

Android Game HUPROSED (Human Reproductive System and Sex Education) as Learning Media on Human Reproductive System Topic

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ABSTRACT The topic of the Human Reproductive System integrated with comprehensive sex education was selected for this research because the concept of the human reproductive system is highly related to daily life. This study aims to develop an Android game application named "HUPROSED" for learning media on human reproductive system topics integrated with sex education. The DDD-E model used as the research method consists of deciding, designing, developing, and evaluating. The deciding stage begins with analyzing content and software. The designing stage consists of making a game hierarchy and storyboard. Then, the application was developed based on the previous stage. The last stage is evaluating, which involves three expert judges, three science teachers, and forty-six students chosen to review the application by purposive sampling. The total average results from the expert judgment show a score of 3.37. The results from teachers and students conduct a score of 3.23 and 3.25. It can be concluded that the development of the game "HUPROSED" using Unity 2019 is categorized as "good" for learning media on the human reproductive system topic.

Keywords Human reproductive system, Android-based application, Comprehensive sex education.

1. INTRODUCTION

The number of cases of violence against women throughout 2020 was 299,911 cases. The case consisting of cases handled by District Courts/Religious Courts totaling 291,677 cases, Komnas Perempuan's partner service agencies totaled 8,234 cases, and Komnas Perempuan's Service and Referral Unit (UPR) totaled 2,389 cases, with a record 2,134 cases were gender-based cases and 255 points of which were not gender-based or provided information. Moreover, the growth of the actors of Lesbian, Gay, Bisexual, and Transgender (LGBT) in Indonesia has increased. The increase also follows the escalating access to the internet, pornography, drugs, and the number of LGBT communities. Despite the biological factor, the influence of the immediate environment, particularly family, friends, sexual violence, and the contents of pornography and drugs are alert to the cause of LGBT (Yudiyanto, 2016). Some of the solutions have been done, such as recently, The ASEAN Queer Advocacy Week (AAW) Lesbian, Gay, Bisexual, and Transgender (LGBT) group's conference in Jakarta was postponed due to strong opposition from various facets of society. Meanwhile, The Garut Regency Government has issued regulations regarding anti-immoral acts as of July 3, 2023. The rules are contained in

“Peraturan Bupati”s Number 47 of 2023 concerning Regulations for Implementing Garut Regency Regional Regulation Number 2 of 2008 concerning Anti-Immoral Acts as Amended by Garut Regency Regional Regulation Number 13 of 2015 regarding Amendments to Regional Regulation Number 2 of 2008 concerning Anti-Immoral Acts.

Phenomena of free sex are also caused married by accident, which also is a big problem in Indonesia. The lack of sex education today is a highly complex problem. Meanwhile, at the same time, good sex education helps us prevent the risk of sexual harassment to infectious diseases. Sex education also being a taboo thing at home. Therefore parents rarely talk to their children. Meanwhile, the student explores sex education on the internet, and those are so many contents that are not in line with the norm in Indonesia and religion. Junior high school is usually around 11 years old until 15 years old. At this age, the student becomes a teenager. Teenagers grow in an immense curiosity. They are easily influenced by lousy influence on

Received: 12 April 2022

Revised: 30 July 2023

Published: 8 October 2023

media because it is easy for them to access information, which opens up various possibilities for the absorption of thoughts that deviate from religious teachings. Harmful content that absorbs children's memories and generates suggestions, the data absorbed can develop into an ideology that will become a child's identity.

Sex education is an aspect that has not been widely researched in several developing countries, such as Southeast Asian countries, including Indonesia. The Department for Education is introducing compulsory relationship education for primary pupils and relationships and sex education (RSE) for secondary pupils from September 2020. It will be mandatory for all schools to teach health education (Lavie-ajayi, 2020). Sex education is broad and can be related to health, sexuality, security, norms, gender, identity, respect, kindness, self-expression, and not just about sex. Sex education also teaches variations in the human body, how our bodies work, and our rights over our bodies. Discussions about sex education make us have to respect our bodies. All treatment of our bodies must be approved by ourselves and not be forced. Sex education also makes us learn to choose to behave and be responsible for our actions. Thus, we can know the consequences of being sexually active. Therefore, integrating human reproduction and sex education with students' critical thinking since the contextual issue is important.

Moreover, biology should provide students with more than just information and facts; it should also provide practical applications in their daily lives (Erlianti, Widiyaningrum & Article, 2017). The human reproductive system is chosen because the concept of the human reproductive system is highly related to real life. Some points are often applied in contextual approaches, such as the menstrual cycle or sexually infectious diseases related to sex education (Erlianti, Widiyaningrum & Article, 2017). One example is AIDS. AIDS is spread by free and unprotected sex. In addition, free sex can also ruin the morale of a good human being.

When COVID-19 descended upon the nation in March 2020, schools quickly turned to social and emotional learning (SEL) to seek guidance to support all school community members' efforts to thrive (Cipriano & Brackett, 2020). School closures required a rapid transition to remote learning amid unprecedented and disproportionate experiences of loss that intensified existing educational inequities. Due to pandemic situations, school closures have been a standard tool in the battle against COVID-19. The research found that students made little or no progress while learning from home. Learning loss was most pronounced among students from disadvantaged homes. (Engzell, Frey, & Verhagen, 2021). One factor is that the teacher rarely explains clearly, or the media is irrelevant to the students. Therefore, tools are needed to overcome these problems; one of them is using

technology to support the teaching-learning process (Putra, 2018).

The expansion of the mobile game creation sector is essential. Smartphone gaming has always been a significant driver of technology. Young people are strongly attracted to gaming, which has increased interest in mobile phone games. Application developers are hardly working on several platforms to meet the growing demand for mobile phone games (Jabbar et al., 2018). One of the media to deliver the material is through Android games application. Nowadays, educational games are considered the new field in which serious games have been applied. Game-based learning will be regarded as either motivating but combined with the learner (cognitive perspective) or approaches that provide the rich contextual information and interactions needed for learning in the 21st century. Games designed to include educational objectives and subject matter can render academic subjects more student-centered, engaging, enjoyable, interesting, and, thus, more effective and efficient. (Anastasiadis, Lampropoulos & Siakas, 2018). Through android-based games, students can access the material, and game-based learning will resolve the lower scores of students when they learn biology topics.

Research about learning media has been done on the human reproductive system. Sarasati and Cahyati researched the study to ascertain how instructional media for dolls will grow in preparation for introducing sex education for kids between the ages of 4-5 (Sarasati & Cahyati, 2021). The second research is from Dewi Fitriani, Heliati Fajriah, and Arnis Wardani intends to create and assess the viability of the Lift the Flap book "Auratku" as a teaching tool for imparting sex education to kids between the ages of 4-5 (Fitriani, Fajriah & Wardani, 2021).

Some research concerns an android application for biology teaching-learning. The study from Pahlifi & Nurcahyo (2019) showed the Android-based biology learning media as a pictorial biology dictionary on students' motivation regarding invertebrates. The method used in the research is a quasi-experiment. The result shows that the Android-based illustrated biology dictionary can significantly improve students' learning motivation (Pahlifi & Nurcahyo, 2019). The technique used in this research is developmental research using the DDD-E model about the human reproductive system and sex education for junior high school.

Another study was conducted by Ayu Nofitasari, Lisdiana & Marianti (2021). They develop learning media based on the My Android Biology App in schools learning biology. Especially in the food digestive system, the material can motivate the student and the result of learning. The result shows that understanding the media My Biology App can increase motivation and student learning outcomes in the food digestive system material (Nofitasari, Lisdiana & Marianti, 2021). The idea of developing Android applications in biology subject is the same.

