DEVELOPMENT OF HEALTH EDUCATIONAL GAME APPLICATION "WORM FREE" BASED ON ANDROID

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ABSTRACT

Background: *Strategies for preventing and controlling worms are carried out by increasing PHBS behavior from an early age. Health promotion efforts such as health education for student have been carried out, one of which was through the game method (gamification) which was able to stimulate various senses, attract and be liked by children. In line with the development of communication and information technology, digital-based educational models were very necessary and helpful in improving children's thinking patterns, creativity, and ability to obtain health information. This study aims to develop a digital game application "worm-free" based on Android.*

Method: *This studied conducted Research and Development (R&D) design with five stages namely needs analysis, product design development, validation, revision, limited trial and field test.*

Result: *The validation results of media experts and material experts as well as limited trials concluded that the digital game product was informative, easy to access and use, and interesting so it was very feasible to use and proven to increase PHBS knowledge for Helminthiasis prevention in primary school students.*

Conclusion: *It is recommended that digital game health education "Worm Free" based on Android can be widely utilized by the community, especially elementary school children to increase PHBS knowledge and behavior to prevent worms from early age.*

Key words*: Health education, worm free, digital game, Android.*

INTRODUCTION

Helminthiasis is environmental-based infectious diseases caused by worm parasites and be transmitted to humans through soil contaminated with feces (Soil Transmitted Helminthiasis / STH)[1]. It was estimated that more than 2 billion people in the world were infected with worm parasites and generally attack school-age children, with the highest prevalence occured at poor sanitation and inadequate availability of clean water areas. Although mortality due helminthiasis was relatively small, more than 850 million school-age children were at risk of morbidity due to helminth infections, especially in developing countries[2]. In Indonesia, prevalence of helminthiasis in children was still high, between 45-65% and in areas with poor environmental conditions it can reach 80%. The 2012 survey of worms in primary school children found that the prevalence of helminthiasis was quite high,

around 60-80% (2), while the 2016 survey of 398 primary schools/MIs in 33 provinces showed an average worm prevalence of 31.8%[3]. A study in Jambi city in 2018 found that the incidence of helminthiasis in children aged 2-4 years was quite high at 49.4%, which was related to parenting and personal hygiene[4].

The impact of Helminthiasis maked children lose adequate nutritional intake such as carbohydrates and protein, as well as blood loss, irritation and allergies, affect to intake, digestion, absorption, and food metabolism[5]. This condition can hinder physical development, intelligence and productivity, reduce body resistance so that it was susceptible to disease, resulted in a decrease of quality of human resources and high risk of illness and mortality[6]. Economically from calculation of Disability Adjusted Life Years (DALYs), loss of productive time due to worm infection causes a loss of 22.1 million rupiahs per child per year.

Prevention and control of helminthiasis requires efforts to improve clean and healthy living behavior (PHBS), such as washing hands, personal hygiene, eat nutritious food, cutting and cleaning nails, wearing footwear when outside, consume clean and healthy food and drinks, and so on. The implementation of PHBS will have a positive impact on reducing the prevalence of helminthiasis. The effective prevention directed to break the chain of transmission in school-age children[7], and healthy environmental sanitation such as clean water sources, houses environment, sewerage, garbage disposal, latrines. as well as control vectors such as flies, cockroaches, and rats[3].

One strategy to increase PHBS from an early age through health promotion efforts by providing health education at Early Childhood Education (PAUD) and Elementary Schools (SD) or Madrasah Ibtidaiyah (MI) institutions, especially children in this age is in the formal operational stage, which is able to think abstractly, reason logically, and draw conclusions from available information. Several methods of health and nutrition education for elementary school children have been carried out, one of which is the game method (gamification) which is able to stimulate various senses, attracts and liked by children. The more senses using, attractiveness and interest of students will be so that the message conveyed is more easily accepted. The game method will make learning concepts more interesting and provide space for more creative thinking. The study of Guspianto, et al (2021) proves that health education using the game method is proven to be more effective than the video method[8].

