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Android-Based Educational Model Cross Puzzle on Improving Dental Health Behavior among Elementary Schools

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Abstract

Background: Dental health problems in the intervention group primary school were dental caries at 81%, persistence at 32%, gingivitis at 35%, and dental health problems in the control group primary school, namely dental caries at 86%, persistence at 36%, gingivitis 48%. Dental health problems in elementary school children are caused by low dental health maintenance behavior. The strategy to overcome this problem is by using an "Android-based crossword puzzle education model," providing education to children through the game method so that the learning process is more exciting and fun. **Objective:** This study aimed to test the effectiveness of the educational model in increasing adolescent oral and dental health knowledge. **Design:** This research design uses *the Research and Development* method *Quasi-experimental* with a *pre-test-post-test control group design*. **Result**: The treatment in the intervention and control groups was 21 days. According to expert validation, the Android-based crossword puzzle education model has an average of 92% and a p-value of 0.002 (very feasible). The application is effective as an effort to improve dental health behavior in elementary school children, as well as a different test of crossword puzzle education models android-based effective as an effort to increase knowledge of delta *p-value* 0.009, attitude delta p-value 0.001, delta p-*value* 0.001 action, *debris index score* delta *p-value* 0.001 compared to the control group. **Conclusion**: The Android-based crossword puzzle education model is feasible, and its application is effective as an effort to improve dental health behavior in elementary school children compared to the control group.

Keywords: Elementary school children, behavior, dental health, crossword puzzle educational model

INTRODUCTION

Dental and oral health is part of overall body health. Dental and oral health is still widely ignored by the general public. This is because people still think that toothache is not a deadly disease, while teeth and mouth are the gateways for germs/bacteria to enter our body so that they can interfere with the health of other body organs (1).

Based on Basic Health Research (RISKESDAS) 2018 shows that the age group 6-12 years has dental caries problems at 83%, the rate of caries experience is 70%, and gingivitis is 63.83%. In the pattern of brushing teeth, that is good and correct, only 2.1% (1).

According to WHO (*World Health Organization*), school-age children are 7-12 years old. (2)The primary school age group is vulnerable to the occurrence of dental and oral health cases, so it is essential to be wary (3)

The Promotion of dental health education is usually given only through lecture methods and demonstrations with dental phantom media, but school students only hear and see, so students easily forget. Variations in learning-by-playing ways are essential for elementary school children because elementary school children enjoy the learning process with the learning-by-playing method, so this method is perfect for dental health education. One of the learning methods of learning while playing is through an educational model of crossword puzzles (4) (5)

The advantages of crossword puzzles in education are that they can train students' logic, eliminate boredom and motivate students in learning, make it easier for students to remember the learning material that has been delivered, can improve students' thinking, make students learn to concentrate in lessons and provide a more accessible and more profound understanding in learning (6)

The application of the educational model through gamification will increase children's interest in learning and knowing information in the field of dental health. The negative impact of children's excessive use of gadgets/mobile phones could affect physical health (vision problems, stiffness, spinal injury due to sitting position), experience dependence, and even hinder social development in children with people nearby /surrounding (7).

Even though this strategy positively affected children's behavior change, no study yet applies this intervention. This model can be one of the educational models of dental health education as a promotive and preventive effort so that it can effectively help improve the behavior of elementary school children in maintaining dental health.

OBJECTIVE

This study aimed to examine the effectiveness of the educational model in increasing adolescent oral and dental health knowledge.

METHODS

This research uses Research and Development (R&D) development methods, which are used to produce an android-based dental disease education model as a medium for dental health promotion and to test the effectiveness of the educational model in increasing adolescent oral and dental health knowledge. The research and development procedure includes five main steps, namely: 1) Information gathering, 2) Model design, 3) Expert validation and revision, 4) Model testing, and 5) Model results. Here is a picture of Research Development.

The design of this study used a Quasi-experimental design with a Pre-Posttest design with a control group design. Respondents consisted of 60 respondents consisting of 30 respondents from the intervention group, 30 from the control group, and respondents from class 1 to class 6, and each class consisted of 5 students. The intervention group was conducted at SDN Bangilan 01, and the control group was conducted at SDN Bangilan 02.

