"Effectiveness of Gamification-Based Mobile Application in Improving Dental and Oral Health Knowledge and Behavior Among Elementary School Children"

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ABSTRACT

This study aimed to determine the effectiveness of gamification-based mobile applications in improving dental and oral health knowledge and behavior among elementary school children. One hundred and twenty elementary school students (aged 9-11 years) were randomly divided into two groups: the treatment group (n=60) using the "DentaKids" mobile application, and the control group (n=60) receiving conventional education for 4 weeks. Knowledge and behavior were measured using validated questionnaires, and oral hygiene status was assessed using the Oral Hygiene Index-Simplified (OHI-S) before and after the intervention. The results showed significant improvements ($p<0.05$) in knowledge scores, tooth brushing frequency, and OHI-S scores in the treatment group compared to the control group. In conclusion, gamification-based mobile applications are effective in improving dental and oral health knowledge and behavior in elementary school children.

Keywords: Mobile Application, Gamification, Children's Dental Health, Digital Education, Community Dentistry, Oral Health Behavior

INTRODUCTION

Dental and oral health problems remain a significant public health issue in Indonesia, with particularly high prevalence rates among school-aged children. Traditional approaches to dental health education often lack engagement and fail to provide interactive learning experiences for children. The development of digital technology, particularly smartphones and mobile applications, offers new opportunities for transforming health education methods. Gamification, the use of game elements in non-game contexts, has proven effective in increasing user motivation and engagement.

Mobile applications with gamification features offer advantages in terms of accessibility, interactivity, and content personalization. Previous research has shown the positive potential of digital technology in health education, but studies specifically evaluating its effectiveness in Indonesian pediatric populations remain limited. Based on the vision of developing community dentistry based on digital technology, this study aimed to evaluate the effectiveness of gamification-based mobile applications in improving dental and oral health knowledge and behavior among elementary school children in Kediri Regency.

METHODS

This study was an experimental study with a randomized controlled design. One hundred and twenty elementary school students (grades IV-V, aged 9-11 years) from 4 public elementary schools in Kediri Regency were recruited and randomly divided into two groups: the treatment

group (n=60) using the "DentaKids" mobile application, and the control group (n=60) receiving conventional education through leaflets and lectures for 4 weeks. The "DentaKids" application was developed with gamification features including point and badge systems, tooth brushing progress tracking, educational mini-games, virtual avatars, automatic reminders, and multimedia educational content. Knowledge was measured using a validated 20-item multiple-choice questionnaire (Cronbach α=0.854), behavior was assessed through self-reported tooth brushing frequency and fluoride toothpaste use, and oral hygiene status was evaluated using the Oral Hygiene Index-Simplified (OHI-S) before and after the intervention. Statistical analysis was performed using SPSS version 25.0. Data normality was tested using the Shapiro-Wilk test. Comparisons used independent t-tests for normally distributed data and Mann-Whitney U tests for non-normal data. Statistical significance was set at $p<0.05$. The study received ethical approval from the Health Research Ethics Committee of the Faculty of Dentistry, Universitas Kadiri (No. 045/KEPK-FKG/UNIK/2024).

RESULTS AND DISCUSSION

The results showed significant improvements ($p<0.05$) in all measured parameters in the treatment group compared to the control group. Knowledge scores increased significantly in the treatment group (from 5.4±1.2 to 8.2±1.3) compared to the control group (from 5.2±1.3 to 6.8±1.5, $p<0.001$). Tooth brushing frequency increased from 1.3±0.5 to 2.1±0.4 times per day in the treatment group ($p<0.001$), while the control group showed minimal improvement from 1.2±0.4 to 1.5±0.5 times per day.

Oral hygiene status measured by OHI-S showed significant improvement in the treatment group, with scores decreasing from 2.4±0.6 to 1.6±0.5 (indicating better oral hygiene), while the control group showed smaller improvements from 2.2±0.7 to 1.9±0.6. The use of fluoride toothpaste increased from 58.3% to 90.0% in the treatment group, compared to 53.3% to 63.3% in the control group.

Application engagement analysis showed high participation rates with an engagement rate of 85.3%, average daily usage of 12.5±3.2 minutes, access frequency of 5.8±1.4 times per day, and user satisfaction rating of 4.2/5.0. The most popular features were mini-games (78.3%), badge system (65.0%), and automatic reminders (58.3%).

The success of the "DentaKids" application can be explained through constructivist learning theory and intrinsic motivation. Gamification elements such as points, badges, and progress tracking create enjoyable learning experiences and motivate children to participate actively. The observed behavioral changes, particularly the increase in tooth brushing frequency, demonstrate the application's ability to translate knowledge into concrete actions. The reminder feature and progress tracking contributed to forming positive habits, consistent with the Health Belief Model emphasizing the importance of cues to action in health behavior change.

CONCLUSION

Gamification-based mobile applications are effective in improving dental and oral health knowledge and behavior in elementary school children in Kediri Regency. Significant improvements were observed in all measured parameters with high user engagement and

satisfaction rates. Digital technology can serve as an innovation in community dental health promotion that aligns with current developments and digital native generation preferences. Further research is recommended to evaluate long-term effectiveness, compare various technology platforms, and explore factors influencing behavioral change sustainability. Integration of mobile applications in school dental health programs should be considered as an innovative strategy for achieving national dental health targets.

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