

Research Article

Practicing Critical Thinking Skills Through an Android Game on the Human Reproductive System

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ORCIDPutri Sekar Melati: <https://orcid.org/0000-0002-0666-7063>Eka Cahya Prima: <https://orcid.org/0000-0002-7852-5611>Eliyawati: <https://orcid.org/0000-0003-3886-9943>**Abstract.**

This study aimed to aid in practicing critical thinking skills through an android game about the human reproductive system. A descriptive method was used in this study, in which students did their own exploration using the Android game named Human Reproductive System and Sex Education (HUPROSED). Six indicators of critical thinking skills based on Facione's work were analyzed. The six indicators were interpretation, analysis, inference, evaluation, and explanation. Forty six students were chosen to review the game by purposive sampling. This research's critical thinking skills were included in the quiz question in line with HOTS (High order thinking skills) about the human reproductive system, such as the menstruation cycle, sexually transmitted diseases, sperm, the concept of twins, and HIV, which usually have cognitive skills above C4 (applying, analyzing, evaluating, and creating). In the game, students answered the quiz. Five test items based on critical thinking were used to exercise students' critical thinking skills. The test got a score of 65 on average. Therefore, this research demonstrated how the android game "HUPROSED" may be used to teach students about the human reproductive system and sex education while also allowing students to practice critical thinking, although it still needs to be developed.

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1. INTRODUCTION

Nowadays, the term 21st-century skills have been one of the key concepts in education. The skills included in 21st-century skills include concepts of problem-solving, creativity, computer and information literacy, collaboration, and critical thinking [1]. 21st-century skills are usually provided on many assessments; one of the most prestigious programs employed to measure educational achievement worldwide is the Programme for International Student Assessment (PISA). PISA offered by the Organization for Economic Cooperation and Development (OECD) [2]. PISA is proposed to evaluate the assessment of scientific literacy across three competencies including process, content, and situation

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which is conducted every three years. Based on the PISA score, students in Indonesia scored lower than the OECD average in reading, mathematics, and science.

The ability to think critically is an important thing, but in reality, in the field it is not as expected. The critical thinking ability of junior high school students in Indonesia is still relatively low [3]. A study by Muhlisin (2012) found that 80.9% of biology students had inadequate critical thinking skills which revealed 80.9% students belonged to a low category [4]. The four-year International Trends in International Mathematics and Science Study (TIMSS) study conducted on junior high school students with the characteristics of questions at a high cognitive level that can measure students' critical thinking skills, showing that Indonesian students consistently fall in the lower ranks.

Less than optimal learning strategy, models, method, and process resulted in low critical thinking among biology students [5]. As seen on Programme for International Student Assessment (PISA) score, the low condition needs to be improved by seeking the core of components tested on PISA. After that, finding solutions for those problems. Solutions that have been implemented in Indonesia to improve PISA score is applying critical thinking skills in national exam questions since 2015, which tested to queries in the form of Higher Order Thinking Skills (HOTS); the question's composition refers to a cognitive level with a range of 10-15% for reasoning, 50-60% for applications, and 25-30% for knowledge and understanding. One of the curriculum components tested on PISA is categorized into two types: the ability to re-reveal information, develop interpretations, and reflect and evaluate texts. From these components, there are similarities to the principles of critical thinking expressed by Facione, which include performance, analysis, evaluation, self-regulation, and inference [6]. The ability to think critically can change students from passive to active, and students can do activities such as reading, analysis, and writing to improve critical thinking [7].

Science subjects are a good way to enhance students' critical thinking skills. Biology is the subject chosen in this research because biology is mainly based on textbooks; therefore, many students are still passive in learning this material [8]. Biology teaching learning process is still teacher-centered. The survey stated that 45.83% of students are accustomed to learning using the lecture learning model varies by the teacher, then 58.33% of students still consider biology as rote learning, also 62.50% of students consider the learning model used by the teacher less attractive, and 58.33% of students are not accustomed to being trained in higher-order thinking skills [9]. Biology education should provide students with more than just information and facts; it should also provide them with practical applications in their daily lives [9]. 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 menstrual cycle, abnormal or sexually infectious diseases related to sex education [9]. One example is AIDS. AIDS is spread by free and unprotected sex. In addition, free sex can also ruin the moral of a good human being. Therefore, in addition to the intended enhancement of critical thinking skills, it is also required to exercise students' critical thinking skills at the completion of the learning.

