

Research Article

The Effectiveness of An Android-Based Quitee Educational Game on Adolescents' Motivation and Oral Health Knowledge

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ABSTRACT

Introduction: Oral and dental health problems remain a major public health concern, particularly among adolescents. Based on the Indonesian Health Survey (SKI) 2023, dental caries prevalence among children aged 10–14 years reached 37.2%. Adolescents are vulnerable due to behavioral changes and limited awareness of oral hygiene. Knowledge and motivation are important factors in promoting healthy behaviors. Therefore, interactive technology-based media, such as digital games, may be an effective educational approach.

Materials and Methods: This study aimed to evaluate the effectiveness of the Android-based Quitee educational game in improving adolescents' oral health knowledge and motivation. A pre-experimental one-group pretest-posttest design was conducted among 158 students of SMP Negeri 29 Makassar, selected using purposive sampling. Data were collected using validated questionnaires consisting of 10 knowledge and 10 motivation items, scored 1 for correct and 0 for incorrect responses.

Results and Discussion: Following the intervention, motivation scores increased from 5.00 to 8.08, while knowledge scores increased from 5.59 to 8.10. Both improvements were statistically significant ($p < 0.001$). The findings indicate that Quitee effectively improved adolescents' oral health knowledge and motivation, with a greater effect observed on motivation.

Conclusion: The Android-based Quitee educational game is a promising digital medium for improving oral health knowledge and motivation among adolescents.

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INTRODUCTION

Poor oral conditions may lead to discomfort, functional limitations, and reduced well-being, particularly during adolescence, a period characterized by rapid physical and psychological changes.¹ Multiple determinants affect oral health status, including biological factors, hygiene behaviors, dietary patterns, socioeconomic background, and accessibility to dental services. Adolescence represents an important stage of development marked by major physical, hormonal, and psychological changes.² During this stage, adolescents may face an increased risk of oral health problems due to poor oral hygiene practices, dietary changes, and evolving lifestyle behaviors. As adolescents become more independent, maintaining proper oral hygiene may become less of a priority.³ In addition, peer influence, academic pressures, and increased autonomy in lifestyle choices may further contribute to neglect of oral health practices. Therefore, improving adolescents' knowledge and motivation toward oral health is essential to encourage the adoption and maintenance of healthy oral hygiene behaviors. Early intervention during this critical developmental stage is crucial for preventing long-term oral health problems and establishing sustainable health-related habits that can persist into adulthood.

Oral health promotion can be enhanced through interventions that address behavioral and psychological factors.⁴ Research has shown that approaches grounded in behavioural theories and incentive tactics may effectively promote improved oral health behaviours. Among these treatments that aim to promote long-term behavioural change are practical toothbrushing exercises, gamification, audio-visual teaching, and ongoing reinforcement. Oral health promotion efforts should also consider environmental factors, education,

and community awareness as essential components of prevention.⁵ In this context, knowledge plays an important role in determining an individual's oral health status and acts as a predisposing factor for behavioral change, as behavior is largely influenced by cognitive understanding. In addition, motivation functions as a psychological driver that encourages individuals to engage in learning processes and adopt behaviors necessary to maintain oral health. Furthermore, motivation not only initiates behavior change but also sustains long-term adherence to healthy practices. Therefore, the use of appropriate educational media, including digital and technology-based approaches, has become increasingly important in delivering oral health education in a more effective, engaging, and sustainable manner.⁶

The rapid advancement of smartphone technology has led to the emergence of mobile-based health education platforms that provide more interactive and flexible learning opportunities.⁷ In oral health education, traditional approaches such as verbal, written, and audio-visual methods are commonly used in schools; however, the emergence of mobile health (mHealth) provides new opportunities for delivering more accessible and engaging health education.⁸ Adolescence, defined as the age of 10–19 years, is a pivotal period of development marked by changes in biological, emotional, and behavioural factors that could impact dental hygiene routines.⁹ Studies have shown that teens may benefit from digital technology, especially educational games and mobile apps, in terms of motivation, health awareness, and the ability to make beneficial behavioural adjustments.¹⁰ These technologies allow users to engage with educational content in a more personalized and interactive manner, which may improve retention and understanding of information. One example is the

Quitee application, an Android-based educational platform that provides interactive features such as quizzes, puzzles, and mini-games to promote oral health awareness. Nevertheless, previous studies have mainly focused on the development of educational media or knowledge improvement, highlighting the need for further research evaluating the effectiveness of such applications in improving both motivation and oral health knowledge among adolescents, particularly within real-world educational settings.

