

CHAPTER III

RESEARCH METHODOLOGY

A. Research Method

The research method that will be used in this research is descriptive research. According to McMillan and Schumacher (2001) descriptive research is concerned with the current or past status of something and simply describe achievements, attitudes, behaviors or other characteristics of a group of subject.

Gall, Gall and Borg (2003) stated that descriptive research is a research that involves making careful descriptions of educational phenomena. They also stated that descriptive studies are limited by the types and quality of available measure, so that many researchers work intensively on developing new measures or perfecting the one that already developed in order to describe precisely and accurately the phenomena. Descriptive research involves gathering data that describe events as organizes, tabulates, illustrate and describe data collection

This research method is descriptive because appropriate with the objectives of the research which is describing the development and validation of critical thinking instrument based on Inch to describe 7th grade students' critical thinking on matter and heat topic.

B. Research Subject

The location of this research is Public Junior High School "X" in Kabupaten Bandung. The school uses *Bahasa Indonesia* in teaching learning process. 2013 Curriculum is implemented for 7th and 8th grade, while 9th grade is still using KTSP Curriculum. This school appropriate because the instrument intended for 7th grade which uses 2013 curriculum. This school has 540 students of 7th grade, 551 students of 8th grade and 533 students of 9th grade in 2015.

This school was chosen because it has been accredited "A" by Indonesia Ministry of Education and also supported by multimedia facilities e.g. personal computer. The subject will be students from three classes of 7th grade students.

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For the descriptive research, the subject is better more than 100 students. In this research, researcher involved 117 seventh grade junior high school students.

C. Operational Definition

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

1. Critical Thinking is measured by Science Virtual Test that has been developed based on Inch elements of critical thinking. The elements are purpose, question at issue, assumption, point of view, information, concepts, interpretation and inference, implication and consequences. These eight elements also developed to be 26 sub elements. These elements can lead student the students to the level of critical thinking.
2. Science Virtual Test is the test using computer as media. It will be developed using Macromedia Flash Professional 8.0. The test is multiple choice questions with four option of critical thinking instrument. The content validity is measured by expert judgment through rubric assessment and students responds that eventually will be analyzed through IBM Statistic 23 and ANATES 4.1.0.

D. Research Instrument

In this research, the instrument is necessary to be used to develop and validate the Science Virtual Test and to know the students' impression toward Science Virtual Test. The two types of instrument are rubric and questionnaire. Those instruments are described below:

1. Rubric

The rubric is used to validate the content of the instrument. The validation is divided into content, media and education which has its own aspects to be assessed. The expert judgment rubric for content, media and education can be seen in Table 3.1, Table 3.2, and Table 3.3.

Table 3.1 Rubric Expert Judgment (Content)

Critical Thinking Element	Critical Thinking Sub-element	Assessed Aspect	Assessment (√) Expert	
			Yes	No
Eight elements of Inch Critical Thinking	26 sub-elements of Inch Critical Thinking	The information about “matter and heat” has been delivered clearly.		
		Using the appropriate term in accordance with the rule stated in chemistry and physics.		
		Article/figure/comic/video/table/graph was appropriate with the rule stated in chemistry and physics.		
		The caption/explanation about the article/figure/comic/table/graph was appropriate with the rule stated in chemistry and physics.		

(Adopted: Rusyati & Firman, 2017)

Table 3.2 Rubric Expert Judgment (Media)

Critical Thinking Element	Critical Thinking Sub-element	Assessed Aspect	Assessment (√) Expert	
			Yes	No
Eight elements of Inch Critical Thinking	26 sub-elements of Inch Critical Thinking	The text’s composition (size, color, font) was clear so it was readable.		
		There was a concordance between text color and background.		
		The quality of illustration (figure, video, animation) was good in term of position, size, and color.		
		The position and navigation		

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		button consistently arranged and they had the similar color and function in each screen.		
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(Adopted: Rusyati & Firman, 2017)

Table 3.3 Rubric Expert Judgment (Education)

Critical Thinking Element	Critical Thinking Sub-element	Assessed Aspect	Assessment (√) Expert	
			Yes	No
Eight elements of Inch Critical Thinking	26 sub-elements of Inch Critical Thinking	The item used had been appropriate with the sub-element of critical thinking.		

(Adopted: Rusyati & Firman, 2017)

Students and teacher are also asked to fill the rubric assessment for the readability test. The students and teacher rubric can be seen in table 3.4.

Table 3.4 Rubric of Teacher and Student Readability Test

Critical Thinking Element	Critical Thinking Sub-element	Assessed Aspect	Assessment (√) Teacher/ Student	
			Yes	No
Eight elements of Inch Critical Thinking	26 sub-elements of Inch Critical Thinking	The description of the article/figure/comic/video/table/graph was easily to comprehend.		
		The question was easily to comprehend.		
		The option was easily to comprehend.		
		There was correlation between the question and the answer.		
		There was no ambiguous word/term which made student find difficulties in comprehending the question.		

