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The Effect of Education with an Islamic Approach Addition in the Diffusion of Innovation for Oral Health Maintenance Using Siwak

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Abstract
The WHO states that tooth decay is the most common chronic disease experienced by people around the world. The result of the 2023 SKI shows that, on average, people aged ≥ 3 years in the last year complained of having dental and oral problems. One of the teachings of Islam regarding health is the Islamic recommendation on dental and oral health, and one of the things recommended by the Prophet Muhammad is to use a miswak. Islamic boarding schools are expected to educate their student in all aspects in accordance with Islamic values and norms, including aspects of dental and oral health. This study aims to analyze the differences in education with the addition of an Islamic approach in the diffusion of innovation in oral health maintenance using siwak. This approach is examined through five characteristics of innovation according to the theory of innovation diffusion, namely relative advantage, compatibility, complexity, triability, and observability. The research method used a quasi-experimental design with two treatment groups: education without the addition of an Islamic approach and education with the addition of an Islamic approach. The sampling technique used was purposive sampling, and the total number of respondents in this study was 60 students. The result shows that education with the addition of an Islamic approach showed a significant increase in the characteristics of triability and observability, and generally yielded higher scores compared to education without the addition of an Islamic approach. The Islamic approach was proven to be more effective in increasing respondents' decisions to use siwak and had a strong influence on the persuasion stage in the innovation adoption process. The conclusion is that the integration of religious values into health education can strengthen public acceptance and intention toward innovations in dental care based on the Sunnah.

Keywords: Oral Health, Siwak, Islamic Education, Innovation Diffusion, Islamic Boarding School.

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1. INTRODUCTION

Oral and dental diseases constitute a major global public health challenge due to their substantial health and socioeconomic impact. Dental caries remains the most prevalent chronic disease worldwide, affecting approximately 3.5 billion people, or nearly half of the global population (Badan Penelitian dan Pengembangan Kesehatan, 2024). In Indonesia, oral and dental health problems remain highly prevalent. Data from the 2023 Survei Kesehatan Indonesia (SKI) indicate that 57% of individuals aged three years and older reported experiencing oral and dental problems within the past year. These issues are primarily driven by a high prevalence of dental caries, limited access to dental services, and insufficient oral health education. According to the WHO Oral Health Country Profile, Indonesia ranks second in Southeast Asia in total dental care expenditure after Singapore, reflecting the growing economic burden associated with treatment costs and productivity loss (Badan Penelitian dan Pengembangan Kesehatan, 2024).

Dental caries develops as a result of bacterial plaque metabolism of sugars, producing lactic acid and other organic acids that lower plaque pH and lead to enamel demineralization (Sharma et al., 2019). Regular and correct tooth brushing is therefore essential for maintaining oral hygiene. However, the 2018 Riskesdas report showed that although 98.5% of individuals aged 15–24 years brush their teeth daily, only 3.3% do so at the recommended times (Badan Penelitian dan Pengembangan Kesehatan, 2019). According to Green's behavioral theory, individual health status is largely determined by personal behavior (Hulu et al., 2020). Consequently, effective and contextually appropriate health promotion strategies are crucial to encourage sustained oral health behaviors (Budiarti, 2013).

Education plays a central role in shaping health behavior. The scientific approach emphasizes systematic and empirical knowledge development, while Islamic counseling seeks to foster knowledge, beliefs, and practices aligned with Islamic teachings and moral values. Religious and cultural values significantly influence attitudes, motivation, and behavior (Budiarti, 2013). In Islam, cleanliness and health are strongly emphasized, as reflected in the saying of the Prophet Muhammad (peace be upon him), "Cleanliness is part of faith" (Hidayati et al., 2023). Oral health holds particular importance in Islamic teachings, as the mouth serves as an entry point for both nourishment and disease (Marzband et al., 2016; Firdaus et al., 2023).

