

CHAPTER III

RESEARCH METHODOLOGY

3.1 Research Method

The method that was used in this research is the developmental research method. Development research focuses on a given instructional product, program, process, or tool (Richey & Klein, 2005). It reflect an interest in identifying any general development principles or recommendations for specific situations. It is addressed in product design and development and evaluation (Richey & Klein, 2005). This research method is suitable for the objectives of this research, which is to develop a ChemFUN android application.

This research used the DDD-E (decide, design, develop, and evaluate) development model, adopted from (Ivers & Barron, 2002). There are four stages of development; (1) Deciding stage consists of determining the project goals and brainstorming the content. (2) Designing stage consists of drawing a flowchart, specifying the screen design, and creating a storyboard. (3) Developing stage consists of the project's development, compiling any source of image, video, graphics, and script. (4) Evaluating stage consists of validating the project to gain a recommendation from experts or the users.

3.2 Research Design

The researcher created the ChemFUN Android application in an Android package or APK using Unity software and Android Studio on the computer. ChemFUN Android application can be accessed from any device that used the Android operating system. Supervisors will supervise the final development of the ChemFUN Android application before the experts judge from chemistry content, language, and media. After ChemFUN goes through several revisions and suggestions, the application will be brought to the science teachers to get some recommendation and validation and the students to be reviewed.

3.3 Population and Sample

In this study, five experts were chosen in order to assess and validate the game itself. Those experts have a background based on their expertise in chemistry, technology, and language. All of the experts were validate the application in the aspect of chemistry content, language, and media. Teachers and students are also included as a research subject. They have given their perspective on mobile connectivity, materials, user interface, and learning experience.

The purposive sampling was used to select respondent to evaluate the ChemFUN android application. Purposive sampling is a nonrandom technique that let the researcher to find the most useful sample regarding the research (Etikan, 2016). In this research, the sample considered as useful is the one who has Android devices and have learned Matter topic. Thus, the purposive sampling is the most suitable technique to choose the respondent in this research. There are six science teachers and thirty-six students as a respondent to review the application. The population of this study is 7th-grade students from “Private Junior High School X.” Both teachers and students come from the school that implements Cambridge Curriculum for their 7th-grade students.

3.4 Operational Definition

To avoid some misunderstanding in this study, here is the following terminology of the operational definition described:

1) Android-Based Application

The Android mobile application is learning that takes place with the support of mobile devices. It was developed using an Android operating system that runs on a smartphone or gadget. This application was created by a software called Unity. For chemistry content, language and media will be assessed by the expert assessment rubric and the readability test for mobile learning applications that will be answered by the rubric of students and science teachers. This application is equipped with various features such as video, animation, music, and text neatly packaged under the design of the making. The material presented in this

application is a Matter topic. The topic was adapted from Cambridge Curriculum for 7th-grade students.

2) Chemical Multiple Representation

There are three levels of chemical multiple representations. The first level is macroscopic representation, which stands for every phenomenon that naked eyes can see. It is observable by the human sense organ, such as a precipitation product of a specific chemical reaction, the color changes, and all of the activities carried out in the laboratory. The second level, microscopic representation, stands for the chemical phenomenon that naked eyes cannot see, such as atoms, ions, molecules, and compounds. The third level, symbolic representation, refers to the chemical phenomenon represented by an image, video, animation, equations, and computational form.

3.5 Research Instrument

The data was collected in the form of rubrics from experts and questionnaires from the teachers and students. The experts' judgment rubrics have a rating, scale, and written review. The rubrics use a scale from 1-4, and it has criteria for each scale. The questionnaire also uses a scale from 1-4, but there are no criteria for each scale like the experts' judgment rubric. The written review contains a blank space to put feedback and suggestion. In order to collect the data, the detailed process is described as follow:

3.5.1 Expert Judgment Rubric

The expert judgment rubric used in this study was the rating scale. This rubric was used to validate the quality of the ChemFUN Android application. This rubric was adapted from Learning Object Review Instrument (LORI) (Leacock & Nesbit, 2007). It is often used to measure all kinds of media used in learning. This rubric consists of three indicators which are chemistry content, language, and media. The scale is 1 to 4 to determine the quality of each aspect. The rubric also consists of blank spaces for feedback and suggestion. The Table 3.1, Table 3.2, Table 3.3, shows the expert judgment rubric respectively

Table 3.1 Rubric for Content

No	Category/Aspect	Assessment Gradient				Score (1-4)	Comment
		1 (Need Improvement)	2 (Fair)	3 (Good)	4 (Excellent)		
1	Accuracy	The content is inaccurate or overly general. Students are unlikely to learn anything or maybe mislead	The content is sometimes inaccurate or incomplete. Students may learn some isolated facts, but they are unlikely to gain new insights about the topic.	The content is generally accurate and reasonably complete. Students may develop a few insights about the topic.	The content is accurate and comprehensive. Students are likely to gain new insights about the topic.		
2	Veracity	There are several errors in the application content, or a lot of the criteria have not been encountered	Almost all information on the application is reliable, and almost all criteria have been encountered	Almost all the information provided on the application is reliable, and all material delivery standards have been	All information given on the application is reliable, and all material delivery standards have already been		

No	Category/Aspect	Assessment Gradient				Score (1-4)	Comment
		1 (Need Improvement)	2 (Fair)	3 (Good)	4 (Excellent)		
				encountered	encountered		
3	Chemical Multiple Representations (Macroscopic, Microscopic, and Symbolic)	All of the materials in this application did not apply chemical multiple representations	There is a small portion of the materials that apply chemical multiple representations	Most of the materials apply chemical multiple representations	All of the materials in this application apply chemical multiple representations		
4	Interconnection of Chemical Multiple Representation	All of the materials in this application did not have an interconnection between macroscopic, microscopic, and symbolic	A small portion of the materials in this application have an interconnection between macroscopic, microscopic, and symbolic	Most of the materials in this application have an interconnection between macroscopic, microscopic, and symbolic	All of the materials in this application have an interconnection between macroscopic, microscopic, and symbolic		

No	Category/Aspect	Assessment Gradient				Score (1-4)	Comment
		1 (Need Improvement)	2 (Fair)	3 (Good)	4 (Excellent)		
5	Scientific Term	The use of terms for each element and learning material in the application is not following scientific terms	A small portion of the use of terms in each element and learning material is following scientific terms	Most of the terms used in each element and learning material are following scientific terms	All of the terms in each element and learning material is following scientific terms		

Table 3.2 Rubric for Language

No	Category/Aspect	Assessment Gradient				Score (1-4)	Comment
		1 (Need Improvement)	2 (Fair)	3 (Good)	4 (Excellent)		
1	Spelling and Grammar	There are many errors in spelling, or grammar in the final draft of the application	There are more than five errors in spelling, punctuation, or grammar in the final draft of the application	There are 1-3 errors in spelling or grammar in the final draft of the application	There are no errors in spelling or grammar in the final draft of the application		
2	Text	The explanation text is not understandable and not easy to read	Not easy to read because several explanations are not following the material	Easy to read but less understandable	Easy to read and understandable, all materials are well delivered		

No	Category/Aspect	Assessment Gradient				Score (1-4)	Comment
		1 (Need Improvement)	2 (Fair)	3 (Good)	4 (Excellent)		
3	Diction	Many dictionaries cause user confusion, so the materials are not well-delivered	There are many different dictionaries but still understandable	Diction is well applied but does not support the comprehension or materials	Diction is well applied and support the comprehension of materials		
4	Audio	The narration in the video is not clear, and the pronunciation is incorrect	The narration in the video is clear but not understandable and does not use a standard accent	The narrator in the video is clear but does not use a standard accent, but the pronouns are understandable	The narration in the video is clear, use a standard accent, and use an understandable pronunciation		