Linked with the development of communication and information technology, digital-based educational models are felt to be necessary and more helpful in improving children's thinking patterns, creativity, and ability to obtain health information. Currently, digital game media is felt to be in accordance with the characteristics of

elementary school-aged children who like to play, work in groups and do virtual activities together. Educational media because it is not only attractive and entertaining, but one of the biggest advantages is the ability to facilitate interactions that increase children's learning opportunities. Digital games can be used as fun and useful health promotion media, stimulate the brain, and can increase children's knowledge and confidence. The combination of literacy using game technology and digital technology in education will support more effective learning because 96% of information provided through digital media will be easily absorbed[9]. This study aims to develop a "worm-free" health education using digital-based game on Android.

METHOD

The research design was R&D (Research and Development) as a process approach to develop a certain product with five stages of procedures, namely needs analysis, product design development, product validation, product revision, and product trial[10].

Figure.1. Stages of Product Development Procedure

Figure.1. describe the stages of product development procedures in this study were as follows: 1) Needs analysis, consisting of: (a) data needs to obtain information as the content of this educational game model as well as an instrument for evaluating the level of knowledge of elementary school children about PHBS to prevent helminthiasis, and (b) system requirements in the form of software and hardware needed to build android-based digital game applications; 2) Product development and design, using the Unity application and Windows 10 Home Single Language 64-bit operating system with operations covering navigation structures, use case diagrams, mock-ups, game asset creation, game mechanics creation, voice-over, and testing; 3) Product validation, carried out to determine the feasibility of game application products developed by material experts and media experts; 4) Product revision based on input obtained from the validation results of material experts and media experts; 5) Product trial was conducted in a small group

at one of primary school in Jambi city. Collecting validation and trial data using a questionnaire filled out by material experts, media experts and elementary school students as respondents.

RESULT

The results of this study were the Android-based health education game application product 'Worms Free', using the Unity application and the Windows 10 operating system, with the following first stages is Needs analysis. Need of data to obtain information to identify PHBS messages that were the content of health education in this digital-based educational game model was through a literature review on PHBS behavior to prevention of Helmithiasis. The results of literature review obtained data needed for educational materials in game applications which were grouped into: 1) PHBS messages in schools in the "PHBS" block; 2) guess the behavior that may or may not be done in the “Kesempatan” block, 3) guess which food or snacks are healthy or unhealthy to be consumed in the “Tebak Kartu” block, dan; 4) educational video in the “Istirahat sebentar yuk!” block. System requirements to build android-based game applications in the form of software, namely the Windows 10 Home Single Language 64-bit and Unity 3D operating system, and hardware consisting of an Intel® Core i7-8250U Processor, 1.8 GHz, 8GB Memory RAM, Intel(R) UHD Graphics 620 Graphics Block, 1TB Hard Drive.

Second stage id Product development and design Navigation structure, was the first step in application design which was described in Figure.2, Use case diagram (Figure.3.), Mockup (Figure.4.

