

## CHAPTER III

### RESEARCH METHODOLOGY

#### 3.1 Research Method and Research Design

This research is an experimental research in which the independent variable is being manipulated. This method enable researcher to sought for changes that occur or might be occur in a variable due to a treatment. Due to the lacking of internal validity threat control, the method that this research use is considered as weak or poor experimental method (Fraenkel, Wallen, & Hyun, 2012).

The design in which this research applies is one group pre-test posttest design as shown by Table 3.1. This kind of research design measure the changes that might occur from implementing a treatment to a certain group by giving out a test before (pre-test) and after (post-test) treatment is applied. Eventhough control towards threats to internal validity that might affect the result of the pos-test still exist, at least a certain condition from participant taken from the pre-test can be used to measure the changes of the post-test result (Fraenkel, Wallen, & Hyun, 2012).

Table 3.1  
The One Group Pre-Test Post-Test Design

O	X	O
Pre-Test	Treatment	Post-Test

(Fraenkel, Wallen, & Hyun, 2012)

#### 3.2 Population and Sample

This research was done in a school located in Bandung city with the 8<sup>th</sup> grader as participants in this research with 2013 curriculum as the applied curriculum in the school. The participants were from the class of 8B which consist of 32 male students and 8C which consist of 36 female students.

The sample taken for this research was based on a convenience sample technique where randomize sampling can not be done due to a certain

condition and uses a group that is conveniently available to be studied upon (Fraenkel, Wallen, & Hyun, 2012).

### **3.3 Research Instrument**

To measure changes and to assess variables discussed within this research, instruments are required for each variable. There are two different instruments used in this research which are objective test to assess students' academic achievement, and science process skill rubric to assess students' science process skill. Both instruments were analyzed and evaluated before the instruments are able to be used. It involves content check by experts and reliability check by field test. The process of instrument validation and evaluation is discussed in the following.

#### **3.3.1 Academic Achievement**

To assess students' academic achievement in the topic of motion and force, an objective test was made in this research. The same objective test is used in the pre-test and the post-test to show the improvement resulted from the learning that implement active learning-based science block. The objective test consists of originally 18 multiple choice questions and encompasses the cognitive level of remembering (C1), understanding (C2), applying (C3), and analyzing (C4) which is made in accordance to The Revision of Bloom's Taxonomy by Krathwohl & Anderson (2009) and the curriculum used in the school which is 2013 curriculum with overall 5 learning objectives. Table 3.2 shows the blueprint of the initial objective test before judgement and reliability check that is used in this research. There are two experts involved in the content validity check of the objective test and 47 samples involved in the reliability check of the objective test.

Table 3.2  
Blue-print of The Objective Test (Before Revision)

No	Learning Objectives	Cognitive Level				Total	Percentage
		C1	C2	C3	C4		
1.	Membedakan dan menghitung panjang lintasan, perpindahan, dan kecepatan benda pada gerak lurus beraturan		2	3,14		3	16.6%
2.	Menafsirkan gerak benda beraturan melalui penggambaran kurva		4			1	5.5%
3.	Menjelaskan dan mengklasifikasikan fenomena sifat kelembaman benda berdasarkan Hukum I Newton	10	1,5			4	22,2%
4.	Menjelaskan dan menerapkan konsep gaya dengan kelajuan berdasarkan Hukum II Newton		9	7,8,11	13,17	6	33.3%
5.	Mengidentifikasi besar tegangan tali dan besar pasangan gaya berdasarkan Hukum III Newton		6,15,18	12		4	22.2%
Total		1	8	6	2	18	100%

### 3.3.1.1 Instrument Development and Analysis

In order to validate the objective test, a series of measurement is taken to show that the objective test can be used as an assessment tool. It includes the measurement of discriminating power, distractor, difficulty level, and validity and reliability.

#### a. Discriminating Power

Discriminating power determines whether the people who have done well on a particular items have also done well on the whole test. There are many ways

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to evaluate the discriminating power of a test. In this research, the discriminating power is evaluated through comparing the high achiever (those who did well on the test) with the low achiever (those who did not do well on a test) (Kaplan, & Saccuzzo, 2008).

#### b. Distractor

Distractors determine how effective an item response on a test is and analyzed by the frequency of it being chosen by participants. If the item response had been chosen several times, it means that the item response is a good distractor. Distractor can only be used in a multiple choice test (Escudero, Reyna, & Morales, 2002).

