

# CHAPTER III

## RESEARCH METHODOLOGY

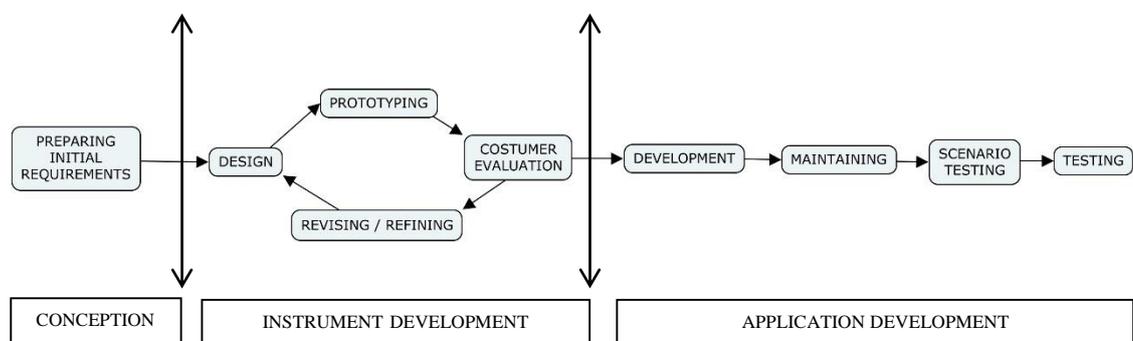
### 3.1 Research Method

The method used in this research is developmental research method. The method can describe the development process of instrument and application in this research, and analyze the readability of the application later on. Developmental research facilitates the study of new models, tools, and procedures. The method several stages where each stage involves reporting and analyzing data. The stages consist of sub-studies to analyze and define the instructional problem, to specify the content, to determine instrument reliability and validity, and to make a summative evaluation (Gravemeijer, 1998).

This research method is suitable and appropriate with the objectives of the research, which is to develop a collaborative problem-solving assessment tool on the cluster topic of organ system, because the research focuses on development process of both instrument and application rather than merely gathering data.

### 3.2 Research Design

Based on the developmental research method, in order to make this research systematically arranged, a development model was used. The development model used in this study is called the Prototyping Development Model. Prototyping development model is a model where a prototype of the end product is first developed, tested and refined as per customer feedback repeatedly till a final acceptable prototype is achieved which forms the basis for developing the final product. The flow of the model is shown in Figure 3.1 as follow:



**Figure 3.1.** The Flow of Prototyping Development Model

Prototyping development model consists of three stages of the procedure which are conception, instrument development, and application development. Conception stage is where all initial requirements for the instrument and application, such as literature review and software analysis, was prepared. Instrument development stage consists of a cycle with four steps, namely design, prototyping, customer evaluation, and revision. Application development stage was where the instrument turned into an application, where its' readability and validity will be tested.

This study use prototyping development model because the assessment tool developed in this study went through cycles that improves the quality of the application in each step. The cycles of customer evaluation that the tool went through are testing by expert judgment and students' evaluation.

### **3.3 Research Subjects**

The participants of this study were one expert of logical thinking assessment, and one ICT expert on application validation. The assessment expert judged and validated the instrument used in this study, while the ICT expert judged and validated the tool made based on the instrument. Both instrument and tool were tested on Junior High School students.

For the testing of the instrument, the location chosen is a Private Junior High School named Pribadi Bilingual Boarding School Bandung (Pribadi BBS) located on Jalan P.H.H Mustofa, Bandung. The school uses English as the communication and delivery language in teaching-learning process. The curriculum that applies in this school are National Curriculum (Curriculum 2013) and Cambridge International Syllabus.

This school was chosen because it has been accredited "A" by Indonesia's Ministry of Education and also because of the facilities that supported students to conduct the collaborative problem-solving assessment. Most of the students come from average to the higher social economy status family, which facilitates the students to have devices such as personal laptop to provide them with the ability to install the application used in this study. The research subject were 17 students from grade 8A of Pribadi BBS.