Multiple studies have shown that oral health teaching programs that include gaming mechanics are more successful. Based on the findings of Baviskar S.A. et al., game-based learning using interactive technologies may enhance oral health knowledge, attitudes, and behaviors among teenagers.¹¹ Mendonça T.S. et al.¹² further emphasized that oral health education games utilize familiar media and animations to deliver information interactively and encourage behavioral change through engaging designs.¹² In addition, Nagarajappa S. et al.¹³ highlighted the potential of smartphone applications in oral health education by assessing the impact of the Dent-O-Xpert application on knowledge, attitudes, and behaviors among adolescents.¹³ Likewise, Gunawan E. et al.¹⁴ reported that educational games can function as effective learning media, as shown in their study using a visual novel game to improve oral health education among adolescents.¹⁴ Furthermore, digital health interventions such as mobile applications incorporating gamification features have been shown to enhance motivation, engagement, and behavior change in maintaining oral hygiene among adolescents.¹⁵ These findings suggest that integrating interactive and technology-based approaches into health education may provide more effective learning experiences compared to conventional

methods, particularly among digitally engaged populations such as adolescents.

However, previous studies have generally focused on specific game formats, such as board games, crossword puzzles, visual novel games, or mobile applications targeting different age groups and learning outcomes. Most of these studies emphasize improvements in oral health knowledge, attitudes, or behavioral awareness among children or young adults. Meanwhile, studies examining the use of Android-based educational games among adolescents, particularly junior high school students, remain relatively limited. In addition, only a few studies have simultaneously assessed the impact of digital educational media on both motivation and oral health knowledge among adolescents. This indicates a gap in the literature regarding comprehensive evaluations of game-based educational interventions that address both cognitive and psychological aspects of learning. Therefore, this study aims to analyze the effectiveness of the Android-based Quitee educational game on adolescents' motivation and oral health knowledge. The Quitee application was selected because it was specifically designed for adolescent oral health education by integrating quizzes, puzzles, and mini-games into a single Android platform. Compared with many existing educational games that primarily focus on knowledge delivery, Quitee combines gamification features, interactive learning, and immediate feedback to enhance both motivation and knowledge acquisition

MATERIALS AND METHODS

The researchers in this study set out to use a pre-experimental one-group pretest-posttest design to examine the effect of the Android-based Quitee educational game on adolescents' motivation and oral health knowledge. Quitee is an

Android-based educational application that consists of interactive quizzes, puzzles, and mini-games covering topics such as proper toothbrushing techniques, dental caries prevention, healthy dietary habits, fluoride use, and regular dental visits. The application provides immediate feedback and gamification elements to encourage active participation throughout the learning process. September 2025 was the research date at SMP Negeri 29 in Makassar, Indonesia. It was possible to compare the same sample's motivation and knowledge levels before and after the intervention thanks to this design. Students at SMP Negeri 29 Makassar made up the population, and 158 of them, ranging in age from 13 to 14, were chosen using purposive sampling according to established inclusion criteria. Nobody was left out of the data since everyone who participated finished the survey. Two structured questionnaires, one evaluating knowledge and the other measuring motivation, were used to gather data. There were a total of ten questions on each survey. One point was deducted for every right answer and zero for every wrong or "do not know" response (0). The total score for each respondent was obtained by summing the scores of all 10 questions, yielding a maximum possible score of 10. Based on the total score, respondents' motivation and knowledge levels were categorized into three groups: good (80%–100%, equivalent to a score of 8–10), fair (50%–70%, or a score of 5–7), and poor ($\leq$ 40%, or a score of 0–4). The motivation questionnaire included items related to oral hygiene practices, attitudes, and learning interest, while the knowledge questionnaire assessed participants' understanding of oral health concepts and preventive behaviors. The motivation questionnaire and the oral health knowledge questionnaire were developed based on relevant literature. Both questionnaires

underwent validity and reliability testing prior to data collection to ensure their suitability for this study. Validity testing using item analysis showed that all items were valid ($p < 0.05$), and reliability testing indicated that both questionnaires were acceptable for use. The data collection procedure began with a pretest to assess baseline motivation and knowledge, followed by the intervention using the Android-based Quitee educational game, which was played three times within one week. A posttest was then conducted using the same questionnaires to evaluate changes after the intervention. The data was analysed using SPSS version 29. To evaluate the amount of score changes between motivation and knowledge, the Mann-Whitney test was used, and the Wilcoxon Signed Rank Test was utilised to check differences between pretest and posttest scores. Additionally, changes to each item on the questionnaire were examined using an item-based analysis. A p-value less than 0.05 was considered statistically significant, along with a 95% confidence interval.