(Adopted: Rusyati & Firman, 2017)

2. Questionnaire

The questionnaire is used to know students' impression after using the science virtual test. It consists of four aspects which are experience, technical, preference and media. The specific statement of every aspect in the questionnaire can be seen in the table 3.5.

Table 3.5 Questionnaire of Students' Impression

Aspect	Statement	SA	A	D	SD
Experience	The science virtual test gave me positive experience.				
	I think science virtual test was not confusing.				
	I think the science virtual test exam was not tedious.				
	I believe that science virtual test ensured justice and equity.				
	The science virtual test didn't make me feel threatened compared with the paper-based test.				
	I think the science virtual test was efficient.				
	I think the science virtual test was undertaken in conducive environment to evaluate student.				
Technical	I prefer receiving my test results using the science virtual test system automatically.				
	I dont have any problem when accessing science virtual test.				
	I can eassily input my identity on science virtual test.				
	I dont have any problem in editing my answer on science virtual test.				
	I can eassily submit my answer on science virtual test.				
	I dont have any problem in using science virtual test.				
Preference	In my opinion the science virtual test was				

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Aspect	Statement	SA	A	D	SD
	better than paper-based test.				
	I prefer science virtual test compared to paper-based test.				
Media	I think there was a concordance between text color and background.				
	The composition of text (size, font and color) was already clear so i can read it easily.				
	I think the quality of pictures in term of position, size and color was already good.				
	I think the quality of video in term of position, size and color was already good.				
	I can easily understand the description in video because of its clearness.				
	I think the quality of table in term of position, size and color was already good.				
	I think the quality of graph in term of position, size and color was already good.				
	I think the position, and navigation button were consistent and it has the same color and function for each screen.				

SA = Strongly Agree; A = Agree; D= Disagree; SD = Strongly Disagree

Adapted:

(Jimoh, Shittu & Kolla (2012), Dammas (2016), Rusyati & Firman (2017))

E. Data Analysis

The instrument used to develop and validate the Science Virtual Test is the rubric expert judgment which results the valid items of the Science Virtual Test. The validity analyzed using the average congruency percentage that explained below. While, the Science Virtual Test as the product of validation which used to measure students' critical thinking in matter and heat topic analyzed its reliability, discriminating power, difficulty level and distractor.

1. Validity

Validity can be defined as the agreement between a test score or measure and the quality it is believed to measure (Kaplan & Saccuzzo, 2009). Validity is also defined as the evidence for inferences made about a test score. In this research, the validity is used to check whether the item is valid to measure students' critical

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thinking in the topic of heat and matter based on the expert. The analysis of the item uses the average congruency percentage (Popham, 1978). The item will be valid if the percentage is 90% or higher. The invalid item will be deleted from the instrument.

2. Reliability

Reliability can be defined as the stability, dependability or consistency of a test results (Kaplan & Saccuzzo, 2009). The most commonly used type of internal consistency reliability is Cronbach coefficient alpha. This measure indicates the consistency of a multiple item scale (Leech, Barrett & Morgan, 2005). Alpha Cronbach's can be calculated by the formula:

$$\alpha = \frac{\sum \sigma_k^2}{\sigma_{\text{total}}^2} (1 - \frac{\sum \sigma_k^2}{\sigma_{\text{total}}^2})$$

Note:

α : cronbach's coefficient alpha

k : number of item

$\sum \sigma_k^2$: the sum of the variances of all the items

σ_{total}^2 : variance of the total score

(Streiner, 2003)

The alpha Cronbach's value can be interpreted using categorization that can be seen in the Table 3.6.

Table 3.6 Reliability Interpretation

The Amount of α Value	Interpretation
$\alpha > 0.90$	Very Good
$\alpha > 0.70$	Good
$0.60 \leq \alpha \leq 0.70$	Acceptable
$\alpha < 0.60$	Low

(Leech, Barrett & Morgan, 2005)

3. Difficulty Level

Difficulty level can be defined by the number of student who get a particular item correct (Kaplan & Saccuzzo, 2009). To make a good quality of the questions,

the item should be considered the proportion of easy, moderate, and difficult questions. It can be calculated using the formula, as follow:

$$P_i = \frac{A_i}{N_i}$$

Note:

P_i : difficulty level of item i

A_i : number of correct answer to item i

N_i : number of correct answer plus number of incorrect answer to item i

(Yuan et al., 2013)

The value of difficulty level can be interpreted using categorization that can be seen in the Table 3.7.