One of the recommended practices for maintaining oral hygiene in Islam is the use of siwak, derived from Salvadora persica (Putra, 2021). The Prophet Muhammad regularly used siwak upon waking, before prayer, and before entering his home (Aboul-Enein, 2014). Siwak has been shown to clean teeth, reduce halitosis, and help maintain saliva pH balance (Thioritz & Ilham, 2021). In Indonesia, Islamic boarding schools (pondok pesantren) serve as influential educational environments where students' daily behaviors, including hygiene practices, are shaped under the guidance of religious leaders (Mahrisa et al., 2020). Previous studies indicate that attitudes, subjective norms, perceived behavioral control, and oral health knowledge influence students' intentions to maintain oral hygiene (Bramantoro et al., 2020).

Although various studies have examined oral health education and the benefits of siwak, limited research has integrated Islamic-based educational approaches with the Diffusion of Innovation (DOI) theory to promote oral hygiene behaviors. According to Rogers, innovation adoption is influenced by five attributes: relative advantage, compatibility, complexity, trialability, and observability (Sahin, 2006). A preliminary study conducted at Madrasah Aliyah Pondok Pesantren At Tauhid Sidoresmo Dalam Surabaya reported that 70% of students experienced dental caries, while none used siwak as an oral hygiene tool (Adam et al., 2022). This indicates a gap in culturally and religiously grounded educational strategies that align scientific knowledge with Islamic values.

Therefore, the novelty of this study lies in integrating Islamic-based education within the diffusion of innovation framework to enhance the adoption of siwak as a sustainable oral health practice. The purpose of this study is to analyze the differences in the effectiveness of education without an Islamic approach and education incorporating an Islamic approach on the diffusion of innovation for oral health maintenance using siwak among students of Madrasah Aliyah Pondok Pesantren At Tauhid Sidoresmo Dalam Surabaya.

2. RESEARCH METHOD

This study employed a quasi-experimental research design using a pre-test–post-test control group approach to examine the effect of educational interventions with and without the addition of an Islamic approach on the diffusion of innovation in oral health maintenance using *siwak*. The design enabled the observation of changes in persuasion and decision-making related to the innovation, both before and after the intervention.

The population of this study consisted of 126 tenth-grade students from SMA An Najiyah Pondok Pesantren An Najiyah Sidosermo Surabaya and Madrasah Aliyah Pondok Pesantren At Tauhid Sidoresmo Dalam Surabaya. A purposive sampling technique was applied to select participants who met the inclusion criteria, namely students aged 15–18 years currently enrolled in grade X. Exclusion criteria included students unable to read or write and those unwilling to participate. Although the minimum sample size required was 16 participants, the researcher recruited 60 students, consisting of 30 students from SMA An Najiyah Pondok Pesantren An Najiyah as the control group (education without the Islamic approach) and 30 students from Madrasah Aliyah Pondok Pesantren At Tauhid as the intervention group (education with the Islamic approach). The research was conducted in June 2025 at both educational institutions.

Prior to data collection, all participants received a detailed explanation of the study's objectives and procedures during a pre-study briefing session. Participants were then asked to provide written informed consent before taking part in the research. The pre-test was administered to evaluate the students' initial levels of persuasion and decision-making regarding the use of *siwak* in maintaining oral health. Following the pre-test, the educational intervention was delivered, in which the researcher provided material on oral health innovation through *siwak* use. Each respondent also received a *siwak* kit to support practical learning.

One day after the educational session, a post-test was administered to assess any changes in students' persuasion and decision-making toward adopting *siwak* as an innovative oral hygiene practice. The data obtained from both groups were analyzed using paired sample comparative statistical tests to determine the effect of the educational intervention, both with and without the Islamic approach, on the diffusion of innovation related to *siwak* use.

This research adhered to ethical standards and received ethical approval from the Ethics Committee of the Faculty of Dental Medicine, Airlangga University, under approval number 0681/HRECC.FODM/VI/2025.

3. RESULTS AND DISCUSSION

Table 1. Distribution of respondents based on student characteristics.