Before analyzing the data, the data normality test was carried out with Kolmogorov-Smirnov because the number of respondents was more than 50. The effectiveness test on normal data used paired

t-tests, while the data not normally used the Wilcoxon test. For the data test, the normal data did not agree with the independent t-test, while the non-normal data test used the Mann-Whitney test.

Model Development Process

Gathering the information

Collection of the results of the information collection concluded that: The results of the information collection concluded that primary school children are at an age that is in the phase of cognitive development, high curiosity, and like direct practice, the preferred learning method of elementary school children is a method of learning while playing. This is the opinion (of Piaget and Inhaler), suggesting that primary school children are active creatures, and their curiosity is high. The cognitive development of elementary school children is at a concrete pre-operational stage, and elementary school children are very fond of playing and teaching most of the games that children play. (8)

The use of the latest technology is recommended for the provision of dental health maintenance education in elementary school children, as well as the formation of behavior change. This is because if the child is given conventional media, the message is not optimally captured by elementary school children. This is in line with previous research; namely, Indonesia's current technological developments are increasing yearly. Smartphones can be used as an android-based educational model by installing applications on android devices. Through the application, extension agents can provide information on how to take care of teeth in children (9). Using android-based media, especially games, will give elementary school children a new passion for learning, increasing their sense of pleasure and interest in dental health education (9).

Model design

The rapid Application Development (RAD) design model consists of several steps, including required planning, system design process, and implementation. The system design steps are as follows:(10)

1. Requirement planning

   The needs plan aims to identify an information system's needs to achieve its objectives. This process is a meeting between users and analysts so that goals will be completed and minimize ineffective communication.
2. System Design Process (design system)

   The system design process aims to make improvements to the system if there is still an improper design between the user and analyst. This step requires the user's activeness in providing an essential role in achieving goals.
3. Implementation

   This step is carried out when the user and analyst agree on the system's design, and the programmer develops the strategy into a program. After the program is completed, a testing process will be carried out to determine whether there is anything that should be revised before implementation.

Expert validation

Expert validation was carried out by 3 experts, including an IT expert, an IT lecturer, a Media expert, and a Health promotion expert.

The expert validation team receives the TEKI LAGI (Dental Crossword Puzzle) application via WhatsApp and an assessment questionnaire on model feasibility. The results of the model feasibility assessment are sent back by the expert validation team via WhatsApp. The assessment criteria for the feasibility of the model are:

1. Not feasible= 0% - 19% (E) Must total/revise
2. Less feasible = 20% - 39% (D) Must replace / total revision
3. Moderately feasible = 40% - 59% (C) With revisions
4. Feasible= 60% - 79% (B) With a revision
5. Very feasible = 80% - 100% (A) No revision

In table 1, the expert validation test obtained a p-value of 0.002 with an average of 92%. The category is very feasible, which means that the Android-based crossword puzzle education model is feasible as an educational model for improving dental health behavior in school children.

Table 1. Expert validation test

Validation Expert					
Name	N	F (%)	Average	*p-value**	Category
IT Expert	18	92%	92%	0.002	Very feasible
Health Promotion Expert	18	97%			
Media Expert	18	94%			

**Intraclass correlation coefficient*

Model Test

Product trials were conducted to determine meaningful changes before and after being given crossword education media based on improving dental health maintenance behaviors in elementary school children. The implementation is as follows:

1. Obtained approval in the form of informed consent from research respondents who met the criteria.
2. Intervention Group
   a. Mexplain the purpose and objectives of the research to be carried out
   b. The pre-test measurement provides a questionnaire of knowledge, attitudes, and actions of dental health maintenance and debris index score status, then evaluate the questionnaire's answers and the examination results.
   c. Men socialize about how to install a dental crossword application, as well as how to use an android-based crossword educational model. Then before respondents play, they are given education with counseling.
   d. Every time they finish providing education, students simulate an android-based crossword educational model, check one by one whether the child has completed the crossword educational model game, and put a mark (√) on the attendance sheet.
   e. The practice of brushing teeth together, guided by the team

      A team guides the practice of brushing teeth together at school. Furthermore, the determination to brush your teeth after breakfast and before going to bed accompanied by old parents at home and uploading evidence after brushing your teeth in the link sent via WhatsApp to parents.
   f. 21st-day meeting