However, the apps, methods, and biology are different. However, there is no research on developing an android game about the human reproductive system and sex education. Therefore, an android application, especially a game, was needed. The lack of digital media, which can be easily accessed through Android game application to assist junior high students in learning the human reproductive system topic integrated with sex education, need to be more developed. Therefore, this study aims to develop an Android game application named "HUPROSED" for learning media on human reproductive system topics integrated with sex education.

This research is essential because in the development of globalization, with the ease of accessing content that is not fully compatible with or even contradicts Indonesian culture, solutions are needed to deal with such information transmission. However, no research explains the human reproductive system integrated with sex education to enhance critical thinking skills, primarily through Android game-based learning. The previous explanation concluded that media is needed to support learning on the human reproductive system and sex education material. It is necessary to develop media to improve students' human reproductive system and sex education teaching through games, therefore "HUPROSED" with the game-based learning method that will give students new fun experiences and additional material for students.

2. METHOD

2.1 Research Method

The developmental research method was used in this study. Developmental research focuses on an instructional product, program, process, or tool. Through an analysis of CAI- PBL development needs, the Decide Stage determines program objectives and materials (Fatah, Chandra & Samsudin, 2019). According to Tegeh, Jampel, and Pudjawan (2014), the DDD-E model has four stages: (1) the planning stage (decide), (2) the design stage (design), (3) the development stage (develop), and (4) the evaluation stage (evaluate) (Patmawati & Kholiq, 2021). This research

method is appropriate for the goal of creating a HUPROSED Android game application.

2.2 Population and Sample

There are four experts chosen to assess and validate the game. Those experts have a background based on three areas of expertise. All of the experts validated the application in biology content and media. The student is also being included as a research subject. They will describe the display, the clarity of buttons, color, image sustainability, mobile connectivity, materials, user interface, ease of understanding the material, and learning experience from their perspective.

2.3 Research Instrument

Rubrics from experts and questionnaires from teachers and students are used to gather data. The experts' judgment rubrics include a rating, a scale, and a written evaluation. The rubrics are measured as follows: one to four, with criteria for each rating. The experts' judgment rubric can be shown in Table 1. The questionnaire likewise uses a scale from 1- to 4, but no criteria exist for each ranking, unlike the experts' judgment rubric. Teachers' questionnaires can be shown in Table 2, while students can be shown in Table 3.

2.4 Research Procedure

As mentioned in the research method, this research and development will decide, design, develop, and evaluate. The development procedures are as follows: the first stage is choosing and organizing the science content, selecting development software, and conducting literature research on science material. The second stage is designing, such as designing a flowchart and then designing a storyboard. The third stage is development, which consists of developing a HUPROSED Android application, rubrics, and questionnaires. The last stage, evaluation, consists of obtaining expert validation, distributing questionnaires to teachers and students, and gathering the results from experts, teachers, and students to analyze the data and present the results

Table 1 Expert judgement rubric

Aspect	No	Sub-aspect	Score			Average Aspect	Average Indicator	Deviation Standard
			A	B	C			
Material	1.	The accuracy of the contents	3	4	4	3.67	3.44	0.58
	2.	Depth of material	3	4	3	3.33		0.58
	3.	Accuracy of examples	3	4	4	3.67		0.58
	4.	Suitability of the picture	2	4	4	3.33		1.15
	5.	Completeness of information.	2	4	4	3.33		1.15
	6.	Conformity tests with essential competencies and indicators	2	4	4	3.33		1.15

Table 2 Teacher's questionnaire

Aspect	No	Sub-aspect	Score			Average Aspect	Average Indicator	Deviation Standard
			A	B	C			
Curriculum	1.	The compatibility of the material with core competencies contained in the applicable curriculum.	3	2	4	3.00	3.08	1.00
	2.	Compatibility of material with essential competencies contained in the applicable curriculum.	3	1	4	2.67		1.53
	3.	Clarity of learning objectives.	2	4	4	3.33		1.15
	4.	The suitability of the order of material contained in learning media with scientific concepts.	4	1	4	3.00		1.73
	5.	Clarity of learning media users.	4	2	4	3.33		1.15
	6.	Adequacy of material description in clarity of scientific concepts.	3	2	4	3.00		1.00
	7.	Adequacy of examples given.	3	3	4	3.33		0.58

Table 3 Students' questionnaire

No	Aspects	Statement	Score				Average Statement	Deviation Standard
			$\sum 1$	$\sum 2$	$\sum 3$	$\sum 4$		
1	Display	The display in HUPROSED has an attractive color and appearance.	1	8	15	22	3.26	7.83
2	Use of buttons	The button in HUPROSED has a good function.	1	11	21	13	3.00	7.12
3	Clarity of buttons	The button in HUPROSED has a useful function.	3	5	18	20	3.20	7.57
4	Type and size of text	The type and size of the Text in HUPROSED can be seen clearly.	2	13	11	20	3.07	6.42
5	Colour sustainability	The color sustainability in HUPROSED can be seen clearly.	1	2	16	27	3.50	10.74
6	Image Suitability	The image in HUPROSED is shown clearly.	2	8	19	17	3.11	6.87
7	Use of image	The images in HUPROSED represent clearly.	1	8	15	22	3.26	7.83
8	Use of Animation	The animations in HUPROSED represent clearly.	1	7	14	24	3.33	8.56

3. RESULT AND DISCUSSION

Based on the research background, the research attempts to explore the research question, and there are. First, how do the stages of development of "HUPROSED" as a learning media in human reproductive system topics exercise students' critical thinking skills? Second, how does experts' response on content, language, and media of development of "HUPROSED" as a learning media in human reproductive system topics exercise students' critical thinking skills? Third, how do the teachers respond to developing "HUPROSED" as a learning media in human reproductive system topics? Fourth, how do students respond to developing "HUPROSED" as a learning media in the human reproductive system?

The development process is divided into four stages following the DDD-E models. There are four stages of development: (1) Decide, (2) The design stage consists of drawing a flowchart, specifying the screen design, and creating a storyboard. (3) The developing stage consists of the project's development, compiling any source of images, video, graphics, and script. (4) The evaluation stage consists of validating the project to gain a recommendation from experts or users.

3.1 Decide Stage

The HUPROSED Game Android application was developed using Unity Software and Android Studio. The topic is restricted by the Indonesia National Curriculum 2013's core competence numbers 3 and 4 and basic competence numbers 3.9 and 4.9. The Cambridge curriculum also elaborates on the issue. The subject of the human reproductive system's core competency and fundamental competence was investigated. "Connecting the human reproductive system to problems of the reproductive system and the implementation of a lifestyle that promotes reproductive health" is the fundamental competency.

Sex education is essential for every human being, especially children of elementary school age. Sex education aims to educate children about sexuality (Insiyah & Hidayat, 2020). The area includes many issues that refer to how a child develops and becomes aware of his/her gender and forms a male or female identity (Kakavoulis, 2010). Sex education in this research, emerging in the development phase, has a prenatal journey, gender reveals, human reproductive system, puberty adventure, and remarriage talk. Sex education explanation begins with gender indicating degree, such as not going with strangers' body parts that can not be touched. In detail, the human reproductive system explains a body part that must be covered, be more careful in public spaces, ask for permission when coming into the bedroom, and separate the bedroom. In pre-marriage talks, sex education is emerging about the sexual health of females and Males.