#### c. Difficulty Level

Item difficulty or difficulty level of an item is defined as the number of people who get a particular item correct on a test, and is used in a test that measures achievement or ability. Some people suggested that it does not indicate the difficulty level of a test instead, the easiness of a test. For a test that is aimed to discriminate between respondents, the test requires items at many different levels of difficulty (Kaplan & Saccuzzo, 2008).

#### d. Validity

Agreement between a test score or measure and the quality it is believed to measure is a definition of validity. Validity is supposed to determine whether the test used in a research can truly measure what it is supposed to measure. It is a concept unity that is able to represent all of the evidence supporting the intended interpretation of a measure (Kaplan & Saccuzzo, 2008). In this research the validity coefficient of objective test is checked using ANATES software.

#### e. Reliability

Reliability coefficient shows the accuracy of a test by comparing the variance of the true scores on a test to the variance of the observed scores. (Kaplan & Saccuzzo, 2008). Reliability test represents how consistent a test is with the representative data collected (Fraenkel, Wallen, & Hyun, 2012).

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### 3.3.1.2 Instrument Development and Analysis Result

The reliability and validity of motion and force objective test was done by doing a field test to a 9<sup>th</sup> grader of another school which also applies 2013 curriculum. The objective test was given to two class of students which in total consist of 47 students. Table 3.3 shows the summary of reliability and validity test of the objective test.

Table 3.3  
Summary of Objective Test Analysis

	Score	Category
Validity	0.84	High
Reliability	0.91	High

The detailed result of the test item analysis are attached on the Appendix 4. Objective Test Validation Recapitulation. Based on the expert judgement and analysis result, out of 18 questions, only 16 that is appropriate to be used. Table 3.4 shows the blue-print of the objective test after revision. The final form of the objective test is attached on the Appendix 3. Motion and Force Objective Test.

Table 3.4  
Blue-print of Objective Test (After Revision)

No	Learning Objectives	Cognitive Level				Total	Percentage
		C1	C2	C3	C4		
1.	Membedakan dan menghitung panjang lintasan, perpindahan, dan kecepatan benda pada gerak lurus beraturan.		1	2,12		3	18.7%
2.	Menafsirkan gerak benda beraturan melalui penggambaran kurva		3			1	6.2%
3.	Menjelaskan dan mengklasifikasikan fenomena sifat kelembaman benda berdasarkan Hukum I Newton	8	4,14			3	18.7%

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4.	Menjelaskan dan menerapkan konsep gaya dengan kelajuan berdasarkan Hukum II Newton	7	6,9	10,15	5	31.2%	
5.	Mengidentifikasi besar tegangan tali dan besar pasangan gaya berdasarkan Hukum III Newton	5,13,16	11		4	25%	
Total		1	8	5	2	16	100%

### 3.3.2 Science Process Skill

A rubric of science process skill which is made based on Learning and Assessing Science Process Skill by Rezba, Sprague, and Fiel (2003) is used to assess students' science process skill. A rubric with the scale of 0 to 3 scoring is used to describe students' work that is appropriate to a particular score. 0 point categorized as missing, 1 point is categorized as inadequate, 2 points categorized as the needs of improvement, and 3 points categorized as adequate. The scoring of this rubric is based on Scientific Abilities and Their Assessment by Etkina et al (2006). Students' science process skill in this research focuses on the basic skill which contains 4 out of 6 skills included as basic process skill. Those are observing skill, measuring skill, inferring skill, and communicating skill. Table 3.5 shows the blue-print of science process skill rubric used in this research.

Table 3.5

Blue-print of Science Process Skill Rubric

Process Skill	Indicator
Observing	Collecting qualitative and/or quantitative data based on observation.
Measuring	Choosing and using the appropriate measuring instrument for data collection.
Inferring	Drawing conclusion from a number of data and finding patterns that shows from data.
Communicating	Using precise language to describe an event or phenomena and presenting data using figure/table/graph/diagram.

In order to validate the rubric, validity of the rubric is evaluated. The validity of science process skill rubric is done through expert judgment. The rubric was

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evaluated based on its' indicator and the description used to measure students' process skill. Two experts on the subject was involved in the validity check process. The rubric of science process skill before and after expert judgement is attached on the Appendix. 5 Science Process Skill Rubric.

### **3.4 Research Procedure**

The procedure of this research includes three stage which are preparation stage, implementation stage, and completion stage. The detailed activities are listed below.