      Post-test by measuring the behavior questionnaire of dental and oral health maintenance in the form of knowledge, attitudes, actions, and status debris index score in children.
3. Control Group 21
   a. Mexplain the purpose and objectives of the research to be carried out
   b. The pre-test measurement provides a questionnaire of knowledge, attitudes, and actions of dental health maintenance and debris index score status, then evaluate the questionnaire's answers and the examination results.
   c. Men socialize about the stages of filling in the crossword model in the book before respondent play is given education with counseling.
   d. After each education, students simulate the use of a crossword book model. The team checks one by one the children whether they child has completed the crossword book model game and puts a mark (√) on the attendance sheet.
   e. The team guides the practice of brushing teeth together.
   f. A team guides t

      he practice of brushing teeth at school. Furthermore, the practice of brushing your teeth after breakfast and before going to bed accompanied by old parents at home and uploading evidence after brushing your teeth in the link sent via WhatsApp to parents.
   g. 21st-day meeting

Post-test by measuring the behavior questionnaire of dental and oral health maintenance in the form of knowledge, attitudes, actions, and status debris index score in children.

The results of the frequency test of respondents' characteristics in table 2 on the sex data of the intervention and control groups obtained a *p-Value of* 0.003 (> 0.05) so it can be concluded that gender in this study does not have the same proportion. In age data, the *p-value is* 0.605 (p>0.05), which means that the data groups have the same variance. In class data obtained *p-Value* 1,000 (p>0.05), it can be concluded that the class in this study has the same proportion. Furthermore, the learning achievement obtained a *p-Value* of 0.567 (p>0.05) so that the data has the same variance.

Table 2. Frequency Distribution of Respondent's Intervention and Control Characteristics

Variable	Intervention Group		Control Group		*p-Value*
	n	(%)	n	(%)	
Gender					
Female	25	83.3	14	46.7	0.003*
Male	5	16.7	16	53.3	
Age					
7 years	5	16.7	4	13.3	
8 years	4	13.3	3	10	
9 years	5	16.7	6	20	
10 years	6	20	7	23.3	0.605**
11 years	6	20	6	20	
12 years	4	13.3	4	13.3	
Mean ± SD	9.53 ± 1.676		9.67 ± 1.583		
Class					
1	5	16.7	5	16.7	
2	5	16.7	5	16.7	
3	5	16.7	5	16.7	
4	5	16.7	5	16.7	1.000*
5	5	16.7	5	16.7	
6	5	16.7	5	16.7	
Achievements					
>80	23	76.7	21	70	
<80	7	23.3	9	30	0.567**
Mean ± SD	82.23 ± 4.477		81.17 ± 3.842		

**Chi-square* ***Levene*

Table 3 tests the data's normality for the intervention and control groups. The Mean ± SD pre-test and post-test values of the intervention group had a more significant and better increase in value than those of the control group. df in the intervention group and the control group value of 30.

Normality testing in this study used the *Kolmogorov-Smirnov* because the number of samples in this study was more than 50. Table 3 shows the normality test results that the knowledge data of the intervention group and control group *had a p-value* (>0.05). Therefore, the parametric test was continued. The data on attitudes, actions, and *debris index scores* of the intervention group and control group mainly were not normally distributed with a *p-value* (<0.05), so the non-parametric test was continued.

Table 3. Test the normality of the data for the intervention group and the control group

Variable	Group	Mean ± SD Pre-test	Mean ±SD Post-test	Sd	df
Knowledge	Intervention	8.67 ± 3.155	16.27 ± 2.132	1754	30
	p-value	0.200	0.200		
	Control	8.37 ± 3.222	14.37± 1.995	1694	30
	p-value	0.200	0.170		
Attitude	Intervention	36.47 ± 5.399	48.13 ± 1.432	4.498	30
	p-value	0.023	0.001		
	Control	33.20 ± 2.987	48.13 ± 1.432	2.716	30
	p-value	0.001	0.002		
Action	Intervention	24.63 ± 1.691	26.40 ± 2.513	1.296	30
	p-value	0.010	0,001		
	Control	23.27 ± 1.596	23.83 ± 1.763	1.225	30
	p-value	0.032	0.001		
Debris Index	Intervention	1.766± 0.268	0.236 ± 0.212	0.63	30