The relationship between religion and science impacts science's history, presenting different views about the

relation. In recent years, the discourse of encouraging scientists to relate science to religion is a new but slowly growing phenomenon (Akbulut, 2020). Al-Quran was revealed to Prophet Muhammad (p.b.u.h) almost 1400 years ago, yet its content is consistent with modern technology or scientific knowledge. With the advance of knowledge and technologies, much scientific information in the Quran has proven accurate, thus proving that the Quran comes from the one and only true God, Allah (Ibrahim, 2019). Some verses in the Quran emerge in the case of the human reproductive system topic and sex education. Such as verses about the process of human creation (Q.S. Al-Mukminun: 12-14), breastfeeding (QS Al-Baqarah: 233), and obeying the Parents (QS. Luqman: 14). Based on the explanation before, parents, especially mothers, sacrifice their children's lives. Therefore, the children have to obey their parents. The process of human creation is perfect; this is stated in (Q.S At-Tin: 4). Human is the best creature, Allah gives the best function of our organ, and our life is precious. Therefore, we have to be grateful. The creation of Males and females is also stated in (QS. Al-Hujurat: 13).

There are also verses in the Quran that explain puberty and sex education. If we keep our bodies safe by covering them appropriately, there are many benefits. This is in line with the ayat in the Quran about our QS. Al Ahzab 59, and QS An-Nur: 31. Female puberty started on menstruation, in Alquran stated on surah QS Al Baqarah: 222. Due to the sexually transmitted disease and various implications and negative impacts of free sex, Allah gives warning on surah QS Al Isra: 32 and QS An-Nur: 2. Allah created mates for humans from our souls to find rest in them. Marriage is one of the ways to prevent free sex. But if we haven't read enough or are still underage, we can do fasting to decrease our sexual desire.

3.2 Design Stage

The second stage of development is the designing stage. In this stage, the researcher analyzes the concept analysis and then designs the HUPROSED Android application's hierarchy and storyboard. The concepts may be used to create media scripts represented as storyboards. After that, the storyboards are turned into android application-based media. This stage is described as follows. Storyboards that have been made are then developed into android application-based media. Figure 1 a-d is an example of a storyboard.

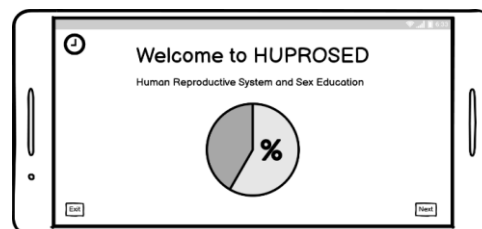


Figure 1 a Story board loading bar

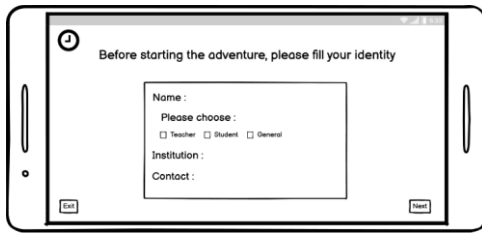


Figure 1 b Story board identity



Figure 1 c Story board introducing HUPROSED

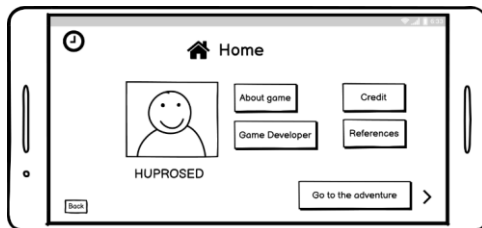


Figure 1 d Story board home

3.3 Development Stage

The development stage is the third step of DDD-E. Based on the determining and designing stages, the researcher created an Android application at this step. The following is a list of the application's results in Figure 2 a-f. The last step in the development stage resulted in HUPROSED. The storyboard that was created provided a basis for the application. The final result of the HUPROSED android application is stated in Figure 3 a-g.

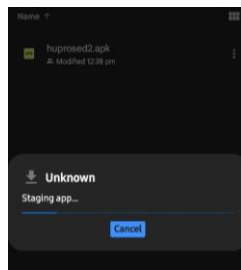


Figure 2 a Installation procedure link to google drive

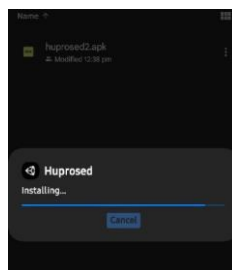


Figure 2 b Installation procedure downloaded application

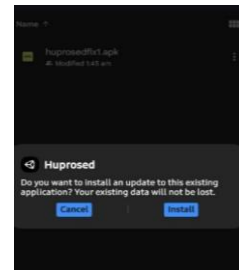


Figure 2 c Installation procedure protection from the phone

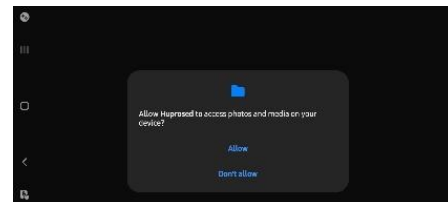


Figure 2 d Installation procedure phone allowance

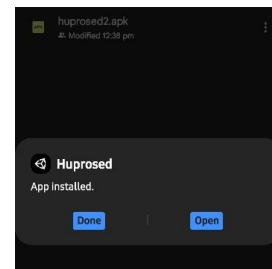


Figure 2 e Installation procedure installations

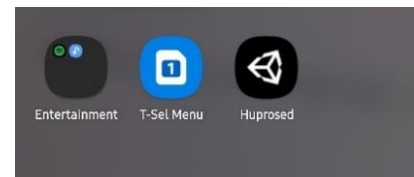


Figure 2 f Installation procedure application readiness



Figure 3 a Application result of welcoming page



Figure 3 b Application result identity

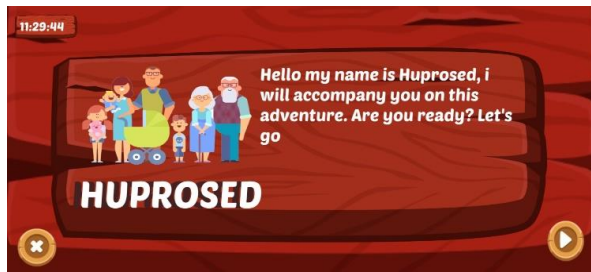


Figure 3 c Application result introducing HUPROSED

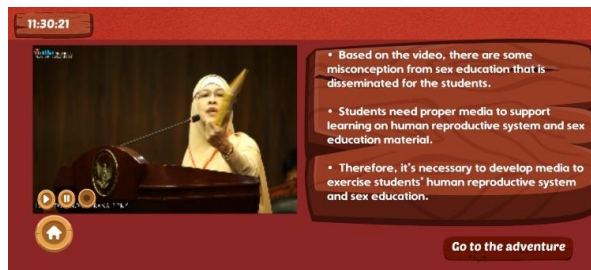


Figure 3 d Application result about game



Figure 3 e Application result game developer

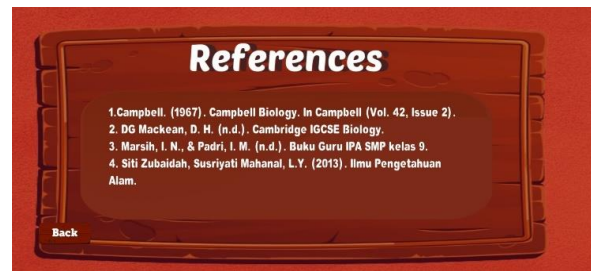


Figure 3 f Application result references



Figure 3 g Application result credit

3.4 Evaluation Stage

Numerous components must be linked to build serious games capable of generating high levels of involvement, including educational material, plot, objectives, rules, controls, algorithms, and aesthetics (Cerra, Álvarez, Parra & Cordera, 2022). Therefore, HUPROSED is confirmed by three teachers in line with the DDD-E development stage, and the evaluation is the last step. The researcher must evaluate the Android application based on the expert judgment evaluation. Following revisions, the application is sent to a science teacher and junior high school students to examine the questionnaire. The following sub-bab will explain the expert judgment, science teacher, and student questionnaire.