Characteristics	Education group without additional approaches		Education group with additional Islamic methods	
	Frecuency(n)	Percentage (%)	Frecuency (n)	Persentage (%)
Age				
15 years old	1	3.3 %	1	3.4 %
16 years old	4	13.3 %	16	53.3 %
17 years old	20	66.7 %	13	43.3 %

18 years old	5	16.7 %	-	-
Gender				
Male	8	26.7 %	16	53.3 %
Female	22	73.3 %	14	46.7 %
Academic Achievement				
Fair	13	43.3 %	1	3.4 %
Good	8	26.7 %	13	43.3 %
Very Good	9	30 %	16	53.3 %
Father's Occupation				
Employee	11	36.7 %	11	36.7 %
Entrepreneur	19	63.3 %	19	63.3 %
Mother's Occupation				
Housewife	19	63.3 %	19	63.3 %
Employee	4	13.3 %	4	13.3 %
Entrepreneur	7	23.3 %	7	23.3 %
Monthly Allowance				
Below average	16	53.3 %	12	40 %
Above average	14	46.7 %	18	60 %

Based on Table 1, the characteristics of respondents in the group that received education without the Islamic approach showed that the majority were 17 years old (66.7%), whereas in the group that received education with the Islamic approach, most respondents were 16 years old (53.3%). In the non-Islamic education group, the majority of respondents were female (73.3%), while in the Islamic approach group, most were male (53.3%). Regarding academic performance, respondents in the non-Islamic education group were mostly categorized as fair (43.3%), while those in the Islamic approach group were predominantly categorized as very good (53.3%). The occupations of fathers in both groups were generally entrepreneurs (63.3%), and most mothers were housewives (63.3%) in both groups. In terms of monthly allowance, the majority of respondents in the non-Islamic education group received below-average allowances (53.3%), whereas in the Islamic approach group, most respondents received above-average allowances (60%).

Table 2. Results of the Wilcoxon Test for the Education Group without the Islamic Approach.

Variable	**Group**		**Sig.**
	Pretest (Mean ± SD)	**Posttest (Mean ± SD)**	
Overall	8.125 ± 1.281	8.466 ± 1.153	0.085
Relative Advantage	3.066 ± 0.520	3.066 ± 0.583	1
Compatibility	8.633 ± 1.771	9.366 ± 1.586	0.029
Complexity	5.600 ± 1.275	6.166 ± 1.116	0.042
Trialability	9.333 ± 1.470	9.266 ± 1.507	0.960
Observability	8.933 ± 1.720	9.066 ± 1.574	0.648

According to Table 2, which presents the results of the Wilcoxon signed-rank test for the non-Islamic education group, the overall mean score increased slightly from 8.125 in the pre-test to 8.466 in the post-test, with a significance value of 0.085 (>0.05). This indicates that there was no statistically significant difference between the pre-test and post-test results. The relative advantage variable showed no change, with identical pre-test and post-test means of 3.066 and a significance value of 1.000 (>0.05), suggesting no significant improvement. In contrast, the compatibility variable demonstrated a significant increase from 8.633 to 9.366 ($p = 0.029 < 0.05$), and the complexity variable also showed a significant improvement from 5.600 to 6.166

(p = 0.042 < 0.05). However, the trialability (p = 0.960) and observability (p = 0.648) variables exhibited no significant changes. These results indicate that education without the Islamic approach was effective in improving compatibility and complexity but did not significantly influence other aspects.

Table 3. Results of the Wilcoxon Test for the Education Group with the Islamic Approach.

Variable	Group		Sig.
	Pretest (Mean ± SD)	Posttest (Mean ± SD)	
Overall	7.841 ± 0.896	8.600 ± 0.661	0.000
Relative Advantage	2.833 ± 0.592	3.166 ± 0.379	0.021
Compatibility	8.566 ± 1.194	9.366 ± 1.033	0.002
Complexity	5.933 ± 0.907	6.333 ± 0.660	0.071
Trialability	8.566 ± 1.06	9.366 ± 1.129	0.002
Observability	8.300 ± 1.512	9.333 ± 0.758	0.001

As shown in Table 3, for the group that received education incorporating the Islamic approach, the overall mean score increased from 7.841 in the pre-test to 8.600 in the post-test, with a significance value of 0.000 (<0.05), indicating a statistically significant improvement. The relative advantage variable showed a significant increase from 2.833 to 3.166 (p = 0.021 < 0.05), and compatibility also increased significantly from 8.566 to 9.366 (p = 0.002 < 0.05). Although the complexity variable increased slightly from 5.933 to 6.333, the difference was not significant (p = 0.071 > 0.05). The trialability variable increased significantly from 8.566 to 9.366 (p = 0.002 < 0.05), and observability also showed a significant improvement from 8.300 to 9.333 (p = 0.001 < 0.05). These findings suggest that the integration of Islamic principles into the educational approach had a positive effect on several dimensions of innovation adoption, particularly relative advantage, compatibility, trialability, and observability.