Score				4	
	p-value	0.001	0.001		
	Control	1.850 ± 0.410	1.637 ± 0.476	0.395	30
	p-value	0.001	0.001		

Kolmogorov-Smirnov

Table 4 shows the effectiveness of paired and unpaired data tests on the variables of knowledge, attitude, and action *debris index score* in the intervention and control groups using parametric and non-parametric tests. The results of the test of the effectiveness of the knowledge variable in the intervention group using parametric tests showed a *p-value* = 0.000. The paired test results in the intervention and control groups were significant. There were differences in the effectiveness of knowledge before and after giving the Android-based crossword puzzle educational model and the crossword puzzle book model.

The results of the paired data test on the attitude, action, and *debris index score* used a non-parametric test. In the intervention group, the *p-value* = 0.000, while in the control group, the *p-value* = 0.164. The paired test results in the intervention group were significant, while in the control group, it was not significant. The results of the paired data test on the action variable used a non-parametric test. In the intervention group, the *p-value* = was 0.001, while in the control group, the *p-value* = 0.173. The results of the paired data test on the *debris index score* using a non-parametric test, in the intervention group, the *p-value* = 0.000, while in the control group, the *p-value* = 0.075. The paired test results in the intervention group were significant, while in the control group, it was not significant. There are differences in the effectiveness of attitudes, actions, and *debris index scores* before and after giving the android-based crossword puzzle education model. At the same time, in the control group, there was no difference in the *debris index score* before and after giving the crossword puzzle book model.

The results of the unpaired data test of the knowledge variable of the pre-test data between the intervention group and the control group were not significantly different. The p-value (0.717) was seen, while the post-test data for the intervention and control groups were significantly different, the p-value (0.007) was seen. The results of the unpaired data test of the attitude variable of the pre-test data between the intervention group and the control group were not significantly different. The p-value (0.081) was seen, while the post-test data for the intervention and control groups were significantly different, from the p-value (0.000) was seen. The results of the unpaired data test of the pre-test data between the intervention group and the control group were not significantly different. The p-value (0.074) was seen.

In contrast, the post-test data for the intervention and control groups were significantly different, and the p-value (0.000) was seen. The results of the unpaired data test for the *debris index score* of the pre-test data between the intervention group and the control group were not significantly different. The p-value (0.811) was seen, while the post-test data for the intervention and control groups were significantly different. The p-value (0.000) means that The Android-based crossword puzzle education model effectively increases knowledge, attitudes, and actions and can reduce the *debris index score* for elementary school children compared to the crossword puzzle book model.

The results of the different group tests for knowledge, attitude, action, and *debris index scores* from the delta (Δ) value of the intervention and control groups obtained knowledge p= 0.009, attitude p= 0.000, action p= 0.000, debris p= 0.000 (p<0.05), this is significantly different. The results are better than the control group. It can be interpreted that the android-based crossword puzzle education model is more effective in increasing knowledge, attitudes, and actions and reducing the *debris index score* for elementary school children than the crossword puzzle book model.

Table 4. Test of the effectiveness of paired and unpaired data on variables of knowledge, attitudes, actions, and *debris index score* in the intervention group and the control group

Variable	Group	Mean ± SD Pre-test	Mean ±SD Post-test	Delta (Δ) ±SD	*P*
Knowledge	Intervention	8.67 ± 3.155	16.27 ± 2.132	7.60 ± 1754	0.001*1
	Control	8.37 ± 3.222	14.37± 1.995	6.40 ± 1694	0.001*1
		p= 0.717 **1	*p*= 0.007** *1	*p*= 0.009 ****1	
Attitude	Intervention	36.47 ± 5.399	48.13 ± 1.432	11.67 ± 4.498	0.001*2
	Control	33.20 ± 2.987	48.13 ± 1.432	3.00 ± 2.716	0.164*2
		p= 0.081 **2	*p*= 0.001** *2	*p*= 0.001 ****2	
Action	Intervention	24.63 ± 1.691	26.40 ± 2.513	2.90 ± 1.296	0.001*2
	Control	23.27 ± 1.596	23.83 ± 1.763	1.50 ± 1.225	0.173*2
		P= 0.074 **2	*P*= 0.001** *2	*p*= 0.001 ****2	
Debris Index Score	Intervention	1.766± 0.268	0.236 ± 0.212	1.53± 0.634	0.001*2
	Control	1.850 ± 0.410	1.637 ± 0.476	0.42 ± 0.395	0.075*2
		p= 0.811 **2	*p*= 0.001** *2	*p*= 0.001 ****2	