Expert Validation Result of HUPROSED Android Game

Game-based learning (GBL) may be challenging to include as an innovative technique in specific courses (Cerra, Álvarez, Parra & Cordera, 2022). Therefore, three experts reviewed the HUPROSED Android application in material, quiz, display, program, and the implementation of critical thinking subskills in the game. The experts' judgment fills a rubric with a scale from 1-4 (poor, fair, reasonable, excellent), with a category and definition for each criterion. The results from the three expert judgments are depicted in Table 4. The score was counted using an average for each aspect to compute the deviation standard. For all of the judges' scores, there is also an average. The average and standard deviation for content quality are given in Figure 4.

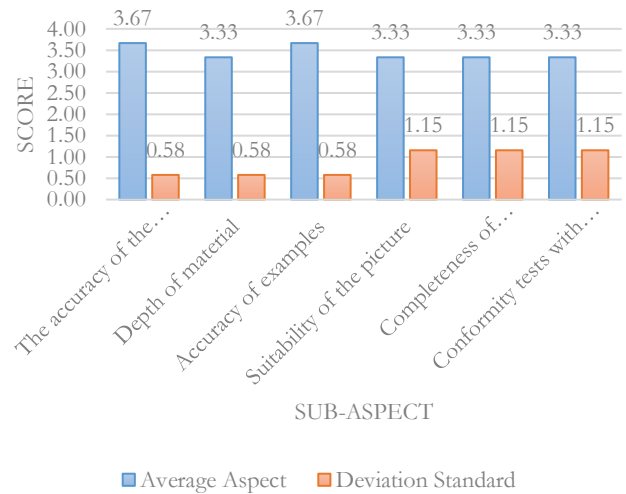


Figure 4 Material quality score

Based on Figure 4, the average score for the material aspects varies from 3.33 to 3.67. The same sub-aspects score 3.33, such as the depth of material, suitability of the picture, completeness of information, and conformity tests with essential competencies and indicators—a score of 3.67 as the highest score belongs to the accuracy of content and examples. The deviation standard on the accuracy of

Table 4 Expert judgement results

Aspect	No	Sub-aspect	Score			Average Aspect	Average Indicator	Deviation Standard
			A	B	C			
Material	1.	The accuracy of the contents	3	4	4	3.67	3.44	0.58
	2.	Depth of material	3	4	3	3.33		0.58
	3.	Accuracy of examples	3	4	4	3.67		0.58
	4.	Suitability of the picture	2	4	4	3.33		1.15
	5.	Completeness of information.	2	4	4	3.33		1.15
	6.	Conformity tests with essential competencies and indicators	2	4	4	3.33		1.15

content, the depth of material, and the accuracy of models 0.58 indicates that it is still quite good, and those aspects did not require any revision. While the deviation standard on the suitability of the picture, completeness of information, and conformity tests with essential competencies and indicators is 1.15, it needs some revision. The total average aspect is 3.44. According to Muzzayana (2018), the Android Application got an excellent material quality score. This application is suitable for learning (Zatulifa, Riswandi, Fitriawan & Akla, 2018).

According to Sukariasih, Erniwati & Salim (2019), the quiz quality consists of interactivity, suitability test with answer key, and accuracy response. For quiz quality indicators, the chart is shown in Figure 5. Based on Figure 5, the score varies from 3.33 to 3.67. There are interactivity, suitability tests with answer keys, and accuracy responses. Score 3.67, the highest score, belongs to the suitability test with answer key and accuracy response, while interactivity scores 3.33. The deviation standard on the suitability test with answer key and accuracy response is 0.58.

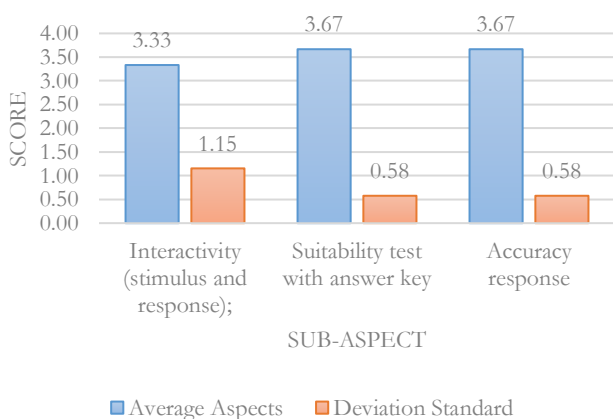


Figure 5 Quiz quality score

In comparison, the deviation standard on interactivity is 3.33. The interactivity might be unattractive because the quiz uses a simple format, but it can be improved. The total average score for this aspect is 3.25. These results stated that the Android Application got a good quiz quality score (Fitriyadi & Wuryandani, 2021).

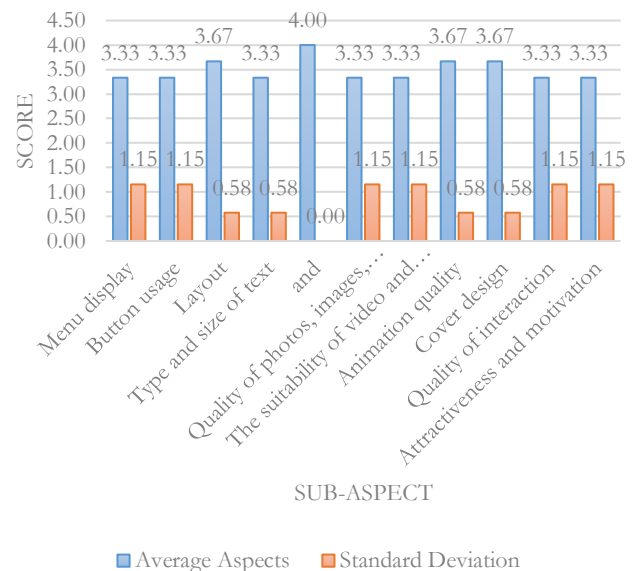


Figure 6 Display quality score

The display is one of the crucial components of the application. The display is a fireworks show, an open-air staging, or a presentation of anything. Based on Figure 6, the average is varied from 3.33 to 4.00. The highest score is 4.00 for type and size of Text while scoring 3.67 on the three sub-aspects: layout, animation quality, and cover design. Eight sub-aspects have the same score, 3.33. The deviation standard varied from 0.00 to 1.15. However, it has a high standard deviation of 1.15, suggesting that the information structure aspect can improve (Tabor & Minch, 2013). The design indicator provides satisfactory results, with a total average score of 3.48. HUPROSED received a high rating for the app's appearance, indicating that the app satisfies users and is ready to use. The next category is materials, and the chart is shown in Figure 7.

Program quality consisted of navigation, button consistency, clarity of instruction, screen usage, and text efficiency. The average varied from 3.33 to 3.00. The highest average score is 3.33 on navigation and efficiency of Text. At the same time, another aspect has the same score, on 3.00. Deviation standard varied from 1.00 to 1.73.