RESULTS AND DISCUSSION

This study was conducted in September 2025 at SMP Negeri 29 Makassar over a one-week intervention period. Data collection was carried out before and after the implementation of the Quitee educational game. A total of 158 respondents participated and completed all stages of the study.

With the use of univariate analysis, we may learn more about the study's research factors, such as the demographics of the participants. The participants' ages are among the data points examined. All of the participants in this research were teenagers, ranging in age from thirteen to fourteen, according to the findings, representing junior high school students at SMP Negeri 29 Makassar. The majority of respondents were within this early

adolescent age group, which is considered a critical developmental stage characterized by behavioral and psychological changes that may influence oral health practices. These findings indicate that the respondents were relatively homogeneous in terms of age, focusing on early adolescence as the target population of this study.

Table 1. Distribution of motivation levels before and after intervention

Category	Pre (n, %)	Post (n, %)
Poor	31 (19.6%)	0 (0%)
Fair	106 (67.1%)	14 (8.9%)
Good	21 (13.3%)	144 (91.1%)
Total	158 (100%)	158 (100%)

The distribution of adolescents' motivation levels before and after the intervention is presented in Table 1. Prior to the intervention, most respondents were categorized as having fair motivation (67.1%), followed by poor (19.6%) and good motivation (13.3%). After the intervention, a substantial improvement was observed, with the majority of respondents classified as having good motivation (91.1%), while the remaining respondents (8.9%) were categorized as having fair motivation.

Table 2. Distribution of knowledge levels before and after intervention

Category	Pre (n, %)	Post (n, %)
Poor	31 (19.6%)	0 (0%)
Fair	106 (67.1%)	20 (12.7%)
Good	21 (13.3%)	138 (87.3%)
Total	158 (100%)	158 (100%)

The distribution of knowledge levels before and after the intervention is presented in Table 2. Before the intervention, most respondents demonstrated a fair level of knowledge (67.1%), followed by poor (19.6%) and good levels (13.3%). After the

intervention, the majority of respondents were categorized as having good knowledge (87.3%), while 12.7% remained in the fair category.

Table 3. Comparison of pretest and posttest scores of motivation and knowledge

Variable	Time	N	Mean	P-Value
Motivation	Pre-Test	158	5.00	<0.001
	Post-Test	158	8.08	
Knowledge	Pre-Test	158	5.59	<0.001
	Post-Test	158	8.10	

*Wilcoxon Signed Rank Test

Table 4. Comparison of score changes (Δ scores) between motivation and knowledge

Variable	Δ Score	P-Value
Motivation	3.08	<0.001
Knowledge	2.51	

*Mann-Whitney Test

In Table 3, it can be seen that the average motivation score went up from 5.00 before the intervention to 8.08 after it. In a similar vein, after the intervention, the average knowledge score rose from 5.59 on the pretest to 8.10. Both the motivation and knowledge scores showed statistically significant changes before and after using the Quitee educational game, which is based on Android ($p < 0.001$), according to the Wilcoxon Signed Rank Test. Based on Table 4, the mean score difference (Δ score) for motivation was 3.08, while the knowledge demonstrated a score difference of 2.51. The Mann-Whitney test revealed a statistically significant difference in the magnitude of score improvement between motivation and knowledge ($p < 0.001$). These findings indicate that the degree of improvement in motivation and knowledge differed significantly following the implementation of the Quitee educational game

Table 5. Item-based analysis of motivation

No.	Motivation item	Response	Pre-test, n (%)	Post-test, n (%)	p-value
1	I try to brush my teeth without being reminded by my parents.	Yes	78 (49.4)	133 (84.2)	<0.001
		No	80 (50.6)	25 (15.8)	
2	I try to avoid consuming excessive sugary foods and drinks because they can cause cavities.	Yes	80 (50.6)	136 (86.1)	<0.001
		No	78 (49.4)	22 (13.9)	
3	I try to consume foods that are beneficial for oral health.	Yes	73 (46.2)	133 (84.2)	<0.001
		No	85 (53.8)	25 (15.8)	
4	I try not to feel afraid when visiting the dentist.	Yes	85 (53.8)	134 (84.8)	<0.001
		No	73 (46.2)	24 (15.2)	
5	I am interested in learning more about proper oral and dental care.	Yes	76 (48.1)	129 (81.6)	<0.001
		No	82 (51.9)	29 (18.4)	
6	Dental appearance affects my self-confidence.	Yes	63 (39.9)	129 (81.6)	<0.001
		No	95 (60.1)	29 (18.4)	
7	I am interested in digital-based education about oral health.	Yes	73 (46.2)	136 (86.1)	<0.001
		No	85 (53.8)	22 (13.9)	
8	I feel the need to brush my teeth before going to bed.	Yes	84 (53.2)	129 (81.6)	<0.001
		No	74 (46.8)	29 (18.4)	
9	I feel that my breath becomes fresher after brushing my teeth.	Yes	80 (50.6)	135 (85.4)	<0.001
		No	78 (49.4)	23 (14.6)	
10	I brush my teeth regularly every day to prevent dental caries.	Yes	77 (48.7)	132 (83.5)	<0.001
		No	81 (51.3)	26 (16.5)	

Values are presented as n (%). p-values indicate differences between pre-test and post-test responses.

