CHAPTER III
RESEARCH METHODOLOGY

3.1 Research Method

The research and developmental research method was used in this study. Developmental research focuses on a particular instructional product, program, process, or tool. Through an analysis of CAI- PBL development needs, the Decide Stage focuses on determining program objectives and materials (Fatah et al., 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 research's goals: to create a HUPROSED android game application.

This DDD-E model is a design model for multimedia development (Wahidah et al., 2020). The first step of development involves (1) Deciding the project objectives and brainstorming material. (2) The designing step includes generating a storyline, drawing a flowchart, and determining the screen design. (3) The developing stage includes the creation of the project, as well as the compilation of any picture, video, graphics, or script from any source. (4) The evaluating step entails verifying the project in order to get feedback from experts or consumers.

3.2 Research Design

The researcher created the HUPROSED Android application as an Android package or APK Using Unity software on a computer. The HUPROSED Android game can be played on any device that runs on the Android operating system. Before the experts judge the biology content, language, and media, supervisors oversaw the final development of the HUPROSED Android game application. After HUPROSED has been through several revisions and suggestions, it was presented to science teachers for approval and validation and students for review**.**

3.3 Population and Sample

There are four experts chosen to assess and validate the game. Those experts have a background based on three areas of each expertise. All of the experts validated the application in biology content and media for about one week. The student is also being included as a research subject. They described display, the clarity of button, color, image sustainability, mobile connectivity, materials, user interface, ease of understanding material, and learning experience from their perspective, because they have been experienced in this case, for example, the expert from biology subject, and computer science.

This research was held in three junior high schools in Bandung City. Two schools are private schools that use English in the teaching-learning process. The students are varied from 14-15 years old. For about 20 females and 16 males. One school is a public school that uses Bahasa. The population of this study is 9th-grade students from each school. Forty-six students participated in this study. Because the researcher needs to select the most relevant sample and gather students' judgments on the application, the purposive sampling technique chooses 9th-grade students.

3.4 Operational Definition

To prevent misunderstandings in this study, the operational definition is provided in the following terminology:

1) Android-based Application

The Android mobile application facilitates learning via the use of mobile devices. It was created utilizing the Android operating system, which is used on smartphones and other mobile devices. Unity, a piece of software, was used to make this application. The expert evaluation rubric for biology content, language, and media was used, as will the readability test for mobile learning apps, which was answered by a rubric of students and scientific instructors. This program has a variety of elements, including video, animation, music, and text, all of which are nicely bundled under the design of the application. The information contained in this application pertains to the human reproductive system. The topic was adapted from Cambridge Curriculum for 9th-grade students.

2) Human Reproductive System

All anatomical parts involved in sexual reproduction make up the reproductive or genital system. The male and female sexes create different kinds of reproductive cells called gametes. Sperm must reach an ovum to fuse. The sperm nucleus then merges with the ovum nucleus. This is seeding. A zygote is the result of sperm fertilizing an ovum. A zygote divides into an embryo and ultimately an adult mammal. The reproductive system has various organs that are unique to females and men. Non-living things including fluids, hormones, and pheromones are also vital to reproduction.

1) Students' Critical Thinking Skills

One of the skills on twenty-century skills is critical thinking. In educational psychology courses, critical thinking skills and problem-solving abilities are important in training student teachers to solve difficult educational challenges, particularly in everyday life. (Toharudin, 2017). Based on Faccione (2011), six critical thinking capabilities emerge in the learning process through the ability(P. A. Facione, 2011).

3.5 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 questionnaire likewise uses a scale from 1-to 4, but there are no criteria for each ranking, unlike the experts' judgment rubric. A free place in the written review is provided for comments and suggestions. The following is a detailed description of the data collection process :

3.5.1 Expert Judgment Rubric

The expert judgment rubric that used in this research was the scale. This rubric was used to verify that the HUPROSED Android game application was of excellent quality. The Learning Object Review Instrument (LORI) created this rubric (Leacock & Nesbit, 2007). It's often used to assess all types of educational media. The biological content, language, and media are the three factors in this rubric. The

quality of each aspect is measured on a scale of 1 to 4. There are two parts, about material and media, including each indicator mentioned on the table. There are also available spaces on the rubric for comments and suggestions. The expert judgment rubric is shown in Table 3.1. The complete version is available in the appendix.