While for the application testing, the location chosen is also a Private Junior High School named SMP Laboratorium Percontohan UPI (Labschool UPI) located on Jalan Senjayaguru, Bandung. The school is Bilingual, using Indonesia and English as the communication and delivery language in teaching-learning process. The curriculum that applies in this school are National Curriculum (Curriculum 2013).

This school was chosen because it has been accredited “A” by Indonesia Ministry of Education and also because of the facilities that supported students to conduct the collaborative problem-solving assessment. Most of the students also has the privileges to have devices such as personal laptop to provide them with the ability to install the application used in this study. The research subject were 19 students from grade 8D of Labschool UPI.

### **3.4 Operational Definition**

In order to avoid misconception in this research, some operational definitions are explained in this research. The research variables are explained as follow:

#### **3.4.1 Collaborative Problem-Solving**

Collaborative problem-solving is a skill consisted of many competencies and defined as the capacity of an individual to effectively engage in a process whereby two or more people attempt to solve a problem by sharing the understanding and effort required to come to a solution and pooling their knowledge, skills, and efforts to reach that solution. The instrument developed is derived from similar instrument developed by OECD on PISA 2015, and using the topics of science as its’ theme. The instrument developed was assessed by the rubric of experts’ judgment shown in Table 3.2.

#### **3.4.2 Einstein’s Riddle**

Einstein’s Riddle is a well-known logic puzzle. Also known as zebra puzzle. It was said that it was developed by Albert Einstein when he was a boy, although there is no proof supporting it.

The puzzle challenges its’ players to match the descriptions given in the information. The most famous version of the puzzle is the version published in Life International magazine on December 17, 1962, as follow,

**Table 3.1.** Einstein's Riddle in Life International magazine

1. There are five houses.
2. The Englishman lives in the red house.
3. The Spaniard owns the dog.
4. Coffee is drunk in the green house.
5. The Ukrainian drinks tea.
6. The green house is immediately to the right of the ivory house.
7. The Old Gold smoker owns snails.
8. Kools are smoked in the yellow house.
9. Milk is drunk in the middle house.
10. The Norwegian lives in the first house.
11. The man who smokes Chesterfields lives in the house next to the man with the fox.
12. Kools are smoked in the house next to the house where the horse is kept.
13. The Lucky Strike smoker drinks orange juice.
14. The Japanese smokes Parliaments.
15. The Norwegian lives next to the blue house.
<b>Now, who drinks water? Who owns the zebra?</b>

In this research, Einstein's riddle developed as an instrument in measuring CPS due to its' simple instruction, constant answer, and constant roadmap into the answer, meaning there is no open-ended answer so everyone who plays will go through the same steps, with solving time as the only different variable. The research provides the template for Einstein's riddle that teacher can develop on their own. For the purpose of measuring CPS in this research, there will be three versions of Einstein's riddle, where each having different theme depends on the science topics, either circulatory system, digestive system, or skeletal system.

#### 3.4.3 Cluster Topic of Organ System

This research used three concepts of science, which are Digestive System, Skeletal System, and Circulatory System. These concepts can be classified into one cluster which is Organ System. Each concept becomes the theme for each case puzzle

of the instrument, but each concept is kept as shallow and as content-free as possible, in order to prevent the variable of scientific literacy affecting the measurement of collaborative problem solving.

The case puzzle with the theme of Circulatory System contains the sub-topic of blood type, where the story assign students as a group of nurses trying to match the blood donor based on the blood types and other characteristics. The case puzzle of Digestive System uses the theme of digestive system's organs. The students play as a group of doctors where each patient has a problem in different organs, and the doctors will match the characteristics given in the information with each patient. The Skeletal System's case puzzle contains the sub-topic of the names of bones in human body. The students play as a group of surgeons on operation table with five injured athletes whose bone is broken in different places.