Table 3.3 Rubric for Design

No	Category/Aspect	Assessment Gradient				Score (1-4)	Comment
		1 (Need Improvement)	2 (Fair)	3 (Good)	4 (Excellent)		
1	Presentation Design	The audio and visual display (background, image, color, font size & type, and music) are unattractive	A small portion of the audio and visual display (background, image, color, font size & type, and music) are attractive.	Most audio and visual displays (background, image, color, font size & type, and music) are suitable and attractive.	All audio and visual displays (background, image, color, font size & type, and music) are suitable and attractive		
2	Navigation	There are no buttons and navigation tools in the application that is made	There is a little difficulty with pressing buttons and navigation tools. There are still errors / out-of-sync with the buttons and navigation tools when played.	Most of the buttons and navigation tools are functional. There are still a few errors in the buttons and navigation tools when played.	All the buttons and navigation tools are functioning correctly. There is no mistake when it is being played.		

No	Category/Aspect	Assessment Gradient				Score (1-4)	Comment
		1 (Need Improvement)	2 (Fair)	3 (Good)	4 (Excellent)		
3	Information Structure	The order of information is not understandable. The menu and flow of information delivery are not straightforward.	The order of information is quite understandable. The menu and flow of information delivery were confusing and contained errors	Most of the order of information is quite understandable. Menu and flow of information are directly delivered and clear.	All of the order of information is clear and understandable. Menu and all information are directly delivered and clear.		

3.5.2 Teachers and Students Questionnaire

The teacher and students questionnaire also uses a rating scale. This questionnaire was used to validate the quality of the ChemFUN Android application. The questionnaire was adapted from the Technology Acceptance Model (TAM) and other relevant studies (Eliyawati et al., 2020; Lee et al., 2003). This questionnaire consists of four indicators: mobile connectivity, materials, user interface, and learning experiences. The scale is 1 to 4 (strongly disagree – strongly agree) to determine the quality of each aspect. The questionnaire also consists of blank spaces for feedback and suggestion, and it is shown in Table 3.4.

Table 3.4 Teachers and Students Questionnaire

Category	Statement	1	2	3	4	Comment
Mobile Connectivity	The application is easy to be installed					
	The application is easy to connect					
	The application is flexible to interact with					
Materials	Materials are understandable and clear					

Category	Statement	1	2	3	4	Comment
User Interface	Materials are accessible					
	The question in the quiz can enhance the comprehension					
	The design is attractive					
	All text can be seen and readable					
	All media can be seen clearly					
Learning experience	The application is fun and makes me motivated to learn					
	The application allows me to learn independently					

Category	Statement	1	2	3	4	Comment
	The application is helpful in my learning activity					

3.6 Data Processing Technique

The rubric of expert judgment and the teachers and students questionnaire goes through the same data processing technique. After the application was developed, the researcher distributes the rubric to the expert judgment via e-mail, alongside the application. The expert judgment then tests the application and fills the rubric. Finally, the researcher got the rubric results and started processing the data by counting the average of each aspect by the following formula:

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

(Wan et al., 2014)

The average got from the total score given by experts in each aspect and divided by five as the number of total experts. After the average of each aspect was counted, the deviation standard also can be counted by the following formula:

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

(Wan et al., 2014)

The data also can be classified that whether it is good or not by looking at the Likert Scale criterion. For the data from teachers and students questionnaire, the data processing is the same; by calculating the mean of each category and then the deviation standard.