Table 3.7 Difficulty Level Interpretation

Value of Difficulty Level (P)	Interpretation
0.00 – 0.30	Difficult
0.31 – 0.70	Moderate
0.71 – 1.00	Easy

(Arikunto, 2012)

4. Discriminating Power

Discriminating power defined as the ability of the test item to discriminate students who have high and low score on a test (Cresswell, 2012). It determines the quality of test item which can differentiate the higher and lower achiever. The discriminating power will be can be determined using the formula, as follow:

$$D = \frac{P_H - P_L}{P_H + P_L}$$

Note:

D : discrimination

P_H : average score for the 27% of those with highest test scores

P_L : average score for the 27% of those with highest test scores

(Yuan et al., 2013)

The value of discriminating power can be interpreted using categorization that presented in the Table 3.8.

Table 3.8 Discriminating Power Interpretation

Value of Discriminating Power (D)	Interpretation
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0.00 – 0.20	Poor
0.21 – 0.40	Satisfactory
0.41 – 0.70	Good
0.71 – 1.00	Excellent

(Arikunto, 2012)

5. Distractor

Distractor is the “incorrect” options in multiple choice questions. According to Escudero, Reyna and Morales (2000), distractor is the stuff of multiple choice question which is offering the incorrect alternative while students should answer the correct alternative. The formula to correct to guess on a test is:

$$\text{Corrected score} = R - \frac{W}{n-1}$$

Note

R : the number of right response

W : the number of wrong response

n : the number of choices for each item

(Kaplan & Saccuzzo, 2009)

Distractors used in the items need to be plausible so that they attract at least 5% students (Chavda, Misra & Duttaroy, 2015).

6. Students’ Attainment in Critical Thinking

Students’ critical thinking will be categorized based on its mean and standard deviation of a group students. Mean and standard deviation can be calculated as follow:

$$\bar{X} = \frac{\sum X}{N}$$

Note

X : mean

$\sum X$: total score

N : number of students

(Minium, 1993)

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

Note

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S_x : standard deviation
 \bar{X} : mean
 X : score
 n : number of students

(Minium, 1993)

After mean and standard deviation have been calculated, it can determine the categorization of students attainment in critical thinking. The interpretation of students' attainment can be seen in the Table 3.8.

Table 3.9 Interpretation of Students' Attainments

Interval	Category
$X \geq \bar{X} + S_x$	High
$\bar{X} - S_x \leq X \leq \bar{X} + S_x$	Moderate
$X \leq \bar{X} - S_x$	Low

Note

X : students' score
 S_x : standard deviation
 \bar{X} : mean

(Arikunto, 2013)

7. Students' Impression

Students' impression towards the use of instrument uses the Likert scale analysis. In Likert, subject read every statement in the questionnaire and evaluate the question based on the categorized answer (Suherman, 2003). There are 4 answers that can be chosen by students and it have its own score. For the favorable statement (positive statement), the strongly agree has 5 score, agree has 4 score, disagree has 2 score, strongly disagree has 1 score, and neutral score is 3. The average value of every aspect is calculated and interpreted based Table 3.9.

Table 3.10 Likert Interpretation

Value	Interpretation
Score > 3 (Neutral Score)	Positive (+) Impression
Score < 3 (Neutral Score)	Negative (-) Impression

(Suherman, 2003)

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E. Research Procedure

In order to make the research systematically arranged, this research procedure is divided into three stages which are preparation, implementation and completion.

1. Preparation

- a. Identification of the problem.
- b. Formulating the research objectives.
- c. Analysis of eight elements of Inch critical thinking and science virtual test.
- d. Analysis the literature review based on the 2013 Curriculum.
- e. Developing the instrument consist of 41 multiple choice questions.
- f. Designing the story board of science virtual test.
- g. Constructing the science virtual test using Macromedia Flash 8.0 by technician.