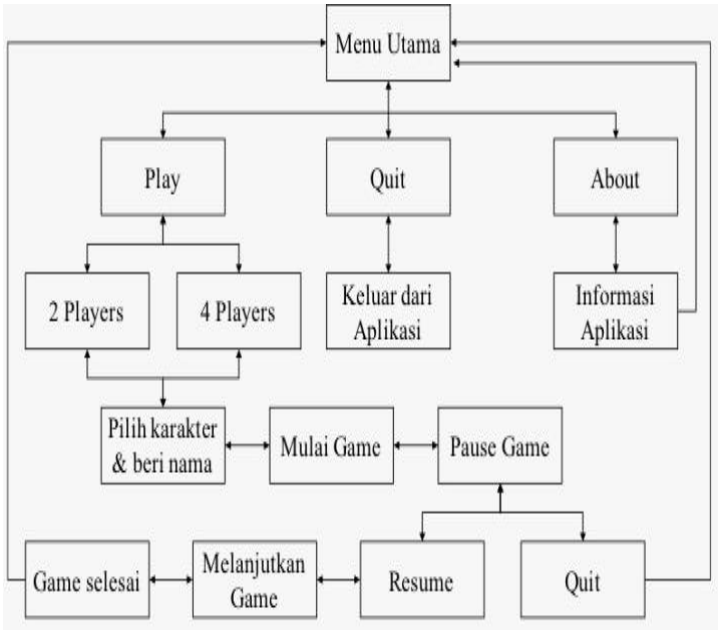

Figure.2. Navigation structure

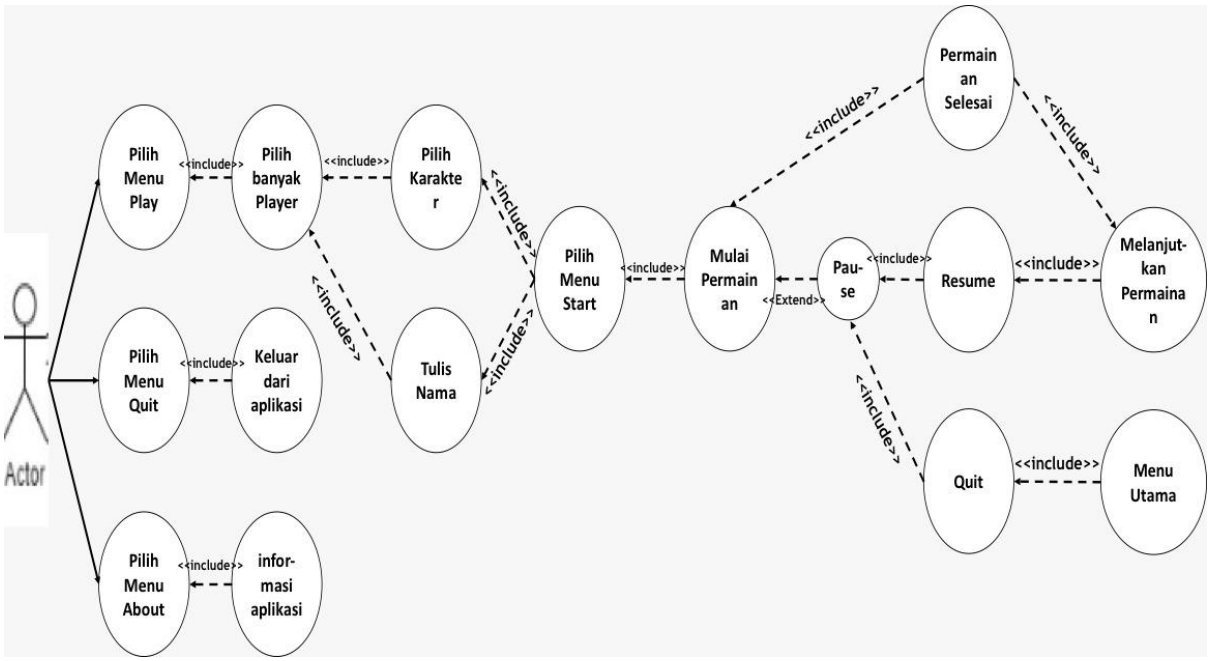

Figure.3. Use Cash Diagram

Figure.4. Mockup

Creation of game assets using Photoshop, Figma and Unity software:

a) Tekstur Background: https://stealthix.itch.io/rpg-nature-tileset/download/eyJleHBpcmVzIjoxNjU5Njk4NjQxLCJpZCI6NTMzNzU4fQ%3d%3d.4FTnXp1d3ghMJUFq8vhhfU3TYaY%3d

b) Pion: https://www.cgtrader.com/free-3d-models/sports/toy/tabletop-lowpoly-collection

c) Audio: https://pixabay.com/id/music/lagu-anak-anak-bahagia-funny-111785/
d) “Kesempatan” block contains do and don't of behavior (pig.5).
e) “Tebak Kartu” block contains healthy and unhealthy snacks or drinks (pig.5).
f) The PHBS block contains messages about clean and healthy living behavior (pig.5).
g) Block "Istirahat sebentar yuk!" contains educational videos (pig.5).