Table 3.1 Expert judgment rubric

Aspect	No	Sub-aspect	Score			
			1 (Poor)	**2 (Fair)**	**3 (Good)**	**4 (Excellent)**
Display (Sukariasih et al., 2019)	1	Menu display				
	2	Button usage				
	3	Layout				
	4	Type and size of text				
	5	Colour composition				
	6	Quality of photos, images, and graphics				
	7	The suitability of video and audio				
	8	Animation quality				
	9	Cover design				
	10	Quality of interaction				
	11	Attractiveness and motivation				

3.5.2 Teachers' Questionnaire

A rating system is also included in the survey for teachers and students. This questionnaire was used to verify that the HUPROSED Android game application can be used in teaching and learning. This questionnaire consists of five indicators: curriculum, education, benefits for teachers, opportunities for Implementation, the Implementation of critical thinking subskills in the game. Each aspect has its sub-aspects. The quality of each element is measured on a scale of 1 to 4. Table 3.2 shows the questionnaire, including blank places for feedback and suggestions. The complete version is available in the appendix.

Table 3.2 Teachers' questionnaire

Aspect	No	Sub-aspect	Score			
			1 Poor	2 Fair	3 Good	4 Excellent
Curriculum (Sukariasih et al., 2019)	1.	The compatibility of the material with core competencies contained in the applicable curriculum.				
	2.	Compatibility of material with basic competencies contained in the applicable curriculum.				
	3.	Clarity of learning objectives.				
	4.	The suitability of the order of material contained in learning media with scientific concepts.				
	5.	Clarity of learning media users.				
	6.	Adequacy of material description in clarity of scientific concepts.				
	7.	Adequacy of examples given.				
	8.	Material conformity with learning objectives.				

3.5.3 Students' Questionnaire

Students are also being included in this research. On a scale of 1 to 4, the score of each aspect is rated. Fifteen aspects were added to this questionnaire. The questionnaire is shown in Table 3.3, which contains blank spaces for feedback and suggestions. The complete version is available in the appendix.

Table 3.3 Students' questionnaire

No	Aspect	Statement	Score			
			1 Poor	2 Fair	3 Good	4 Excellent
1	Display (Masril et al., 2018)	The display in HUPROSED has an attractive color and appearance.				
2	Use of buttons (Sukariasih et al., 2019)	The button in HUPROSED has a good function.				
3	Clarity of buttons (Sukariasih et al., 2019)	The button in HUPROSED has a helpful function.				
4	Type and size of text (Sukariasih et al., 2019)	The type and size of the text in HUPROSED can be seen clearly.				

3.6 Data Processing Technique

The same data processing approach is used for the expert judgment rubric, teacher questionnaire, and students questionnaire. Following the development of the application, the researcher sends the rubric, together with the HUPROSED android game application, to the expert judgment by e-mail. After that, the expert judgment evaluates the application and completes the rubric. The researcher received the rubric findings and began analyzing the information by calculating the average of each element using the formula:

$$\bar{X} = \frac{\Sigma x}{n}$$

(Wan et al., 2014)

The average was obtained by dividing the total score of experts in each aspect by five, the total number of experts. The deviation standard may be calculated using the following method once the average of each aspect has been calculated:

$$s = \frac{\sqrt{\Sigma(xi - \bar{x})^2}}{N - 1}$$

(Wan et al., 2014)

The Likert Scale criteria may also be used to determine if the data is adequate or not. The data from the teachers' and students' questionnaires are processed in the same way: the mean of each category is calculated, followed by the standard deviation.

3.7 Research Procedure

As mentioned in the research method, this research and development will decide, design, develop, and evaluate. The development procedures are as follows:

1) **Deciding Stage**
   a) Organizing the science content
   b) Selecting development software
   c) Conducting literature research on science material
2) **Designing Stage**
   a) Designing flowchart
   b) Designing storyboard
3) **Development Stage**
   a) Developing HUPROSED Android application
   b) Developing rubrics and questionnaire
4) **Evaluation Stage**
   a) Obtaining expert validation
   b) Distributing questionnaires to teachers and students
   c) Gathering the result from experts, teachers, and students
   d) Analyze the data
   e) Presenting the results

The scheme of the research procedure stages is shown in Figure 3.1.