Based on Table 5, all items in the motivation questionnaire showed an increase in the proportion of “Yes” responses after the intervention. Before the intervention, respondents demonstrated fair levels of motivation across several aspects, including oral hygiene practices, dietary habits, dental visit behavior, learning interest, self-

confidence, and interest in digital health education. After the intervention, changes were observed across all these aspects, indicating an increase in adolescents’ motivation toward oral health. All items demonstrated statistically significant differences ($p < 0.001$).

Table 6. Item-based analysis of knowledge

No.	Knowledge item	Response	Pre-test, n (%)	Post-test, n (%)	p-value
1	Brushing teeth at least twice a day (in the morning after breakfast and at night before going to bed).	Yes	82 (51.9)	135 (85.4)	<0.001
		No	76 (48.1)	23 (14.6)	
2	Bleeding gums when brushing teeth is something that should be a concern.	Yes	86 (54.4)	118 (74.7)	<0.001
		No	72 (45.6)	40 (25.3)	
3	Smoking can damage teeth.	Yes	68 (43.0)	132 (83.5)	<0.001
		No	90 (57.0)	26 (16.5)	
4	Visiting the dentist is only necessary when experiencing pain.	Yes	63 (39.9)	118 (74.7)	<0.001
		No	95 (60.1)	40 (25.3)	
5	Food debris stuck between teeth can be cleaned using dental floss.	Yes	72 (45.6)	142 (89.9)	<0.001
		No	86 (54.4)	16 (10.1)	
6	Toothpaste containing fluoride can prevent dental caries.	Yes	85 (53.8)	135 (85.4)	<0.001
		No	73 (46.2)	23 (14.6)	
7	Toothbrushes should be replaced every 3 months or when the bristles are worn out.	Yes	68 (43.0)	134 (84.8)	<0.001
		No	90 (57.0)	24 (15.2)	
8	Teeth that are not properly cleaned can cause bad breath.	Yes	85 (53.8)	135 (85.4)	<0.001
		No	73 (46.2)	23 (14.6)	
9	Consuming healthy food affects overall body health as well as oral health.	Yes	84 (53.2)	118 (74.7)	<0.001
		No	74 (46.8)	40 (25.3)	
10	The risk of oral cancer due to smoking only occurs in heavy smokers.	Yes	84 (53.2)	40 (25.3)	<0.001
		No	74 (46.8)	118 (74.7)	

Values are presented as n (%). p-values represent the comparison between pre-test and post-test responses. n = 158.

Based on Table 6, all items in the knowledge questionnaire showed changes in the proportion of responses after the intervention. Before the intervention, respondents demonstrated fair levels of knowledge across several aspects, including oral hygiene practices, risk factors, and preventive behaviors. After the intervention, changes were observed across all items, indicating an increase in adolescents' understanding of oral health-related information. All items demonstrated statistically significant differences ($p < 0.001$).

The present study demonstrated that the Android-based Quitee educational game significantly improved adolescents' motivation and knowledge regarding oral and dental health. Both motivation and knowledge scores increased after the intervention, and the differences were statistically significant ($p < 0.001$). These results suggest that the Quitee application can be considered an effective educational tool for enhancing adolescents' engagement and understanding of oral health. The observed improvements also imply that integrating digital learning media into oral health education may lead to better learning outcomes among adolescents.