#### **1. Preparation Stage**

- a. Investigate problems and difficulties of teaching and learning process of science subject area.
- b. Determine both dependent and independent variables that are going to be investigated in this research.
- c. Investigate factors that might affect the outcome of the research such are:
  - a) Curriculum used in the targeted school and the suitability of the learning topics with the variables defined in the research.
  - b) Students' prior knowledge related to the topic of motion and force.
  - c) Learning schedule of the targeted participants.
- d. Identify research problems and research question.
- e. Design hypotheses from the research.
- f. Design and make instrument to collect data and assess variables which include objective test of motion and force and rubric of science process skill.
- g. Design and construct lesson plan and worksheet for the implementation of science block as active learning.
- h. Judgement of instruments by related experts.
- i. Receive and revise instrument based on experts' judgement.
- j. Field test to check validity, reliability, difficulty level, and discriminating power of objective test which is gained from students who had learned the topic of motion and force.
- k. Choose and revise objective test item based on field test.

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## 2. Implementation Stage

- a. Collect pre-test data of objective test on the topic of motion and force from participant.
- b. Implement treatment of science block as active learning in the class.
- c. The implementation of the treatment was done in one practical meeting with three topic being covered in this treatment. The implementation of science block as active learning held outside of the class but still in the school area. Since there are three topics being discussed in the research, hence there are three blocks that students need to encounter in turn and do activities written on the worksheet. The participants were divided into 3 big groups in order to allow every students to come to each block and in each block participants have maximum 20 minutes to collect data and discuss the result with the instructor in each block. The overall discussion and data observation written on the worksheet ought to be completed by participants and reseracher collect the result two days after the implementation. The pre-test was done before the implementation was held and the post-test was taken after the students collect the worksheet on the second day after the implementation.
- d. Collect post-test data of objective test on the topic of motion and force as well as worksheet filled by students in the two previous days.
- e. Recapitulate data from both instrument.

## 3. Completion Stage

- a. Analyze the collected data according to the instrument used for each variables and interpret the result based on generelized category of each instrument.
- b. Collecting and arranging further discussion about the result gained from the implementationof science block as active learning.
- c. Construct conclusion and recommendation based on result and discussion that has been constructed previously.

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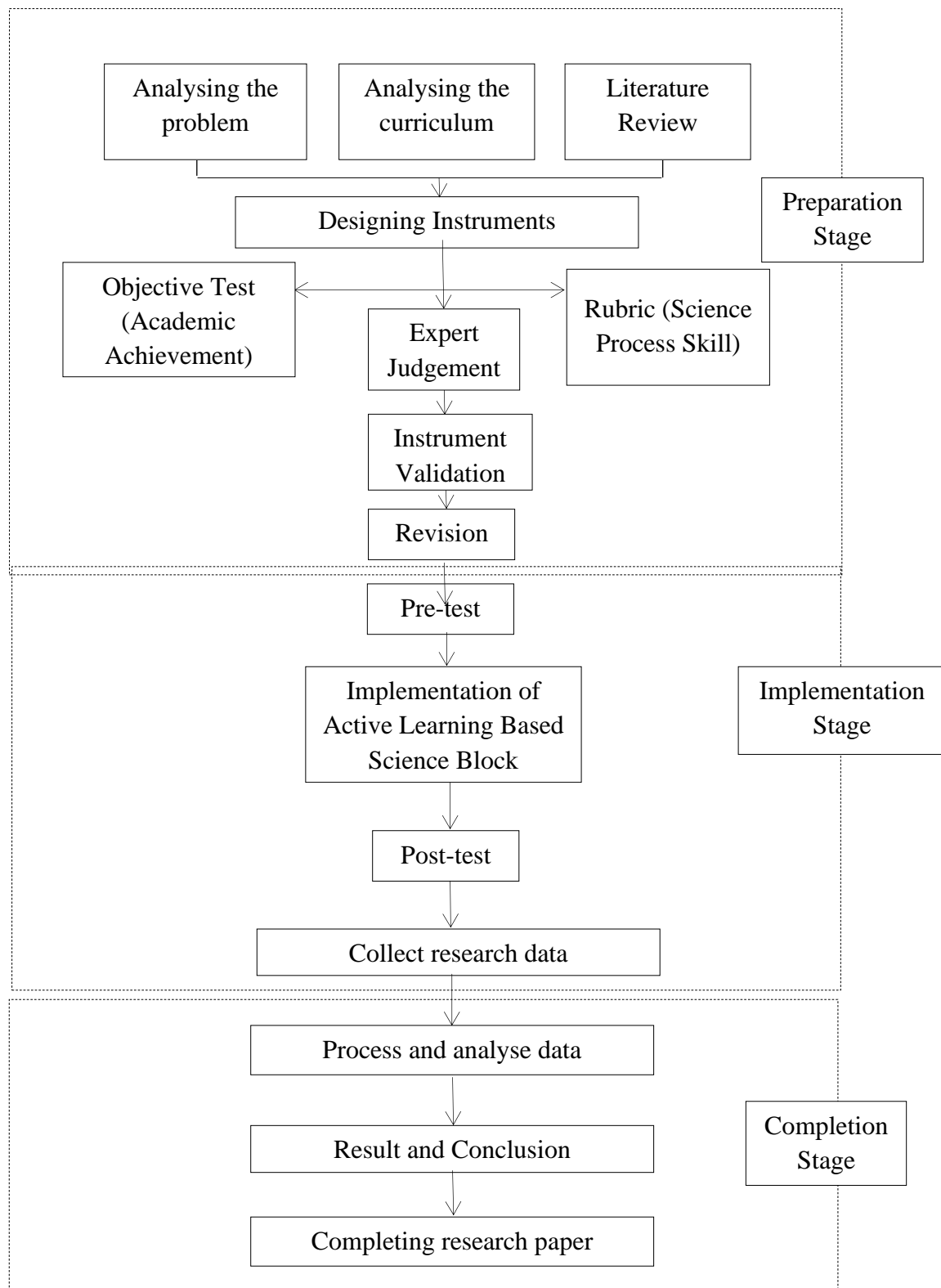