### 3.5 Research Instrument

The instruments are used to obtain or gain the data in this research. There are four data gathered in this research, which are the expert judgments of the instrument, instrument field testing, expert judgments of the application, and readability of the application.

#### 3.5.1 Expert Judgments of the Rubric

The rubric that is used to validate the rubric through expert judgments can be seen in Appendix B.1. In the rubric, three aspects of every item were assessed, the aspects are the clarity of the item, clarity of expected answers, and whether the item reflects the competency or not. The expert can then judge whether the item is valid or not, and add feedbacks to the items. The validation format can be seen in Table 3.2 as follow,

**Table 3.2.** Format used to validate the test items in the rubric

No.	The Assessed Aspects	Experts' Assessment (✓)	
		Yes	No
1	The item is clear		
2	The expected answer is clear		
3	The item reflects the competency		
Judgment and Suggestion		Conclusion	
		Please mark one of the items below that best represents the question based on the judgment.	

	<ol style="list-style-type: none"> <li>1. Already appropriate to be used without revision</li> <li>2. Appropriate to be used but needs revision</li> <li>3. Not appropriate</li> </ol>
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The rubric was given directly to the expert along with the instrument and general overview of the research so no miscommunication may occur between researcher and the expert assessing the assessment of the instrument.

### 3.5.2 Empirical Instrument Testing

After the expert judgments of the instruments, the instrument and the assessment of the instrument were tested in real condition. Testing was carried out towards junior high school students of Pribadi BBS, to test whether the test items are measurable and can be used in real situation.

The instrument was given to the students for the researcher to collect and assess later. The result of testing was then tested by the researcher whether the items can actually be used in real situation or not.

### 3.5.3 Expert Judgments of the Application

The rubric used to validate and test the readability of the application was derived from a journal titled “A Detailed Rubric for Assessing the Quality of Teacher Resource Apps” (Cherner, 2016). In the rubric provided by the research, there are three domains, which are Efficiency, Functionality, and Design. These domains have a cumulative of 20 dimensions that can be seen in Table 3.3 as follow:

**Table 3.3.** Dimensions Measured by the Rubric

<b>DOMAIN A: EFFICIENCY</b>	<b>DOMAIN B: FUNCTIONALITY</b>	<b>DOMAIN C: DESIGN</b>
A1. Productivity: 5	B1. Multipurpose: 5	C1. Navigation: 4
A2. Frequency: 5	B2. Collaboration & Communication: 4	C2. Ease of Use: 4
A3. Guidance: 5	B3. Ability to Save Progress: 4	C3. Customization: 5
A4. Relevance: 5	B4. Modification: 4	C4. Aesthetics: 5
A5. Credibility: 3	B5. Platform Integration: 4	C5. Screen Design: 5

A6. Differentiation: 5	B6. Security: 3	C6. Information Presentation
C7. Media Integration: 5		
C8. Free of Distractors: 5		

From these 20 dimensions, this research only uses two dimensions from domain A, which are the A3 for Guidance, and A4 for Relevance; two dimensions from domain B, which are B1 for Multipurpose, and B6 for Security; and five dimensions from domain C, which are C1 for Navigation, C2 for Ease of Use, C4 for Aesthetics, and C5 for Screen Design that is divided into C5.1 for Text, and C5.2 for General Design. These dimensions were chosen purposefully to match the goal and the capabilities of the application.

Likert scale and rating were used to measure the result of the expert judgements. The 3-scale was used and assigned to the indicators to measure the dimension. The full rubric can be seen in Appendix C.1. Table 3.4 shows the example of the format to assess one dimension.

**Table 3.4.** Format used to assess the dimensions of the application

<b>A3. Guidance: Does the app provide assistance/guidance support to the user?</b>						
<b>3</b>		<b>2</b>		<b>1</b>		<b>Comment</b>
The app provides detailed tutorials.		The app provides simple overview on how to use the app.		The app has no assistance features at all.		

The rubric was given directly to the expert along with the application and general overview of the research so no miscommunication may occur between researcher and the expert assessing the application.