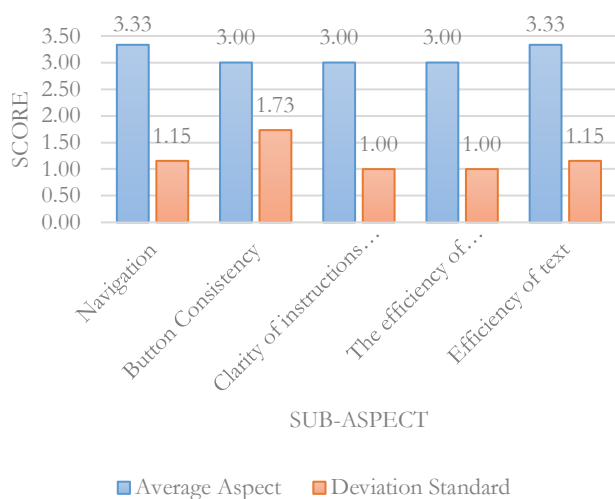


Figure 7 Program quality score

At the same time, the elements of implementing critical thinking subskills in the game are described in Figure 8.

The last aspect is about implementing critical thinking skills in the game. It consists of five statements. The first statement is about the interpretation subskills in the game's concept and the quiz to comprehend and express the meaning or significance of various experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures, or procedures criteria. These sub-aspects got a 3.33 average score and 0.58 on the deviation standard. The second sub-aspects are analysis subskills in the game concept and the quiz to identify the intended and actual inferential relationships among statements, questions, concepts, descriptions, or other forms of representation intended to express belief, judgment, experiences, reasons, information, or opinions. These sub-aspects got a 3.00 on average score and 1.00 on the deviation standard.

The third sentence is about inference subskills in the concept of the game. The quiz assesses the credibility of statements or other representations that are accounts or descriptions of a person's perception, experience, situation, judgments, beliefs, and opinion and assesses the logical strength of the actual or intended inferential relationships among statements, descriptions, question, or other forms of representation. These sub-aspects got a 3.00 on average score and 1.00 on the deviation standard. The third sentence is about inference subskills in the game's concept. The quiz assesses the credibility of statements or other representations that are accounts or descriptions of a person's perception, experience, situation, judgments, beliefs, and opinion and assesses the logical strength of the actual or intended inferential relationships among statements, descriptions, question, or other forms of representation. These sub-aspects got a 3.33 on average score and 0.58 on deviation standard.

The fourth sub-aspect is about evaluating subskills in the concept of the game. The quiz assesses the credibility of statements or other representations that are accounts or

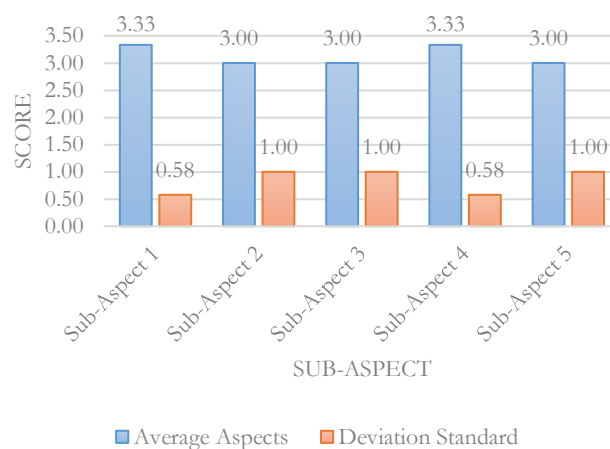


Figure 8 The implementation of critical thinking subskills in the game

descriptions of a person's perception, experience, situation, judgments, beliefs, and opinion and assesses the logical strength of the actual or intended inferential relationships among statements, descriptions, question, or other forms of representation. These sub-aspects got a 3.33 average score and 0.58 on the deviation standard. At the same time, the last sub-aspect is about explanation subskills in the concept of the game and the quiz to assess the credibility of statements or other representations that are accounts or descriptions of a person's perception, experience, situation, judgments, beliefs, opinion and to assess the logical strength of the actual or intended, inferential relationships among statements, descriptions, question, or other forms of representation. These sub-aspects got a 3.00 on average score and 1.00 on the deviation standard. The average score is 3.13, which is good enough even though some minor components can be revised.

Overall, 3.37 is the average of all expert's responses, based on Hadi (2015). It represents that the application is perfect and can be used as learning media (Astra, Nasbey & Nugraha, 2015). As a result, the HUPROSED Android application is ready for use in learning activities; however, several aspects might be enhanced. In addition, the experts provide some suggestions regarding the application. As the judges said, the suggestion can be accepted because there is some limitation on the game. Because of the Unity software's limitations, the navigation button tends to remain static (Saputra, Abidin, Ansari & Hidayat, 2018). However, the developer may learn how to make the program more interactive in the future. The application's audio, spelling, and grammar must be improved based on the expert judgment score and comments.

Table 5 Teacher response

Aspect	No	Sub-aspect	Score			Average Aspect	Average Indicator	Deviation Standard
			A	B	C			
Curriculum	1.	The compatibility of the material with core competencies contained in the applicable curriculum.	3	2	4	3.00	3.08	1.00
	2.	Compatibility of material with essential competencies contained in the applicable curriculum.	3	1	4	2.67		1.53
	3.	Clarity of learning objectives.	2	4	4	3.33		1.15
	4.	The suitability of the order of material contained in learning media with scientific concepts.	4	1	4	3.00		1.73
	5.	Clarity of learning media users.	4	2	4	3.33		1.15
	6.	Adequacy of material description in clarity of scientific concepts.	3	2	4	3.00		1.00
	7.	Adequacy of examples given.	3	3	4	3.33		0.58

Furthermore, before being distributed to science teachers and students, the program has been updated in audio, spelling, and grammar. Another recommendation from other judges is some critical thinking subskills have to be more related to the material. The triggering question for the student to write down their opinion and analysis based on sub-skills of critical thinking are also good to be added to the application. Even though the program has a guide, the judge is confused, suggesting that the application needs user advice to ensure that users understand it entirely. Also, the quiz appearance can still be revised.

Teachers' Responses about HUPROSED Android Game

After completing an expert judgment review, the application was delivered to the science teacher. Three science teachers evaluated the application and completed the questionnaire. The questionnaire has five aspects, each rated on a range of 1 to 4. (poor, fair, reasonable, excellent). This is shown in Table 5.

The average score and standard deviation of the answer were then calculated. There is also a category average and a total score average. The graph shows data on teacher responses. Its average score and deviation standard can be seen in Figure 9. The average score varies from 2.67 to 3.33, and the deviation standard varies from 0.58 to 1.73. The first statement is about "the compatibility of the material with core competencies contained in the applicable curriculum," which gained average scores of 3.00 and 1.00 for standard deviation. At the same time, the second statement about "the compatibility of the material with basic competencies contained in the applicable curriculum" got an average score of 2.67 and 1.53 for standard deviation. "The clarity of learning objectives" gained 3.33 for average score and 1.15 for standard deviation. "The suitability of the order of material contained in learning

media with scientific concepts" got a 3.00 average score and 1.73 for standard deviation.

