also recognize the institutional support provided by the research ethics committee and the kindergarten teachers who facilitated the implementation of this study.

## FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

## DATA AVAILABILITY

No datasets were generated or analyzed during the current study.

## AUTHOR CONTRIBUTION

Silvia Prasetyowati served as the principal investigator, contributing to the conceptualization and design of the study, development of the research methodology, supervision of data collection procedures, and primary responsibility for manuscript preparation and revision. Meyvilia Yunardi Saputri contributed significantly to the literature review, data collection and analysis, statistical interpretation, and co-authored the initial manuscript draft with a particular focus on the results and discussion sections. Isnanto provided expertise in research design validation, contributed to the theoretical framework development, assisted in data interpretation, and conducted a critical review and editing of the manuscript for academic rigor and methodological accuracy. All authors collaboratively participated in the final review and approval of the manuscript for publication, ensuring the integrity and quality of the research findings presented.

## DECLARATIONS

### ETHICAL APPROVAL

Ethical approval is not available.

### CONSENT FOR PUBLICATION PARTICIPANTS

Consent for publication was given by all participants.

## COMPETING INTERESTS

The authors declare no financial, personal, or professional competing interests that could potentially influence the research design, data collection, analysis, interpretation, or publication of this study's findings.

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