In many countries, the engagement of science education and communication has been emphasized using teaching media [10]. Some research about media development to enhance critical thinking was conducted. Other researcher studied the validity of Prest developed in the Momentum and Impulse material to improve students' critical thinking skills (Critical Thinking) of high school students [11]. Meanwhile, others research aims to determine the effect of the web module science integrated local batik potential toward the thinking ability of seventh-grade students of junior high school. The research method used was quasi-experimental design with a posttest-only design. The instrument used is about thinking skill [12]. However, there is no research on exercising critical thinking in the human reproductive system and sex education. Therefore, an android application, especially a game, was needed to exercise students' critical thinking on human reproductive system topics integrated with sex education. The lack of digital media which can be easily accessed through android game application to assist junior high students in learning 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" to exercise students' critical thinking on human reproductive system topics integrated with sex education.

2. RESEARCH METHOD

The research method used in this research was descriptive because it is dealing with making a description of the current or past status of phenomena [13]. The process of this research includes arranging the test item, attempting the test, implementing the test to the students, and gaining the data, and converting it to the Microsoft excel, process the data, and analyze it. Data profiling utilizes methods of the descriptive statistic by proper analyses, interpretation, comparisons, identification of trends, and relationships. The participants in the current study are from three junior high schools (X) in Bandung. Bahasa Indonesia and English is used as the main language in this school.

This research attempts to test forty six (46) students in their third year study. The instrument consisted of test items related to the critical thinking skills adapted from

Facione. There are six capabilities of critical thinking emerging in the learning process through the ability. The six indicators are interpretation, analysis, inference, evaluation, explanation. Forty six students chose to review the application by purposive sampling. This research’s critical thinking skills are included in the quiz question in line with HOTS (High order thinking skills) about human reproductive system such as menstruation cycle, sexual transmitted disease, sperm, the concept of twin, and sexual transmitted disease about HIV, which usually have cognitive skills above C4, applying, analyzing, evaluating, and creating. In this game, students will answer quiz questions inserted into the games.

3. RESULT AND DISCUSSION

3.1. Students' Performance Results

An objective exam with five questions assessed students’ essential thinking ability. Below is the percentage of each question; the first question is in Figure 5.

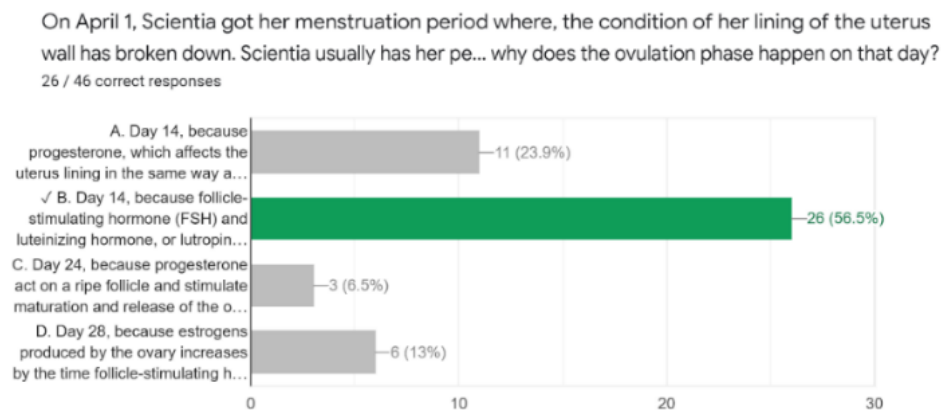


Figure 1: First question.

Figure 5 shows that the first question is about the menstruation cycle, and has critical thinking sub skills on interpretation, especially about deciding significance. 56.5 % or 26/46 students got the correct answer. In contrast, 20 students got the wrong answer. More than 50% of students already understand the menstruation cycle material, and they can exercise their critical thinking skills, especially interpretation skills. The second question is explained in Figure 4.2.