"The clarity of learning media users" got a 3.00 average score and 1.00 for standard deviation. For "adequacy of material description in clarity of scientific concepts," I got a 3.00 average score and 0.58 for standard deviation. "The adequacy of examples given" earned 3.33. "The last statement about material conformity with learning objectives" got a 3.00 average score and 1.00 for standard deviation. The total average score is 3.08, meaning the application is very suitable for students to learn independently, and there is no need for revision. The deviation standard indicates the application is helpful in the learning activity. There is no need for any revision. It suggests that the application is well-suited for students to learn independently without further review. The standard

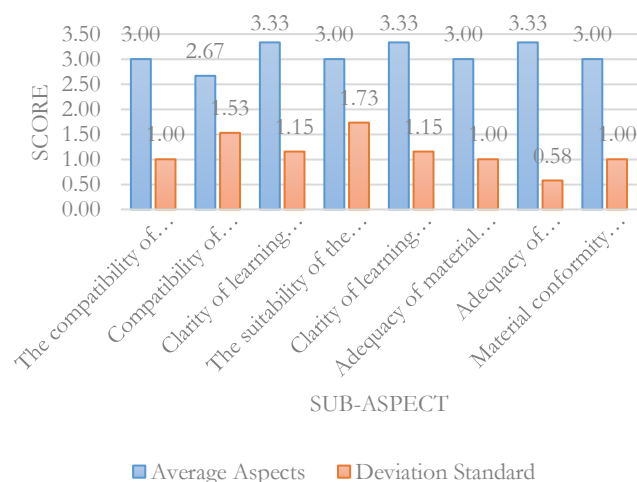
**Figure 9** Score of curriculum aspect



Figure 10 Score of learning aspect

deviation indicates that the application is helpful in the learning process; hence, no revision is needed.

Based on Figure 10, the average score varies from 3.00 to 3.83, and the deviation standard varies from 0.00 to 1.55. The first statement, "The clarity of learning instructions," got an average score of 3.00 and a deviation standard of 0.00, indicating the application is clear enough in learning instruction. The second statement, "The ease of understanding sentences in text/writing," got an average score of 3.67 deviation standard of 0.58, meaning the sentence in text/writing is easy to understand. The third sentence, "Ease of understanding material (content) lessons," got an average score of 3.33 and a standard deviation of 1.15. The fourth statement is about "the accuracy of the order of presentation," which earned an average score of 3.00 and a standard deviation of 1.00. It means the presentation is already accurate. The fifth statement is "The clarity of feedback/response," which has an average score of 3.33 and a standard deviation of 1.15, meaning the feedback or response after the user clicks is good enough. The sixth statement is "Suitability of material with student characteristics," with an average score of 3.00 and a standard deviation of 1.00. It means the material suits the student's characteristics. The seventh statement is that the "ease of media users" got an average score of 3.00 and a standard deviation of 1.00. It means the media is easy to use. While the last statement is that the "Interesting media used" got an average score of 3.67 and a deviation standard of 0.58, the media is engaging. The third category is about to benefit the teacher, and the chart is shown in Figure 11.

Based on Figure 11, the average score varies from 3.00 to 3.67, and the deviation standard varies from 0.58 to 1.00. The first statement, "can be a reference for the teacher to activate the student in learning," got an average score of 3.00 and a standard deviation of 1.00, indicating the application can be a reference for the teaching and learning

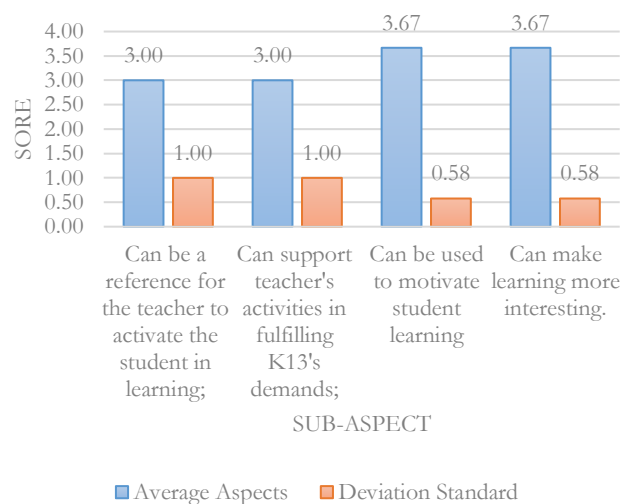


Figure 11 Score of benefit for teacher aspect

process. The first statement, "can support teacher's activities in fulfilling K13's demands," got an average score of 3.00 and a deviation standard of 1.00, indicating the application is in line with K13 activities. The third statement, "Can be used to motivate student learning," got an average score of 3.67 and a deviation standard of 0.58, indicating the application can motivate student learning. The last statement is "can make learning more enjoyable. The total average score is 3.33. Therefore, the HUPROSED Android application can be a learning source for students to exercise their critical thinking skills. The fourth category is about opportunities for implementation, and the chart is shown in Figure 12

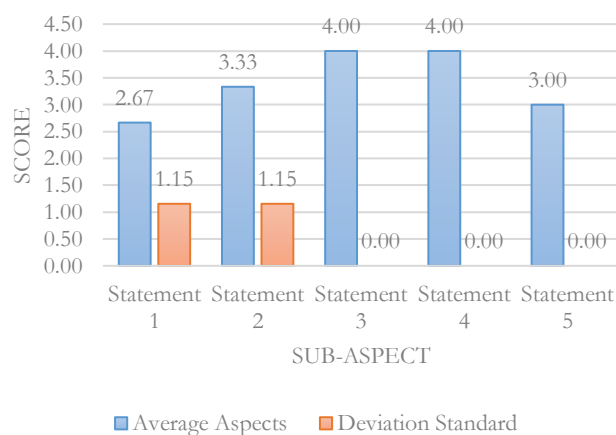


Figure 12 Score of the opportunities for implementation

The opportunities for implementation consist of five states: Facilitates students to work following the scientific method; helps students think critically; makes learning time more efficient; can help students learn independently; evaluations can be used to measure students' mastery of learning materials. The first statement is about "the application can facilitate students to work following scientific method," got an average score of 2.67 and a

deviation standard of 1.18, indicating the application still needs to be developed to facilitate students to work following the scientific method. The second statement, "help students think critically," got an average score of 3.33 and a deviation standard of 1.15, indicating the application helps students think critically. The third and fourth statements make learning time more efficient; can help students learn independently," got an average score of 4.00 and a deviation standard of 0.00, indicating the application makes learning time more efficient; can help students learn independently. The last statement is "evaluations can be used to measure students' mastery of learning materials" got an average score 3.00 and deviation standard on 0.00, indicating the application is good enough to be an evaluation to measure students' mastery of learning materials. With a total score of 3.40, HUPROSED can be a medium with good opportunities for implementation. The last aspect concerns the performance of critical thinking subskills in the game, as shown in Figure 13.

Based on Figure 13 about implementing critical thinking subskills in the game. There are five sub-aspects. The average score varied from 3.00 to 3.67, and the standard deviation ranged from 0.58 to 1.73. The first statement concerns interpretation subskills in the game concept and the quiz to comprehend and express the meaning or significance of various experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures, or criteria. The first statement got a 3.67 average score and 0.58 on the deviation standard. It means HUPROSED's subskills comprehend and express the meaning or significance of various indicators. Based on the respondents' assessment in a small-scale trial, it can be concluded that the app is of good quality (Saputra, Abidin, Ansari & Hidayat, 2018).