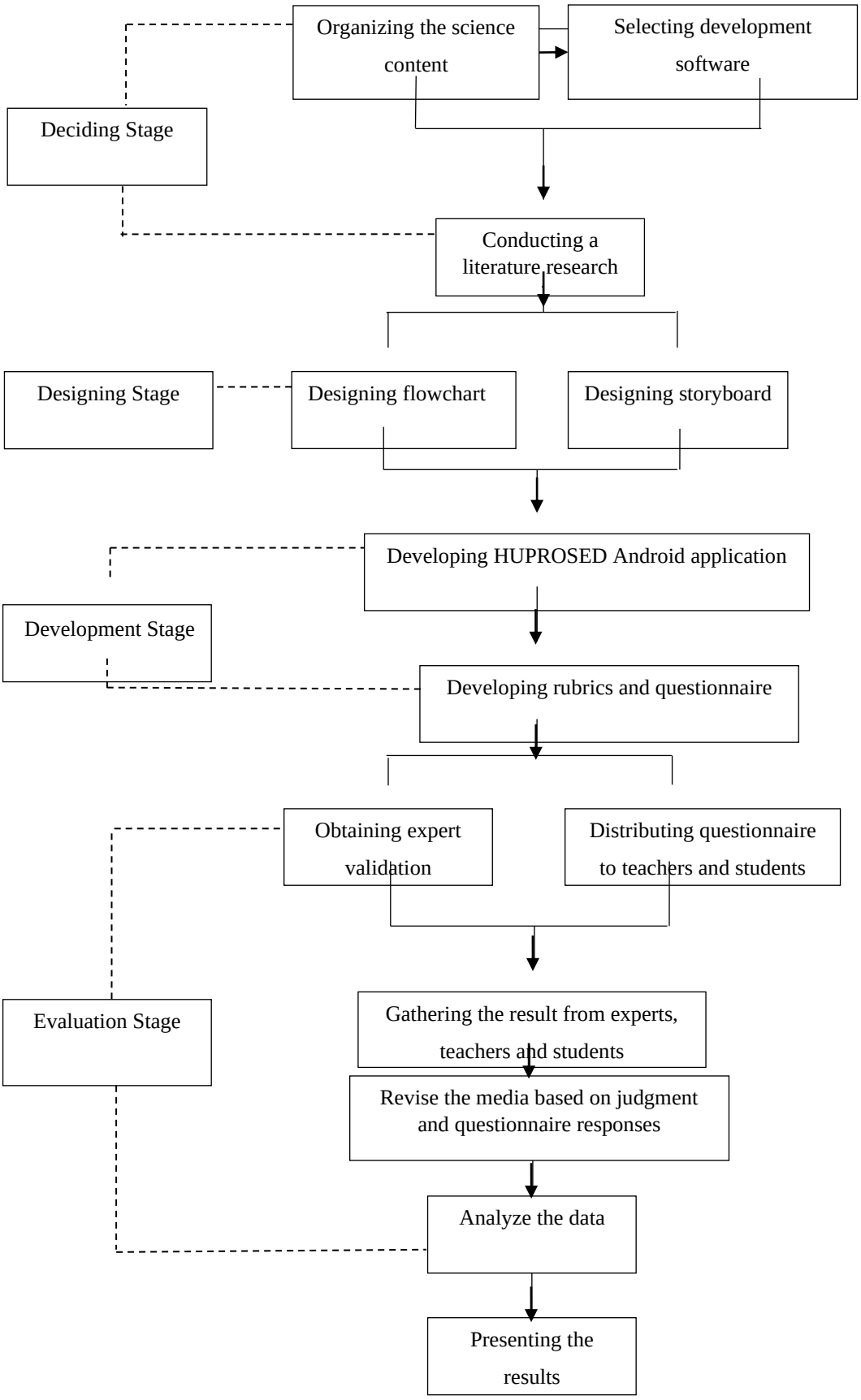

Figure 3.1 Research procedure