The game mechanics were made on the Unity 2020 software as a game engine to produce the “WORRY-FREE” game. The advantage of Unity was be easy to operate compared to other similar engines. Unity also has many extensions that are useful in the production process. Unity requires additional software for writing program code, namely Microsoft Visual Studio. The program code in the script that is written regulates the course of the game.

Voice charging which aims to make the game application more interesting and comfortable accompanying the game from beginning to end. The sound that is entered is instrument music adapted from the internet google link: https://pixabay.com/id/music/lagu-anak-anak-bahagia-funny-111785/

Using a black box to test feature functionality in game applications on several Android smartphones to assess whether the function of each feature was as expected so that the results were declared valid (Table.1.)

Product Validation. Product validation to determine the feasibility of game applications with the help of material experts and media experts, respectively quantitatively and qualitatively. Material expert validation test quantitatively to determine the feasibility of material in game media consists of four aspects, namely educational goals (4 indicators), message quality (10 indicators), and feedback (3 indicators). The calculation results show a high score so it was concluded that the application material is very worthy. Furthermore, qualitatively some inputs and suggestions for improvement from material expert team were:

a) Many images of messages, need to be screened for messages that seem repetitive.
b) Typos and misspellings of words
c) Duration of the video, especially the “eye exercise” video is too long
d) Need to be added with symbols and inscriptions of institutions (Jambi University and Faculty of Medicine and Health Sciences)
e) Add research team information

Figure.5. Block of “Kesempatan”, Tebak Kartu, “PHBS”, and "Istirahat sebentar yuk!"

The media expert validation test aims to determine the feasibility of the media used in the game covering 4 aspects, namely percentage design (6 indicators), interaction use (5 indicators), accessibility (6 indicators), and reuse (2 indicators). Calculation results show a high score so it was concluded that the application media was very worthy. Qualitatively, some inputs and suggestions for improvement from the media expert team were:

a) There has been a “bug” or error in some game episodes (button doesn't work)
b) The choice of background color is not contrasting
c) Need to be added with the feature of writing the player's name and the choice of the player's image
d) Need to add game tutorials
e) Need to be added with the number of players selection feature.

Table 1. Black Box Testing

No.	Testing Scenarios	Test Case	Expected results	Test result	Conclusion
1	Open the game app 'BEBAS CACINGAN'	Click game app 'BEBAS CACINGAN'	The system displays the Jambi University logo and 'Faculty of Medicine and Health Sciences', enters the main menu and the game background reads	The system displays the Jambi University logo and 'Faculty of Medicine and Health Sciences', enters the main menu and the game background reads	Valid
2	Start playing the game	Click the play button	The system displays the player page with 2 player and 4 player buttons	The system displays the player page with 2 player and 4 player buttons	Valid
3	Open the about menu	Click the 'i' button	The system displays an information page about the application	The system displays an information page about the application	Valid
4	Turn off the background	Click the 'mute' button	System disable background	System disable background	Valid
5	Turn on background	Click the 'unmute' button	System activates background	System activates background	Valid
6	Choose the number of players 2 players	Click the '2 players' button	The system displays the name and character input page for 2 players	The system displays the name and character input page for 2 players	Valid
7	Choose the number of players 4 players	Click the '4 players' button	The system displays the name and character input page for 4 players	The system displays the name and character input page for 4 players	Valid
8	Choose a character	Click the '< and >' buttons	The system displays the player character	The system displays the player character	Valid
9	Enter name	Click 'write name'	The system displays the character name on the game page	The system displays the character name on the game page	Valid
10	Enter the game page	click the 'start' button	The system enters the game page and displays the game tutorial	The system enters the game page and displays the game tutorial	Valid
11	Showing tutorials	click the 'next' button	The system displays the second page tutorial	The system displays the second page tutorial	Valid
12	Displaying the board page	click the 'start' button	The system displays the board page	The system displays the board page	Valid
13	Rolling the dice	click the 'roll' button	The system displays the results of the dice and the character pawns move according to the dice numbers	The system displays the results of the dice and the character pawns move according to the dice numbers	Valid
14	Answering the 'kesempatan'	click the 'boleh' button	If the answer is correct, the system displays a tick symbol then displays an explanation regarding the answer and the score increases for the player who answered	If the answer is correct, the system displays a tick symbol then displays an explanation regarding the answer and the score increases for the player who answered	Valid