*1*Paired t-test* **1 *Independent t-test Pre-Test* ***1 *Independent t-test Post Test* ****1 *Independent t-test Data* **Δ**
*2*Wilcoxon* **2*Mann-Whitney Pre Test* ***2*Mann Whitney Post* ****2*Mann-Whitney Data* **Δ**

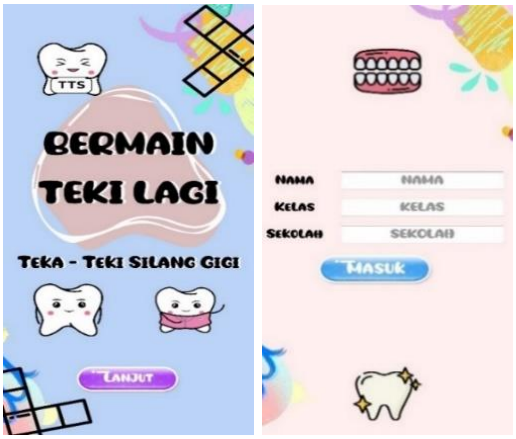
Table 5 shows that the constant value is 0.663 with a knowledge coefficient of 0.010, meaning that an increase in student knowledge of 1% will reduce the debris index score to 0.010. The attitude coefficient value of 0.046 indicates that an increase in the attitude value of 1% will reduce the debris index score of 0.046. The action coefficient value of 0.167 means that an increase in the action of 1% will reduce the debris index score of 0.167.

The results of the analysis show R=0.539 > 0.291, meaning that there is a moderate and significant correlation between knowledge, attitudes, and actions with a decrease in the debris index score. The result of the R square is 0.291 or (29%), meaning that knowledge, attitudes, and actions have an effect of 29% on the decrease in the number of debris index scores in elementary school children.

Table 5 The effect of knowledge, attitude, and action variables on the debris index score

Variable	B	*P-Value*	R	R Square	Adjusted R Square	C	*P-value Anova**
Knowledge	0.010	0.842	0.539	0.291	0.253	0.663	0.001
Attitude	0.046	0.011					
Action	0.167	0.012					

The resulting product is one of the innovative promotive and preventive efforts based on Android to prevent dental and oral health problems in elementary school children and to change dental and oral health maintenance behavior in elementary school children. The system developed by the researcher is as follows:



Pictures 1. Image Display Application Playing Puzzled Again

DISCUSSION

the research found that collecting information from dentists, dental nurses, school principals, teachers, and psychology related to educational methods was suitable for elementary school children in the 4.0 era. It included providing technology-based learning while playing techniques because, during the COVID-19 pandemic, 19 elementary school students applied online learning, so many elementary school students have cellphones. Therefore the technology education method created is an Android-based crossword educational model with the application name "Playing Puzzles Again (Tooth Crosswords). In addition, elementary school children like the learning while playing-method. This method will make it easier for elementary school children to remember the material presented by the operator and will be easily applied by them.

The formation of changes in dental health maintenance behavior in elementary school children requires methods and media that are interesting, not boring, and involve many senses to be easy to remember and apply. A good educational process for elementary school children is media in the form of games (11).

A suitable model to realize an increase in dental health maintenance behavior is to follow the development of the modern era, namely the "Android-Based Crossword Educational Model," a game application. Education is in the application, and it will be fun when children learn while playing. This will make it easier for children to capture learning outcomes from the games they play and form children's independence in maintaining oral and dental health.