Based on the Figure 2 the second question is about the sexually transmitted disease, categorized as C4 (attributing), and has critical thinking sub skills on analysis, especially

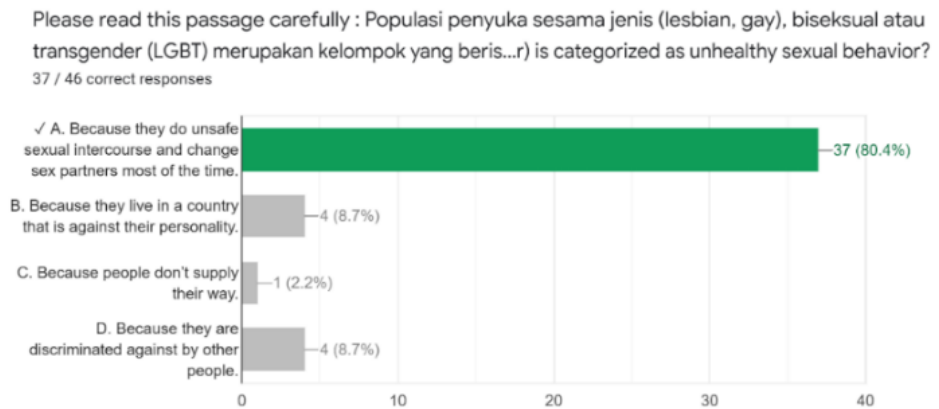


Figure 2: Second question.

about identifying arguments. 80.4 % or 37/46 students got the correct answer. At the same time, nine students got the wrong answer. More than 50% of students have already understood the material about sexually transmitted diseases, and they can exercise their critical thinking skills, especially analysis skills. The third question is explained in Figure 3.

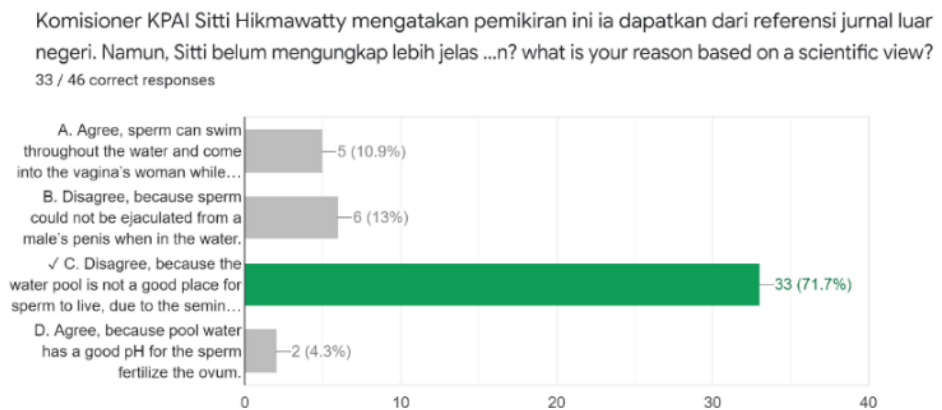


Figure 3: Third question.

Figure 3 shows that the third question is about the sperm concept, and also has critical thinking sub skills on inference, especially about drawing logically valid or justified conclusions. 71.7 % or 33/46 students got the correct answer. At the same time, 13 students got the wrong answer. More than 50% of students already understand sexually transmitted diseases, and they can exercise their critical thinking skills, especially analysis skills. The third question is explained in Figure 4.