Table 4. Results of the Mann-Whitney Test between the Education Group without the Islamic Approach and the Education Group with the Islamic Approach.

Variable	Group		Sig.
	Without the Addition of the Islamic Approach (Mean ± SD)	With the Addition of the Islamic Approach (Mean ± SD)	
Relative Advantage	0.000 ± 0.587	0.333 ± 0.758	0.096
Compatibility	0.733 ± 1.818	0.800 ± 1.214	0.976
Complexity	0.566 ± 1.430	0.400 ± 1.132	0.614
Trialability	-0.066 ± 1.460	0.800 ± 1.323	0.034
Observability	0.133 ± 1.888	1.033 ± 1.351	0.043

Table 4 presents the results of the Mann-Whitney test comparing the education with and without the Islamic approach. No significant differences were found in the variables of relative advantage (p = 0.096), compatibility (p = 0.976), and complexity (p = 0.614). However, significant differences were observed in trialability (p = 0.034) and observability (p = 0.043). This indicates that the integration of the Islamic approach into education significantly enhanced participants' perceptions of trialability and observability, suggesting that Islamic-based education made the innovation easier to try and its benefits more visible to participants.

Table 5. Results of the McNemar Test on Siwak Use Decisions in the Education Group without the Islamic Approach.

Decision		No	Yes	Total	Sig
Pre test	**n**	6	24	30	0.375
	%	20%	80%	100%	
Post test	**n**	3	27	30	
	%	10%	90%	100%	

According to Table 5, which shows the McNemar test results for the non-Islamic education group, there was no significant difference in respondents' decisions to use siwak between the pre-test and post-test ($p = 0.375 > 0.05$). Before the intervention, 80% of respondents decided to use siwak, while 20% did not. After the educational intervention, 90% decided to use siwak and 10% did not. Although there was a numerical increase in siwak use, the difference was not statistically significant.

Table 6. Results of the McNemar Test on Siwak Use Decisions in the Education Group with the Islamic Approach.

Decision		No	Yes	Total	Sig
Pre test	**n**	12	18	30	0.004
	%	40%	60%	100%	
Post test	**n**	3	27	30	
	%	10%	90%	100%	

In contrast, Table 6 presents the McNemar test results for the education group with the Islamic approach, showing a statistically significant difference in decisions before and after the intervention ($p = 0.004 < 0.05$). Before the intervention, 60% of respondents decided to use siwak, while 40% did not. Following the intervention, 90% decided to use siwak, and only 10% did not. These results demonstrate that the integration of the Islamic approach in education significantly influenced participants' decision-making, strengthening their motivation and commitment to adopting siwak as part of their oral hygiene practices.

This study examined the effect of education with the addition of an Islamic approach in the diffusion of innovation for oral health maintenance using siwak among high school students in Surabaya. The respondents consisted of 60 students from two schools, each group receiving different educational interventions. The findings revealed interesting patterns in demographic characteristics, persuasion processes, and decision-making stages related to the adoption of siwak as an oral health innovation.

Most respondents were between 16 and 17 years old, with a relatively balanced distribution of gender and academic achievement across both groups. The majority of the students' fathers worked as entrepreneurs and their mothers as housewives, while the average monthly allowance was slightly higher in the group that received Islamic-based education. These socio-demographic factors provided an initial understanding of the students' background, which might influence their openness to adopting health-related innovations.

The diffusion of innovation theory explains that persuasion plays a critical role in determining whether individuals will accept or reject a new idea. The findings indicated that education with an Islamic approach significantly improved students' perceptions of siwak's relative advantages, while conventional education did not yield such improvement. This suggests that integrating religious and cultural values into health education enhances the perceived benefits of siwak use. These results are consistent with Suryafma et al. (2023), and Syarifah et al. (2020), who found that relative advantage positively affects innovation adoption, including in digital and financial technology contexts.