15	Answering the 'kesempatan'	click the 'boleh' button	If the answer is wrong, the system displays a cross symbol then displays an explanation regarding the answer and the score is reduced for the player who answered	If the answer is wrong, the system displays a cross symbol then displays an explanation regarding the answer and the score is reduced for the player who answered	Valid
16	Answering the 'kesempatan'	click the 'tidak' button	If the answer is correct, the system displays a tick symbol then displays an explanation regarding the answer and the score increases for the player who answered	If the answer is correct, the system displays a tick symbol then displays an explanation regarding the answer and the score increases for the player who answered	Valid
17	Answering the 'kesempatan'	click the 'tidak' button	If the answer is wrong, the system displays a cross symbol then displays an explanation regarding the answer and the score is reduced for the player who answered	If the answer is wrong, the system displays a cross symbol then displays an explanation regarding the answer and the score is reduced for the player who answered	Valid
18	Answering the 'tebak kartu'	click the 'sehat'' button	If the answer is correct, the system displays a tick symbol then displays an explanation regarding the answer and the score increases for the player who answered	If the answer is correct the system displays a tick symbol then displays an explanation regarding the answer and the score increases for the player	Valid
19	Answering the 'tebak kartu'	click the 'sehat'' button	If the answer is wrong, the system displays a cross symbol then displays an explanation regarding the answer and the score is reduced for the player who answered	If the answer is wrong, the system displays a cross symbol then displays an explanation regarding the answer and the score increases for the player who answered	Valid
20	Answering the 'tebak kartu'	click the 'tidak' button	If the answer is correct, the system displays a tick symbol then displays an explanation regarding the answer and the score increases for the player who answered	If the answer is correct, the system displays a tick symbol then displays an explanation regarding the answer and the score increases for the player who answered	Valid
21	Answering the 'tebak kartu'	click the 'tidak' button	If the answer is wrong, the system displays a cross symbol then displays an explanation regarding the answer and the score is reduced for the player who answered	If the answer is wrong, the system displays a cross symbol then displays an explanation regarding the answer and the score is reduced for the player who answered	Valid
22	Player stops at block 'PHBS'	Character pawns stop at PHBS block	The system displays PHBS information	The system displays PHBS information	Valid
23	The player stops at the block 'Istirahat sebentar yuk!'	The character pawns stop at the block 'Istirahat sebentar yuk!'	The system displays PHBS video	The system displays PHBS video	Valid

24	*Player stops at 'Get point' block*	*Character pawns stop at the get point block!*	*The system adds two points to the player*	*The system adds two points to the player*	*Valid*
25	*The player stops at the 'Isolasi' block*	*Character pawns stop in "isolasi" block*	*The system will give a penalty to the player in the form of not being able to roll the dice for one turn*	*The system will give a penalty to the player in the form of not being able to roll the dice for one turn*	*Valid*
26	*The player stops at the 'Cacingan' block*	*Character pawns stop at "cacingan" block*	*The system will deduct one player point*	*The system will deduct one player point*	*Valid*
27	*Player stops or passes the 'Start' block*	*Character pawns stop or skip the start block*	*The system adds one point to the player*	*The system adds one point to the player*	*Valid*
28	*Choose pause*	*click pause*	*The system pauses the game*	*The system pauses the game*	*Valid*
29	*Choosing a resume*	*click resume*	*Sistem melanjutkan permainan*	*Sistem melanjutkan permainan*	*Valid*
30	*Exit the app*	*click quit*	*System exit game*	*System exit game*	*Valid*
31	*Exit the app*	*click quit*	*System exit game*	*System exit game*	*Valid*

Product revision. Based on the results of the validation analysis of material experts and media experts, revisions/improvements and additions were made according to the recommendations, including: removing the same image or message, correcting typing wrong words, cutting video duration that is too long, adding display for symbols and institutional writings as well as research team information, fixing "bugs" or errors, improving color contrast, adding features to choose number, player names and characters, and adding game tutorial features. Revisions of both material and media were consulted with experts for re-validation until was decided that the overall "Worm Free" game application based on Android was informative, easy to use, clearly, and interesting, so that this digital game application deserves to be field trials.