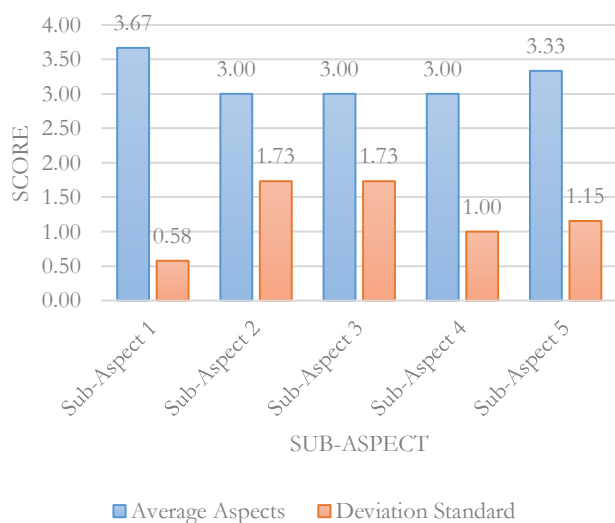


Figure 13 The implementation of critical thinking subskills in the game

The second statement is "there are analysis subskills in the concept of the game, and the quiz, to identify the intended and actual inferential relationships among statements, questions, concepts, descriptions, or other forms of representation intended to express belief, judgment, experiences, reasons, information, or opinions" got 3.00 on average score and 1.73 on deviation standard. It means HUPROSED is good enough but needs to improve the analysis subskills in the game's concept and the quiz. The third statement is "There are inference subskills in the concept of the game, and the quiz, to assess the credibility of statements or other representations that are accounts or descriptions of a person's perception, experience, situation, judgments, beliefs, opinion and to assess the logical strength of the actual or intended, inferential relationships among statements, descriptions, question, or other forms of representation" got 3.00 on average score and 1.73 on deviation standard.

The fourth statement is about Evaluating subskills in the game's concept. The quiz to assess the credibility of reports or other representations that are accounts or descriptions of a person's perception, experience, situation, judgments, beliefs, and opinion and to assess the logical strength of the actual or intended inferential relationships among statements, descriptions, question, or other forms of representation, got 3.00 on average score and 1.00 on deviation standard. The last idea is that explanation subskills exist in the game's concept. The quiz assesses the credibility of statements or other representations that are accounts or descriptions of a person's perception, experience, situation, judgments, beliefs, or opinion and assesses the logical strength of the actual or intended inferential relationships among statements, descriptions, question, or other forms of representation, got 3.33 on average score and 1.15 on deviation standard.

In addition, the teacher provides some suggestions regarding the application. The offer can be accepted because some of the Text on the HUPROSED application is still long and dense. At the same time, the images are still being improved because some of the pictures are from many sources. The background will be enhanced to the softer one. Perhaps it needs a new language to make prominent people access HUPROSED. It indicates that, with minor changes, the prototype is perfectly valid and viable (Cahyono, Muslim, & Djoko, 2019).

Furthermore, the application has been revised and fully developed in design and interactivity. According to Putra (2020), the Android learning material produced is worthy of being used and successful in upper and middle-class students but not yet effective in lower-class students (Putra, Asi, Anggraeni & Karelius, 2020). Another reason is that it is provided in an offline format, so it can be used anywhere and at any time without any time constraints, even if there is no internet connection (Cahyana, Paristiowati & Fauziyah, 2018).

Table 6 Students' response

No	Aspects	Statement	Score				Average Statement	Deviation Standard
			$\Sigma 1$	$\Sigma 2$	$\Sigma 3$	$\Sigma 4$		
1	Display	The display in HUPROSED has an attractive color and appearance.	1	8	15	22	3.26	7.83
2	Use of buttons	The button in HUPROSED has a good function.	1	11	21	13	3.00	7.12
3	Clarity of buttons	The button in HUPROSED has a useful function.	3	5	18	20	3.20	7.57
4	Type and size of text	The type and size of the Text in HUPROSED can be seen clearly.	2	13	11	20	3.07	6.42
5	Colour sustainability	The color sustainability in HUPROSED can be seen clearly.	1	2	16	27	3.50	10.74
6	Image Suitability	The image in HUPROSED is shown clearly.	2	8	19	17	3.11	6.87
7	Use of image	The images in HUPROSED represent clearly.	1	8	15	22	3.26	7.83
8	Use of Animation	The animations in HUPROSED represent clearly.	1	7	14	24	3.33	8.56

Students Responses about HUPROSED Android Game

The application was delivered to the forty-six students. The questionnaire has five aspects, each rated on a range of 1 to 4. (poor, fair, reasonable, excellent). This is shown in Table 6. The average score and standard deviation of the answer were then calculated. There is also a category average and a total score average. The graph shows data on teacher responses. Its average score and deviation standard can be seen in Figure 14. Based on Figure 14, the average score varies from 3.00 to 3.61, and the deviation standard varies from 6.42 to 11.95. The students' responses consist of fifteen aspects, such as display, use of buttons, clarity of buttons, type and size of Text, color sustainability, image suitability, use of image, and use of animation, to prevent misunderstandings in this study, the operational definition is provided in the following terminology, ease of understanding language, use the navigation buttons, quality of interaction, use of multimedia, problem adequacy, attractiveness, and motivation.

The first aspect displays, the statement "display in HUPROSED has an attractive color and appearance," got a 3.26 average score and 7.83 on the deviation standard. It indicates that HUPROSED's display has an attractive color and appearance. The second aspect is using the button, and the statement "The button in HUPROSED has a good function" got a 3.00 average score and 7.12 on the deviation standard. It means the button has an exemplary

function but still needs improvement. The third aspect is clarity of controls, and the statement is the button in HUPROSED has explicit instructions and roles. The fourth statement is the type and size of Text, which got a 3.07 on average score and 6.42 on the deviation standard, which means the Text already has the proper type and size.

The fifth aspect is color sustainability, which got a 3.50 on average score and 10.74 on the deviation standard, which means the color sustainability in HUPROSED can be seen clearly. The sixth aspect is image suitability, which got a 3.11 average score and 6.87 on the deviation standard, which means the image in HUPROSED is shown clearly. The seventh aspect is an illustration, which gained a 3.26 average score and 7.83 on the deviation standard, which means the pictures of HUPROSED are represented clearly. The eighth aspect is animation, which got a 3.33 average score and 8.56 on the deviation standard, which means the spirits in HUPROSED represent clearly.

The ninth aspect is about preventing misunderstandings in this study, and the operational definition is provided in the following terminology, which got a 3.43 on average score and a 10.11 deviation standard. It means the delivery of the material of the "Human Reproductive System and Sex Education" in a HUPROSED game is delivered. The tenth aspect is about the ease of understanding language, with a 3.20 on average score and 7.43 on deviation standard. It indicates the language and writing used in the HUPROSED game are easy to understand. The eleventh aspect concerns