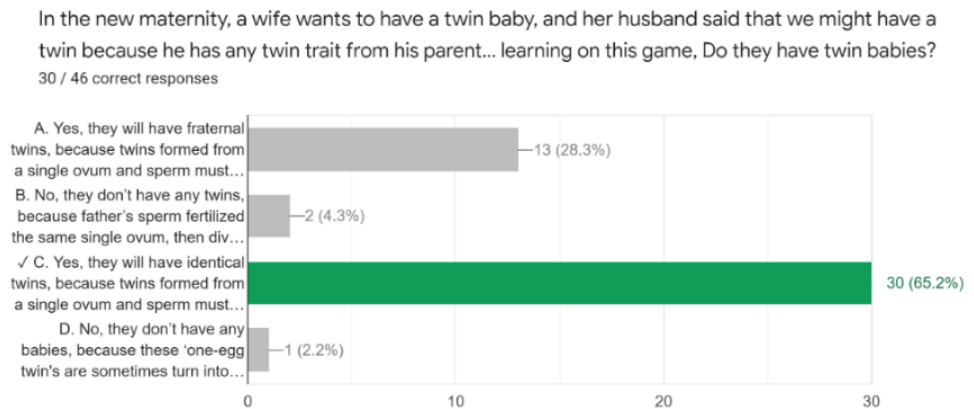


Figure 4: Fourth question.

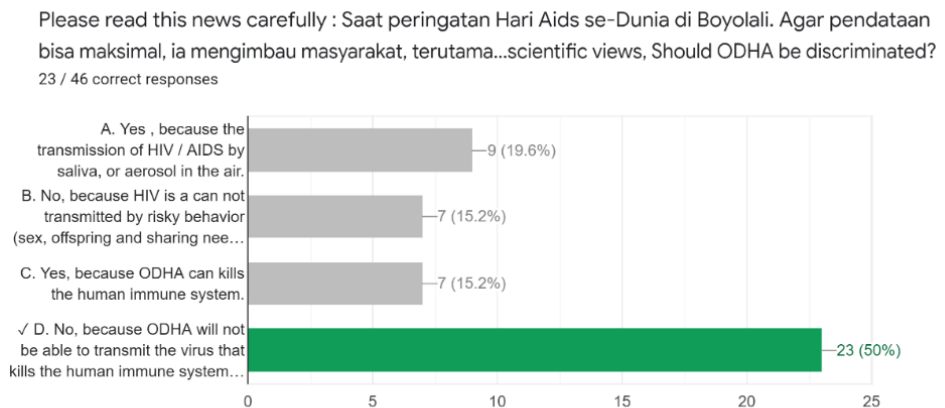


Figure 5: Fifth question.

Based on Figure 4 the fourth question is the twin concept. It has critical thinking sub skills on evaluation, especially about assessing the quality of arguments made using inductive or deductive reasoning to evaluate the credibility of claims. 65.2 % or 30/46 students got the correct answer. In comparison, 16 students got the wrong answer. More than 50% of students have already understood the material about sperm concept, and they can exercise their critical thinking skills, especially inference skills. The fourth question is explained in Figure ??.

Figure ?? shows that the last question is the HIV concept. It has critical thinking sub skills on explanation, especially about assessing the quality of arguments made using inductive or deductive reasoning to evaluate the credibility of claims. 50% or 23/46 students got the correct answer. While 23 students got the wrong answer. 50% of students already understood the material about twin concepts, and they can exercise their critical thinking skills, especially evaluation skills.

3.2. The Recapitulation of Students' Results

The test was completed by 46 students, with an average score of 65. The highest percentage is 80.4 %, or 37/46 students got the correct answer. The question is about the menstruation cycle, categorized as C4 (organizing), has critical thinking sub skills on interpretation, especially about deciding significance. At the same time, nine students got the wrong answer. Please adjust with your own data results. This is only an example. Table 1 depicted the recapitulation of those five test items.

TABLE 1: The recapitulation of students' results.

No	Concept	Critical Thinking Sub skills	Student with Correct Answer	Student with Wrong Answer	The percentage of correct answer
1.	Menstruation Cycle	Interpretation	26	20	56.5 %
2.	Sexually Transmitted Disease	Analysis	37	9	80.4 %
3.	The Concept of Sperm	Inference	33	13	71.7 %
4.	The Concept of Twin	Evaluation	30	16	65.2 %
5.	The Concept of HIV	Explanation	23	23	50%

Table 1 shows the question is about the menstruation cycle, has critical thinking sub skills on interpretation, especially about deciding significance. At the same time, nine students got the wrong answer. More than 50% of students already understand sexually transmitted diseases, and they can exercise their critical thinking skills, especially analysis skills. The lowest percentage is 50 %, or 23/46 students got the correct answer. At the same time, 23 students got the wrong answer. The question is about twin concepts and critical thinking skills, especially evaluation skills. This demonstrates how the game “HUPROSED” may be used to educate students about the human reproductive system while simultaneously putting their critical thinking skills to the test. This game may also be a resource for academics or instructors who want to understand using technology as a teaching tool. The android-based-media material is feasible to be implemented in learning, especially during the covid-19 pandemic [14]. The graph of the critical thinking in the test item is depicted on Figure 6.