Furthermore, both educational approaches were found to significantly increase compatibility perceptions, indicating that students perceived siwak use as consistent with their personal values and needs. This aligns with Rogers' diffusion theory and studies by Al-Jabri and Sohail (2012) and Suryafma et al. (2023), which emphasized that compatibility facilitates innovation adoption. However, differences emerged in the perception of complexity. The group without the Islamic approach showed a significant change, while the group with the Islamic component did not. This might be due to the perception that incorporating siwak within religious contexts such as using it before prayers requires additional effort, making it seem more complex to practice. Similar findings were reported by Suryafma et al. (2023), Al-Jabri and Sohail (2012), and Rahmawati et al. (2023), who noted that complexity is not always the dominant determinant of adoption.

The variable of trialability demonstrated that students who received education with an Islamic approach were more inclined to try siwak before committing to regular use, compared with those in the non-Islamic education group. This finding supports Rogers' theory and previous studies by Intani and Rikumahu (2020), and Suryafma et al. (2023), which emphasized that the ability to experiment with an innovation increases the likelihood of its adoption. Similarly, observability improved significantly among students receiving the Islamic-based education, suggesting that linking siwak practice to visible religious and cultural values made it more socially observable and acceptable. These findings echo those of Intani and Rikumahu (2020), who highlighted the role of observability in promoting innovation adoption.

At the decision-making stage, the data indicated that educational intervention with an Islamic approach was more effective in influencing students' willingness to adopt siwak. The number of respondents willing to use siwak increased significantly in this group, whereas the non-Islamic education group showed no significant difference. This underscores the power of integrating Islamic values such as the Prophet Muhammad's example of maintaining oral hygiene through siwak in shaping behavioral intentions. The results are supported by studies by Trisna et al. (2025), Elsayed et al. (2023), which found that incorporating spiritual and scientific perspectives enhances the effectiveness of health education. Moreover, Amiruddin et al. (2024) demonstrated that Islamic approaches are particularly effective in modifying smoking behavior among students compared to educational or health-based approaches alone. Community engagement research by Al Faizi and Saputra (2025) further emphasized that Islamic-based health education can increase public participation in health services. Waqar et al. (2024) similarly observed that faith-based educational interventions improved knowledge and screening participation among Muslim communities in East London.

Religiosity, therefore, emerges as a meaningful determinant of health behavior change. The incorporation of Islamic teachings not only increases awareness but also fosters intrinsic motivation to adopt healthy practices as part of faith-based behavior. This finding aligns with Abd Rahman et al. (2015), who reported a positive relationship between religiosity and individual health attitudes and practices.

Despite these promising findings, this study has several limitations. Some respondents might have been previously exposed to information about siwak, potentially influencing their responses. Additionally, differences in individual characteristics such as prior knowledge, religious commitment, and socio-economic background were not controlled in the analysis, which may have affected the results. Response bias in questionnaire completion might also have occurred due to differences in interpretation or honesty. Future research should therefore include more diverse samples, incorporate qualitative validation through triangulation, and explore additional psychosocial variables to obtain more comprehensive insights into faith-based health behavior adoption.

4. CONCLUSION

Based on the findings of this study on the effect of education with the addition of an Islamic approach in the diffusion of innovation for oral health maintenance using siwak, several

conclusions can be drawn. Education incorporating an Islamic approach significantly enhanced persuasion in terms of relative advantage, compatibility, trialability, and observability, but not in the aspect of complexity. The significant differences compared to education without the Islamic component were found particularly in the aspects of trialability and observability. These findings indicate that Islamic-based education fosters a more positive attitude toward innovation and significantly increases respondents' intention to use siwak.

Furthermore, education without the addition of an Islamic approach did not significantly influence respondents' decisions regarding siwak use, whereas education incorporating Islamic values did show a significant effect. This suggests that the inclusion of Islamic principles provides moral encouragement and strengthens individual conviction in making the decision to adopt siwak as part of oral health maintenance practices.

Future studies are recommended to involve samples with similar characteristics or to conduct more specific analyses focusing on individual factors that may influence siwak use. Further research should explore motivational and barrier-related aspects in greater depth to better understand the psychological, cultural, and spiritual dimensions affecting the adoption of siwak as an innovation in oral health behavior.

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