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) Brainstorming the science content
 - b) Deciding the software that will be used to develop
 - c) Literature review about science content

- 2) Designing Stage
 - a) Designing flowchart
 - b) Designing storyboard
- 3) Development Stage
 - a) Developing ChemFUN Android application
 - b) Developing rubrics and questionnaire
- 4) Evaluation Stage
 - a) Testing validity from experts
 - b) Giving teachers questionnaire
 - c) Giving students questionnaire
 - d) Collecting data from experts, teachers, and students
 - e) Making data analysis
 - f) Reporting the results

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

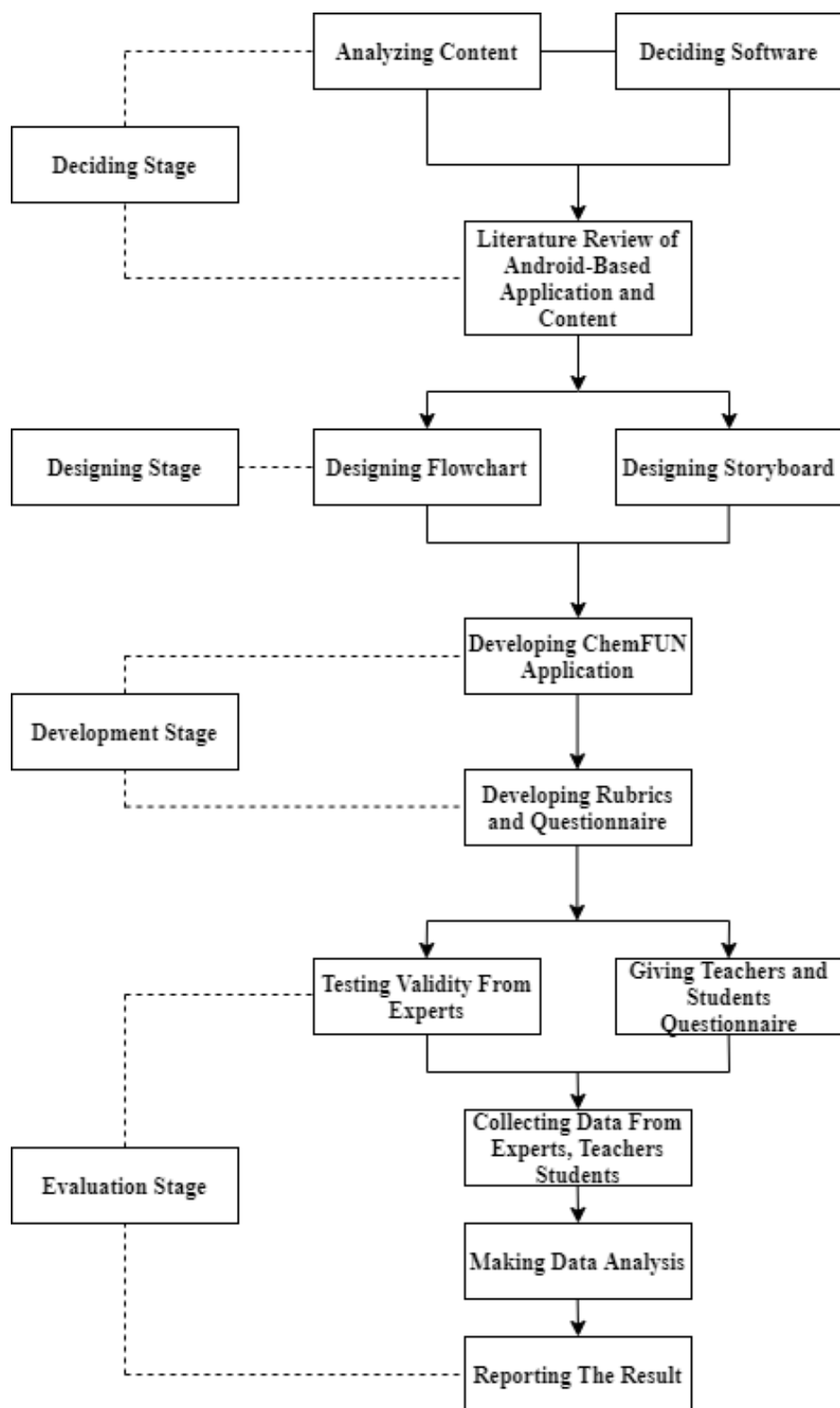


Figure 3.1 Research Procedure