Figure 3.1 Research Procedure

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### 3.6 Data Analysis

In order to analyse the result from data taking and to be able to interpret the result, statistical and non-statistical procedure is done.

#### 1. Academic Achievement

##### a. Scoring of Test

The maximum scoring for motion and force objective test is 100. This score gained by summing the correct answer of the participants and divide it by the total number on the test item. The result from the division then changed into the form of percentage by times it with 100%. Each item has the score of 1 for correct answer and 0 for incorrect answer.

##### b. Gain Score and Normalized Score

To measure the change on students' academic achievement, gain score and normalized gain score is calculated. Gain score is calculated by finding the difference between post-test and pre-test. And the normalized gain score is calculated by dividing gain score by the difference of maximum score of test with pre-test score (Hake, 1998).

##### c. Normality Test

Normality test shows the distribution of the data and in this research is measured using SPSS software. Normality test is required to determine the kind of test the data should measured through to test its' hypothesis. A normally distributed data will then undergo a parametric statistical test meanwhile the not normally distributed data will then undergo a non-parametric statistical test to check its' homogeneity.

##### d. Homogeneity Test

Homogeneity test is used to check whether any part of the data with similar statistical properties can be compared to any part of the overall data. The result of homogeneity test will be used to determine the kind of hypothesis test that we should use. In this research, since the data is not homogen and not normally distributed, Wilcoxon Hypothesis Test is used.

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## 2. Science Process Skill

### a. Scoring of Rubric

The scoring of rubric is based on students' work on data collection and analysis on the worksheet. The total score is the accumulation of each score that students gain on each indicator. The score of 0 to 3 is used to measure each indicator based on the suitable description in the science process skill rubric. The category of each score is as follows.

0 = missing

1 = inadequate

2 = need improvement

3 = adequate

### b. Percentage

The percentage of the score is calculated by dividing the total score that students gain with the maximum score of the rubric and times it by 100. The percentage from each skill is presented as well as the overall percentage of students' science process skill.

## 3.7 Assumption

The assumption of this research according to the literature review are as follows.

- 1) Science block as an active learning helps students in learning science by involving students in the teaching learning process by observation and discussion.
- 2) Academic achievement is a result from students' learning process.
- 3) Students' worksheet are filled in based on students' own observation and the result of the discussion is not a shared work.

## 3.8 Hypothesis

The hypothesis ought to be tested in this research includes the following:

H<sub>0</sub>: There is no difference in students' academic achievement before and after the implementation of science block as active learning.

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H<sub>1</sub>: There is difference in students' academic achievement before and after the implementation of science block as active learning.

### **3.9 Operational Definition**

1. Active learning based science block in this research is applied by providing several activities for students (Yaldede, 2018) to learn about motion and force as well as by giving students worksheet to allow them to record data and do reflection towards their learning as the element of active learning (Cattaneo, 2017).
2. Students' academic achievement in this research refers to the cognitive level explained by Krathwohl & Anderson (2009) in the Revised Bloom' Taaxonomy that includes the level of remembering (C1), understanding (C2), applying (C3), and analyzing (C4) which is measured using a 16 multiple choice questions that covers all the stated level.
3. Students' science process skill in this research refers to the basic science process skill as explained by Fowler (1990) that includes observing, measuring, communicating, and inferring which is assessed by the use of rubric whihc had been judged by relevent experts.