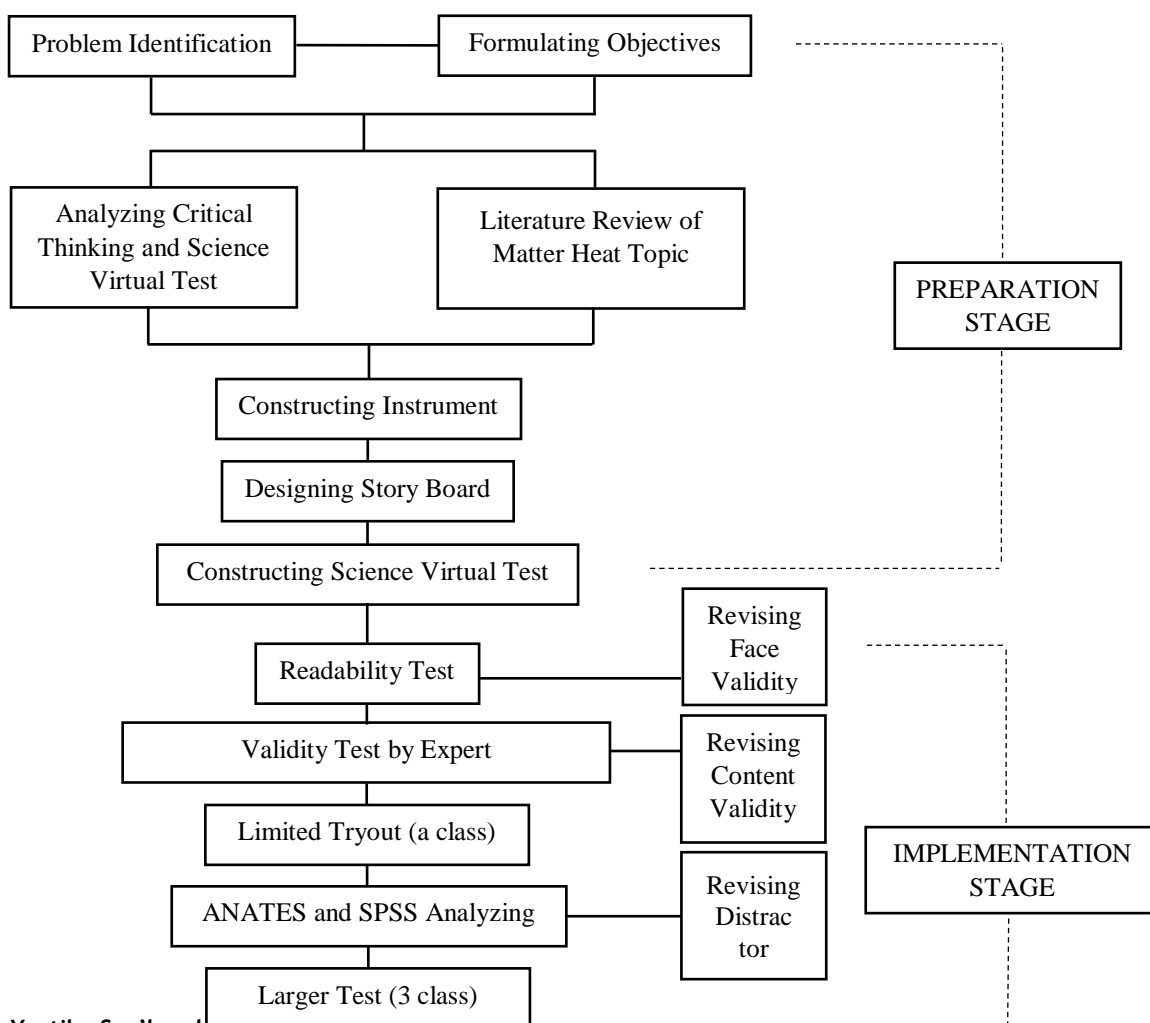
2. Implementation

- a. Testing of students and teacher readability.
- b. Validating the content by expert judgment.
- c. Revising the instrument based on test of readability and expert judgment.
- d. Limited tryout to a class of students.
- e. Analyzing the data using ANATES 4.1.0 and IBM Statistics 23 to check the reliability, difficulty level, discriminating power and distractor.
- f. Revising the instrument based distractors analysis.
- g. Conducting larger test.
- h. Analyzing the data using ANATES 4.1.0 and IBM Statistics 23 to check the reliability, difficulty level, discriminating power and distractor.

3. Completion

- a. Making result and discussion and conclusion.
- b. Reporting the result.

In order to make the research procedure easy to understand, the stages of the research procedure is constructed into the Figure 3.1.



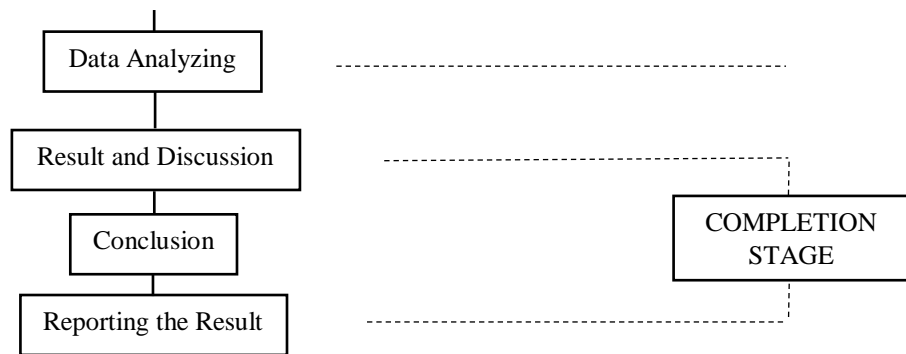


Figure 3.1 Research Diagram