Based on the Figure 6. The objective test's questions were based on Facione's critical thinking book, including analysis, inference, evaluation, explanation, and interpretation. The highest score is 80.40 % for the analysis sub skills, and the lowest score is 50% for the explanation skills. It means students' analysis skills are good, students are able 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 in the test item. While

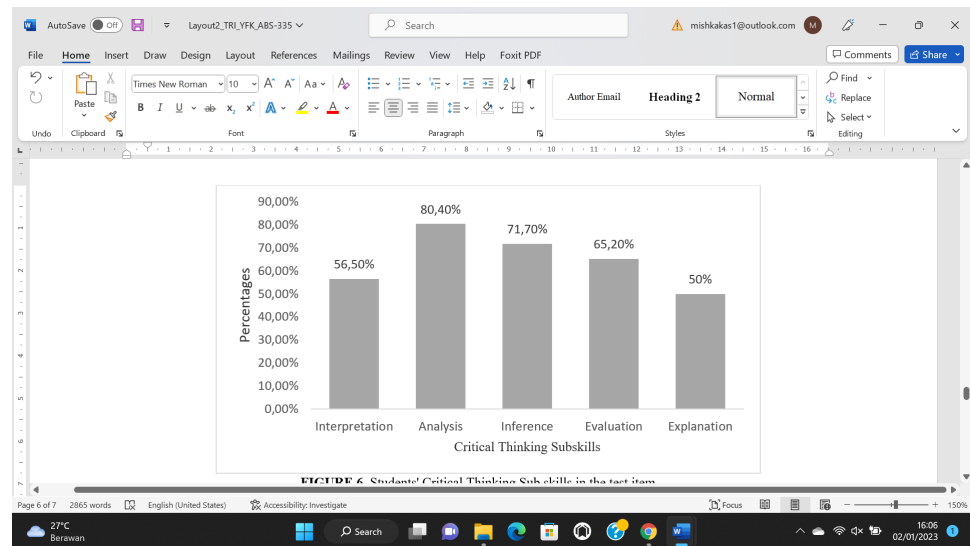


Figure 6: Students' critical thinking sub skills in the test item.

students' explanation skills still need to be exercised, these skills can be enhanced by questioning, confirming, validating, or correcting either one's reasoning or one's results.

Forty-six students did the exercise, and the average score is 65. This shows that the game "HUPROSED" may teach students about the human reproductive system while also challenging their critical thinking abilities. This game may also be a resource for researchers or teachers interested in leveraging technology as a learning media. The author recognizes that there are still many flaws in this game that need to be addressed; one of them is that it has to be updated regularly to avoid boredom among students. The stages in this game may then be added to make it more difficult for students to master the respiratory system in a new manner. The implementation of students' critical thinking must be maximized to make the game meaningful. The performance of game and critical thinking tests should be improved to ensure that students may be trained. Following that, in the application of critical thinking, adapting not only the capacity to think critically to one principle but also to other principles to compare the outcomes of critical thinking skills questions by adjusting one direction and other regulations.

4. CONCLUSION

The ability to think critically is an important thing, but in reality, in the field it is not as expected. The critical thinking ability of junior high school students in Indonesia is still relatively low. However, there is no research on exercising critical thinking in the human reproductive system and sex education. Therefore, an android application, especially a

game, was needed to exercise students' critical thinking on human reproductive system topics integrated with sex education. Each of the variety of games stands for critical thinking indicators. The objective test's questions were based on Facione's critical thinking book, including analysis, inference, evaluation, explanation, and interpretation. Forty-six students did the exercise, and the average score is 65. This shows that the game "HUPROSED" may teach students about the human reproductive system while also challenging their critical thinking abilities. although it still needs to be developed.

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