The advantages of crossword puzzles in education are to train students' logic, eliminate boredom, motivate students in learning, and make it easier for students to remember the learning material that has been delivered. Furthermore, it improves students' thinking, makes them concentrate on lessons, and provides better understanding. More accessible and deeper in learning (6)

Lack of crossword puzzles, including in crossword puzzles only learning short words are not able to explain or describe the material in detail, students need a relatively long time to think about the answers to questions both individually and in groups, and each letter answer is continuous, so that students feel confused if they cannot answer one of the questions that affect other solutions (12)

The expert validation process is essential in developing models that will be useful in health promotion activities. (13) Validator assessment aims to test the

product's validity that was designed previously. The validator provides suggestions/input for improving the product made before it is applied to the respondents (14)

The results of the expert validation test obtained a p-value of 0.002, and the average effect of several expert validators is 92% in the "very feasible" category. It can be interpreted that the model Android-based crossword puzzle education is "very feasible" as an effort to improve dental health behavior in elementary school children.

The application of the android-based crossword puzzle education model was proven to increase knowledge, attitudes, and dental health maintenance actions in the intervention group compared to the control group and could reduce the number of debris index scores of elementary school children in the intervention group compared to the control group.

The results of the paired data test on the knowledge variable of the intervention and control groups obtained a p-value <0.05, meaning that the android-based crossword puzzle education model and books can increase the knowledge of dental health maintenance in elementary school children.

The success of the intervention can be shown from the results of the unpaired data test on the post-test data, p-value <0.05. It was indicated that the Android-based crossword education model is more effective in increasing the knowledge of elementary school children than the puzzle book model. This cross is evidenced by the intervention group that the mean ± SD and delta values are higher than the control group.

There is an increase in knowledge in children because, for 21 days, respondents were given intervention in the form of counseling and application of an Android-based crossword puzzle education model to make children independent and increase children's awareness of maintaining dental health.

This study is in line with (Fijacko et al.), which states that support for self-care in elementary school children, especially in maintaining dental health, it can be given using the learning method by playing through gamification applications can motivate children to gain knowledge about dental health maintenance (15)

the attitude variable among the intervention group was a p-value <0.05, while the control group had a p-value>0.05. It was indicated that the android-based crossword education model could improve dental health care attitudes in elementary school children compared to the control group.

According to (Harisnal) Changes in children's attitudes cannot be separated from increasing knowledge from not knowing to know and then understanding and changing attitude patterns (15). It was in line with a previous study, which states that the attitude of elementary school children toward maintaining dental health depends on their knowledge. Therefore, dental health education is essential to help children in changing attitudes and actions of children in maintaining healthy teeth (16).

In the paired data test results on the action variable, the intervention group obtained a p-value <0.05, while the control group had a p-value>0.05. It was indicated that the android-based crossword education model could improve dental health care actions in elementary school children compared to the control group.

The application of the Android-based crossword puzzle education model improves children's actions in maintaining dental health. It was due to education and games related to brushing teeth and how to brush teeth packaged into an enjoyable educational match with pictures. - clear image.

The activities promote activities of brushing their teeth together at school. Brushing their teeth twice a day, in the morning after breakfast and night before going to bed at home, and monitored by parents. Self-brushing activities at home were carried out for 21 days consistently morning and night. Respondents also sent evidence of activities after brushing their

teeth which was documented and then sent to researchers.

Knowledge and attitudes significantly impact children's actions in maintaining dental health. This is in line with previous researchers, namely, good knowledge and a positive attitude will affect a person in good behavior. If knowledge is not good, it will support a negative attitude, and someone will tend to behave less well (17).

This study is in line with a study that mentioned that BDN intervention (*Brush day and night*) for 21 days could increase knowledge and influence new behaviors towards elementary school children (18).

The variable effectiveness test results show a significant difference in paired data. In the intervention group, the *p-value* <0.05 means that the Android-based crossword puzzle education model effectively reduces the *debris index score* for elementary school children. While in the control group, the *p-value* > 0.05 implies that the crossword puzzle book model is ineffective as a decrease in the *debris index score* for elementary school children.

In Sherlyta's research, it is stated that, in habitual behavior, there are compliance efforts in acting as an effort to prevent dental and oral health diseases. Efforts in maintaining one's health on dental health are obediently brushing your teeth, and brushing your teeth regularly will be able to clean up debris (19).

CONCLUSION

The Android-based crossword puzzle education model is very feasible. Its application is effective as an effort to increase knowledge, attitudes, and dental health maintenance actions and reduce debris index scores in elementary school children.

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