The effectiveness of the Quitee educational game may be attributed to the inherent characteristics of game-based learning, which integrates educational content with interactive elements such as challenges, feedback, and immersive experiences. Game-based educational approaches have been shown to enhance engagement and sustain learners' attention, thereby encouraging active participation and fostering a more meaningful learning experience. These interventions enable users to learn through experiential processes, including problem-solving and decision-making, which contribute to improved knowledge acquisition and behavioral outcomes. Better oral health habits and

enhanced cognitive development may be achieved via the use of digital game-based platforms, which provide accessible and adaptable learning settings. Most importantly, students may be more motivated to acquire and sustain good habits related to oral health if they are exposed to such interesting methods.¹⁶ By raising awareness about the need for good oral hygiene and the role that food plays, oral health education is vital in reducing the prevalence of dental illnesses.¹⁷ In addition, by fostering an atmosphere of inquiry and encouraging active engagement, interactive learning spaces have the potential to elevate the learning experience as a whole.¹⁸

The results of this study are consistent with previous research demonstrating that game-based learning can improve oral health knowledge. Educational games have been shown to enhance students' understanding through interactive and engaging approaches. However, studies specifically examining the impact of educational games on adolescents' motivation remain limited, particularly those focusing on Android-based educational platforms and simultaneously evaluating both motivation and oral health knowledge outcomes. Dietary awareness and dental hygiene routines may be enhanced using game-based interventions, according to earlier studies,¹⁹ but research by Malik et al.²⁰ showed that when compared to conventional techniques, game-based oral health education improved knowledge and oral hygiene status more significantly and for longer periods of time.²⁰

Research using mHealth apps, which have recently gained popularity as a means of disseminating health information, has also shown similar results. By allowing users to access material whenever and wherever they choose, smartphone-based apps provide learners with convenient and adaptable learning options. These applications have been

shown to improve awareness, knowledge, and user engagement, particularly among adolescents who are active users of digital technology.⁸ Therefore, integrating mobile-based educational tools such as the Quitee application may represent an effective strategy for improving oral health education among adolescents.

Another important finding of this study is that the improvement in motivation was greater than that observed in knowledge. This suggests that educational games may have a stronger influence on psychological aspects, such as engagement and learning interest, compared with cognitive outcomes. Interactive elements, including challenges, rewards, and feedback, can stimulate curiosity and encourage adolescents to participate more actively in learning activities. Motivation plays an important role in directing and sustaining individuals' involvement in learning processes.^{21,22} The higher increase in motivation may occur because game-based learning creates a more enjoyable and engaging learning environment compared with conventional educational methods. Moreover, adolescents tend to respond positively to digital and interactive media due to their familiarity with smartphone technology. Therefore, educational games may effectively enhance learning motivation and support long-term improvements in oral health behaviors among adolescents.

In addition, the results show that digital educational media might be a new way to promote dental health among teenagers. The importance of mobile-based learning platforms for this demographic is bolstered by the extensive usage of digital technologies. Research shows that teenagers spend a lot of time on digital media, and technology is becoming a part of their everyday life. This may have both good and bad effects on their health.²⁴ Adolescents are often considered digital natives, as they grow up in a

technology-driven environment and commonly own personal smartphones.²⁵ Therefore, digital technology plays a significant role in adolescents' daily lives.²⁶ Here, the Quitee app and other digital teaching tools might be a great way to get people interested and involved while also raising their oral health literacy and encouraging better habits.

It is important to keep in mind the study's limitations while analysing its results. Lacking a control group in a pre-experimental design makes it difficult to conclude cause and effect. Another limitation is that the research only included one school; thus, the findings may not apply to other situations. There is a possibility of response bias due to the use of self-reported questionnaires to evaluate knowledge and motivation. However, because of the many physical, mental, and social changes that occur throughout adolescence, this demographic must receive targeted health promotion interventions.²⁷ The rapid development of digital technology has expanded access to information and services, including those related to health promotion.²⁸ Adolescence is also a crucial stage for establishing healthy habits, such as maintaining proper oral hygiene and overall well-being,²⁹ while adolescent health is closely associated with levels of physical activity and fitness.³⁰ Therefore, digital educational games may represent a promising approach to support oral health promotion among adolescents. Research on the impact of digital educational interventions on oral health behaviours should be conducted in the future with more rigorous designs and with bigger and more varied populations.

CONCLUSION

The findings of this study indicate that the Android-based Quitee educational game can improve adolescents' motivation and knowledge regarding oral and dental health. Although the present study

evaluated only these two outcomes, the application may potentially be adapted for future studies to assess oral health behaviors, learning engagement, self-efficacy, and long-term knowledge retention. The results also showed that both motivation and knowledge improved significantly following the intervention, with a greater increase observed in motivation than in knowledge. This study implies that digital game-based learning can be used as an effective approach in oral health education for adolescents. Practically, the Quitee application may be utilized as a supportive educational tool in school-based or community oral health programs. From a theoretical perspective, this study supports the use of interactive digital media to improve both motivation and knowledge in health education. Future studies are recommended to involve larger populations and apply more rigorous research designs to further evaluate the effectiveness of digital educational interventions, including their long-term impact on oral health behavior.

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