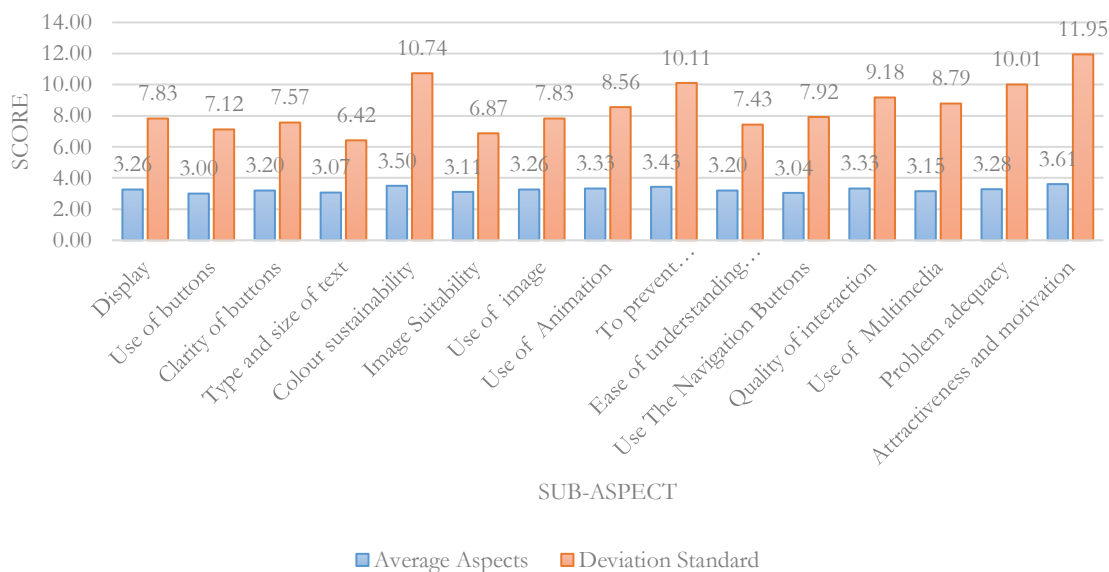


Figure 14 Students' response

navigation buttons, which got a 3.04 average score and 7.92 on the deviation standard, indicating that the HUPROSED game's controls work well.

The twelfth aspect is the quality of interaction, which got a 3.33 average score and 9.18 on the deviation standard. It means each level in the HUPROSED game has different levels of difficulty. The thirteenth aspect is multimedia, which got 3.15 on average and 8.79 on the deviation standard. It means the use of multimedia on the HUPROSED game works well. The fourteenth aspect is problem adequacy, which got a 3.28 on average score and 10.01 on deviation standard. It means each level in the HUPROSED game has different levels of difficulty. The last aspect is attractiveness and motivation, which got 3.61 on average and 11.95 on the deviation standard. The HUPROSED game increases understanding of the material in "Human Reproductive System and Sex Education." The final average score of students' responses is 3.25, indicating HUPROSED is good from students' perspective, but it still needs some improvement. In addition, the students provided some suggestions regarding the application. The comments vary in some aspects; here are a few remarks regarding the aspects detailed in Table 7. The suggestion can be accepted; some buttons are slow and not smooth. The idea may be helpful since, according to the findings, their motivation to play the app is still low. It has been discovered that the application's design might help students feel motivated rather than bored.

Due to this idea, the students requested an experiment or a simulation in the application. It will not be possible soon due to Unity software limitations and developer skills, but it will be possible in the future. The design seems to have the same problem as the previous findings: the students want a colorful application rather than a plain

design. The students also demanded that the application be available in Indonesian. The creator intends to create one, but it will not be merged with the English version due to the file size. The application's design, interactivity, and quiz questions must be improved based on the student's scores and comments. As a result, the application's design, interaction, and quiz questions have all been changed and thoroughly developed.

According to the findings and analyses of experts, science teachers, and junior high school students who used this mobile learning application, the HUPROSED Android application may increase students' interest in learning about the human reproductive system and sex education as a subject and make them eager to use it in science classes. Consequently, this Android-based software as an enrichment source for leading textbooks would help students study more effectively. Android-based apps revealed various opportunities to add a wide variety of information and context creation outside formal education environments. This result demonstrates that HUPROSED, an Android application, is very effective, efficient, and practical (Diani & Syarlisjswan, 2018). As a result, this kind of learning material can make the teaching and learning process more accessible in the future.

4. CONCLUSION

Industrial Revolution 4.0 encourages the development of information and communication technology, allowing for technology implementation in all aspects of life, including education (Eliyawati, Agustin, Sya'bandari & Putri, 2020). The HUPROSED application supports only the Android operating system. The user may interact with a variety of buttons. The resources demonstrate the human reproductive system and its relationships and complete sex

Table 7 The percentage of students' comment

No	Aspect	The amount of student	Percentage
1	Display (Masril, Hidayati & Darvina, 2018)	12	26.1 %
2	Use of buttons (Sukariasih, Erniwati & Salim, 2019)	18	39.1 %
3	Clarity of buttons (Sukariasih, Erniwati & Salim, 2019)	5	10.9 %
4	Type and size of text (Sukariasih, Erniwati & Salim, 2019)	23	50 %
5	Colour sustainability (Masril, Hidayati & Darvina, 2018)	10	21.7 %
6	Image Suitability (Sukariasih, Erniwati & Salim, 2019)	10	21.7 %
7	Use of image (Sukariasih, Erniwati & Salim, 2019)	9	19.6 %
8	Use of Animation (Masril, Hidayati & Darvina, 2018)	14	30.4 %
9	To prevent misunderstandings in this study, the operational definition is provided in the following terminology (Sukariasih, Erniwati & Salim, 2019)	6	13 %
10	Ease of understanding language (Sukariasih, Erniwati & Salim, 2019)	10	21.7 %
11	Use The Navigation Buttons (Sukariasih, Erniwati & Salim, 2019)	7	15.2 %
12	Quality if interaction (Sukariasih, Erniwati & Salim, 2019)	7	15.2 %
13	Use of Multimedia (Sukariasih, Erniwati & Salim, 2019)	4	8.7 %
14	Problem adequacy (Sukariasih, Erniwati & Salim, 2019)	3	6.5 %
15	Attractiveness and motivation (Masril, Hidayati & Darvina, 2018)	10	21.7 %

education through guided inquiry. Currently, there is just one version of the program: the English version. The program may yet be improved in terms of design and interaction. The games need to be for Android because of A collection of Android features known as accessibility can make it easier for users, especially those with disabilities, to operate the device. Accessibility-enabled programs have full access to the screen, allowing them to alter settings and interact with other apps and other things as if they were the user (Ignatov et al., 2018).

There are four steps to developing a HUPROSED Android application: deciding the content, designing the features, developing the game, and evaluating the application. The application got a review from three expert judgments. The final average score on the material aspects is 3.44, followed by the quiz category with an average score of 3.56 and the display category with an average score of 3.48. The category got 3.13 for the program, and the implementation of critical thinking subskills in the game got 3.13. The average for all types is 3.37.

The application got a review from three science teachers. The final average score on the curriculum aspects is 3.08, followed by the learning category with an average score of 3.25 and the benefit for teachers with an average score of 3.33. The opportunities for implementation were 3.40, and the performance of critical thinking subskills in the game was 3.20. The overall average is 3.23, which is excellent and indicates that the HUPROSED Android application was ready to use, while it still needed more improvement.

The students also provide feedback on the application. The final average score on display aspects is 3.26, followed

by button aspects with an average score of 3.00, color sustainability with a 3.50, and image suitability with a 3.11 average score. Using an image with a 3.26 average score, animation with a 3.33 average score, and the aspects that explain HUPROSED as the application to prevent misunderstandings in this study, the operational definition is provided in the following terminology 3.43 average score. The ease of understanding language got a 3.20 average score, while the navigation buttons got a 3.15 average score, and the quality of interaction got a 3.28 average score. The use of multimedia got a 3.15 average score, and problem adequacy earned 3.28. Also, the last aspect is attractiveness and motivation got 3.61. The HUPROSED Android application has an average score of 3.25, or excellent in all categories, suggesting that it is ready to be utilized in learning activities.

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