#### 3.5.4 Application Readability Test

After the expert judgment for the application was done, the application was then given to junior high school students for the readability of the application to be tested. The rubric used to measure the readability will be the same rubric used for expert judgments, but the language used will be changed to be more child-friendly.

The rubric is then given through Online Form to be filled by the students after they tested the application. The rubric can be seen in Appendix C.2.

### 3.6 Instrument Validation

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Before the instrument was used, some analysis were done by supervisors and experts. The analysis was aimed to make sure whether the instrument is appropriate to be used or not. The validity of the instrument has to meet the standard competencies of collaborative problem-solving instrument developed in PISA 2015 (OECD, 2017).

### **3.7 Data Collection**

In order to gain the data by using the instruments as declared before, some different ways were taken for each subject in this study described as follow:

#### **3.7.1 Experts**

The rubric was given directly to each expert based on the aspects that will be judged. The rubric and instrument developed was given to the assessment expert, to then be collected and revised based on the suggestions given by the expert. Similarly, the tool was given directly to the ICT expert to then be collected and revised based on the suggestions given by the expert.

#### **3.7.2 Students**

For the instrument, the assessment was conducted towards the students of grade 8A in Pribadi BBS. After given the permission, the students were divided into 2-3 people per group, then the explanation of the puzzle was given. After they understand the goal, the groups work on the puzzle and are asked to record their activities using mobile phone so that researcher can conduct assessment easier on a later time. The rubric was then filled based on the observation made during the assessment.

The assessment for the tool was conducted in the class 8D of Labschool UPI. After given permission, the conduct of the assessment was similar to the instrument data collection, but after the assessment was done, students were asked to fill a questionnaire on the readability of the tool.

### **3.8 Data Analysis Technique**

After all the data was collected by using the instruments, the results are analyzed in a descriptive way regarding to each variable's reference. The data analysis techniques are described as follow:

#### **3.8.1 Likert Scale and Ratings**

The experts' judgment rubric was analyzed by a quantitative measurement, adapted from (Riduwan, 2010). Then, comparing the result with the total amount of highest score and the result is converted to a percentage.

$$\% = \frac{Na}{Nx} \times 100\% \quad (\text{Riduwan, 2010})$$

Arikunto (2000) stated that the media that is mobile learning application can be elaborated with the category of percentage range and descriptive criteria of the program. The category is described as follow:

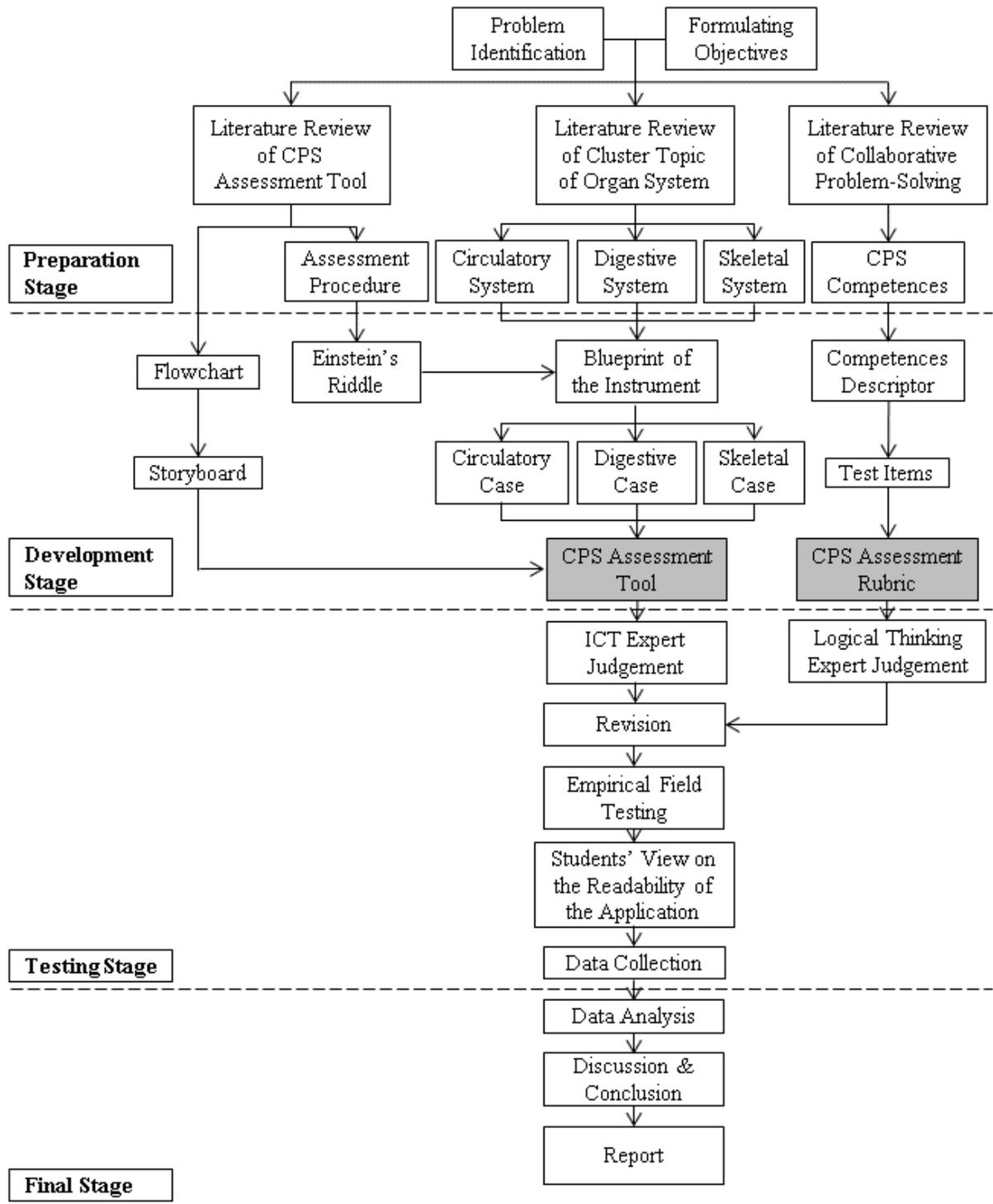
**Table 3.5** Percentage Range and Descriptive Criteria of Program

No.	Interval	Criterion
1	76% < score ≤ 100%	Very Good
2	51% < score ≤ 75%	Good
3	26% < score ≤ 50%	Fair
4	0% < score ≤ 25%	Poor

On the other hand, the students and teachers' questionnaire use the overall rating that gets from an average of all rating. The explanation of rating is the same as the criterion in Table 3.1.

### 3.9 Research Procedure

The prototyping development model presented in Figure 3.1 is then expanded to fit the purpose of this research. The procedure taken in this research can be seen in Figure 3.2.



**Figure 3.2.** Research Procedure based on Prototyping Development Model

The research went through several stages, which are (1) Preparation Stage, (2) Development Stage, (3) Testing Stage, and (4) Final Stage. The prototyping development model mentioned previously was stretched.

The preparation stage started by problem identification and formulating objectives, and then literature reviews to gather data that are used in developing CPS assessment tool. The development stage was where the data gathered previously were developed into the instrument and rubric of measuring CPS skill. The final products in this stage were then tested in the next stage. The products tested by expert judgments first to test its' validity and readability, with the help of logical thinking assessment expert and ICT expert respectively. Revision was made based on the feedback of the experts. Then the revised products were tested with the help of students in junior high school, where the readability of the application was tested. After the data of testing through expert judgments and field testing were gathered, the data was then analyzed in the final stage. The final stage analyzed the data gathered previously, to be then the discussion and conclusion was based from. Report was made to conclude the result of the study. Each step of the procedure is explained thoroughly in Chapter 4.