Small Group Trial. Small group trial to test the use of digital-based game applications on thirty students from an elementary school in Jambi City. There were two ways of analysis, namely perceptual analysis of game applications and conducting pre and post intervention testing using the t-paired test. Perceptual analysis of game application in small group trials consisted of seven indicators, namely ease of access and play, attractive front view, images according to the message, clear and attractive images, easy to understand, good language, and clear text. The results of the analysis show that the average proportion of the total indicators is strongly agree (84.5%) and agree (15.5%). It was meaning that game applications were easy to access and play, the front view was attractive, the images match message content, looks clearly and attractive, the

material content was easy to understand, the use of language in sentences was well-organized, and the text was clearly. Furthermore, the results of t-paired test can be seen in the table below.

Figure.5. Small group trials

Table 2. T-Paired test

Variable	*Mean*	*SD*	*SE*	*P-value*	*N*
Knowledge:					
- pre-test	*32.70*	*1.95*	*0.35*	*0.001*	*30*
- post-test	*50.27*	*3.04*	*0.55*		

Based on Table 2. shows the average knowledge of students in the first measurement was 32.70 (SD= 1.38), and the second measurement was 50.27 (SD= 3.04). It can be seen that mean difference value between the first and second measurements is 17.57 (SD= 3.245), which means that there was an increase in average knowledge of students between before and after treatment. The results of the statistical test obtained p = 0.001, it can be concluded that there was a significant difference in respondents' knowledge between before and after android-based digital game education.

DISCUSSION

The results of the calculation of respondents' responses show that the average score strongly agrees 84.5% and agrees 15.5%, and there are no respondents who state less/disagree, so that this game application product can be categorized as very suitable for use as an educational medium for early childhood. The results of the researchers' observations during the trial found that this Android-based educational game application was able to attract children's attention, provide motivation to learn while playing in a fun way, not only fixated on reading or watching activities but also being physically active

involving various senses making it easier to remember and understand. Purbasari research, et al. (2019) found that the mobile learning application-based learning media “Edmodo program” is an interesting educational application based on social networks[11]. Widyatmoko's research (2019) concluded that the flash media puzzle game learning media is interesting for both teachers and students[12].

The results of the t-dependent test analysis showed a value of p = 0.02 which proved that the application of the "Worm Free" game was effective in increasing students' knowledge about clean and healthy living behavior in schools to prevent worms. This condition is in line with the research of Ibrahim and Ishartiwi (2017) which shows that android-based mobile learning products are declared feasible as learning media with very good and effective categories in improving learning outcomes[13]. The use of learning media in digital form is interesting to use and has a positive impact on children's understanding of a concept[14]. Learning will be more effective through an interactive process using manipulative materials that involve multiple senses[15]. Independent learning is supported by fun edutainment in a friendly and easy-to-use interface[16]. Android-based educational game applications are preferred by children because the use of Android-based applications will support fun learning for children because they are in accordance with the latest technological developments.

CONCLUSION

This study produces product a health educational game application based on Android that was proven to be feasible and effective for use in early childhood to provide an understanding of PHBS behavior in schools to prevent helminthiasis among children.

AUTHORS’ CONTRIBUTIONS

G was the project lead and was responsible for the study and design of development projects. Both G, DS, and MI made conceptual contributions in preparing the first manuscript, conducting data collection and calculating study results. H and YNE co-authored and were involved in the revision of the manuscript. All authors approved the final manuscript.

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