CHAPTER III
RESEARCH METHODOLOGY

A. Population and Sample

Population in this research is 7th grade students in one of Junior High School in Bandung, especially 7 (A to D) classes. Sample of this research is two classes through simple random sampling, namely 7A as an experimental class and 7B as a control class.

B. Research Design

The research design in this paper is Matching Pretest-Posttest Control Group. This design is used to know how improvement students' cognitive achievement through 7E learning cycle model and conventional learning model.

First, both classes do pretest. Then in experimental class do the treatment by using 7E learning cycle. After that do the posttest on both classes and analyze the result of pretest and posttest from both classes.

Based on the description above, the design of research according to Sugiyono (2008) is shown on the table 3.1 below:

Table 3.1

Research design

Group	Pretest	Treatment	Posttest
Experimental	T_1	X	T_2
Control	T_3	-	T_4

Where:

T1, T3   : Pretest done to both experimental and control class

T2, T4   : Posttest done to both experimental and control class after

experimental class given treatment

X   : Treatment by using 7E learning cycle model

C. Research Method

According to Sugiyono (2008) state that research method is defined as a scientific way to get the data with the purpose and specific uses. The method used in this research is quasi experiment (Quantitative) method, because it was not conducted randomization of the subjects (students) but the randomization of the class and would like to see the relationship between research variables where 7E learning cycle as independent variable and students' achievement in cognitive domain as dependent variable.

It can be seen from Ruseffendi's opinion (2005) states that the quasi-experimental research is research that aims to see a causal relationship and the treatment of quasi-experimental research that has already occurred and oversight control cannot be done.

D. Operational Definition

1. The seven phases are as follows: **Elicit phase** to determine students' prior knowledge of the lessons about motion with constant acceleration to be learned. **Engage phase** is the teachers motivate the students to generate interest in learning the material to be studied by using animation about motion with constant acceleration. **Explore phase** is investigate about motion with constant acceleration by doing experiment to gain knowledge and experiences directly related to the motion with constant acceleration concepts that will be studied. **Explain phase** is to explain the motion with constant acceleration concepts that students find on explore phase. **Elaborate phase** is the students are given the opportunity to apply their new knowledge about motion with constant acceleration concepts that has been found. **Evaluate phase** is evaluating the learning outcomes by doing paper and pencil test.

Extend phase is the phases to think, search, discover and describe examples of applying concepts about motion with constant acceleration in daily life.

2. Conventional learning is learning process that uses conceptual approach by give lecturing and motion with constant acceleration experiment method to verify the concept about motion with constant acceleration. Teacher gives all concepts to students and then it is approved by doing the experiment.

3. Achievement is capabilities of the student after they received a learning experience. The achievement in this study only covers the cognitive domain. Cognitive domains that will be examined in this study include are remembering (C1), understanding (C2), applying (C3) and analyzing (C4) that relate with motion with constant acceleration concepts.

E. Research Instrument

In an effort to obtain a comprehensive data and information this research, it was made set of instrument. In this research there is 2 kinds of instruments, they are test and non-test. The instruments to be used in this research are as follows:

1. Test

Test used in this study is divided into two, namely:

a) Pretest is test done before learning process about motion with constant acceleration concepts is given.

b) Posttest is test done after learning process about motion with constant acceleration concepts is given.

Pretest is conducted in first meeting of the lesson. Pretest conducted to know students' prior knowledge about motion with constant acceleration concept. While posttest conducted in the last meeting of the lesson. Posttest is to determine the students' understanding about the concept of motion with constant acceleration and to know the improvement of students' achievement after given the treatment or the implementation of learning. Pretest and posttest are conducted by experimental and control class.

Question form which is given at pretest and posttest in the form of multiple choice, and questions used are the same. Instrument tests used to measure

students' achievement. All of instrument refers to cognitive domain based on Bloom Taxonomy Revised (Anderson, 2001), the aspects which is measured are remembering (C1), understanding (C2), applying (C3) and analyzing (C4).

Blueprint of pretest and posttest is provided on the table 3.2 is shown below.

Table 3.2

Blueprint of pretest and posttest

Indicator	Test Item Number
Describe about motion with constant acceleration.	1
Describe acceleration as change in velocity per unit of time.	2
Analyzing the graph related with motion with constant acceleration	4
Analyzing the picture related with motion with constant acceleration	11
Apply the formula to the problem	3 and 7
Differentiate graph and picture related to motion with constant acceleration which is accelerated and deaccelerated	10 and 15
Apply examples of motion with constant acceleration related with daily life	5, 6, 8, 9, and 12
Interpret the graph related with motion with constant acceleration	13
show the graph related with motion with constant acceleration	14

Before instrument used in this research, instruments must be tested for validity, then analyzed whether instruments are valid or invalid. The valid instrument will be used as an instrument to take the data. Instrument is tested on class VII-A which already learned the material about motion with constant acceleration at the different school with the number of students is 45. Analysis of test instrument as follow:

a) Items Validity

Validity which is used in this research is content validity, which is related to the ability of assessment tool to measure what should be measured (Sudjana, 2009). In this research, instruments are validating by research supervisor.

b) Reliability

Reliability of an instrument is intended as a tool that gives the same results if the measurement is given on the same subject although done by different people, at different times and different places (Suherman, 2003). Not affected by the behaviour, circumstances, and conditions. High reliability measurement tool called a reliable gauge. Reliability was determined from the value of the reliability coefficient.

Then, the reliability coefficient obtained interpreted in classification reliability coefficient according to Arikunto (2008) are presented on the table 3.3 below:

Table 3.3

Classification of reliability coefficient

Correlation coefficient	Interpretation
0,81 - 1,00	Very high
0,61 - 0,80	High
0,41 - 0,60	Medium
0,21 - 0,40	Low
0,00 - 0,20	Very low

According to result's test trial obtained the correlation coefficient of instrument is shown on the table 3.4 below:

Table 3.4

Result of reliability

Correlation coefficient	Interpretation
0.66	High

From the table 3.3 above, it is seen clearly that result's test trial obtained the correlation coefficient of instrument as much as 0.66. It means that reliability of instrument which is categorized as high.

c) Difficulty level

A good test item is neither too easy nor too difficult. A scale that shows the difficulty level of test item is difficulty index (Arikunto, 2008). The equation which is used to calculate the difficulty level is:

$$P = \frac{B}{JS} \tag{1}$$

With:

P = difficulty level

B = amount of student who answer question with the right answer

JS = total amount of students who undertakes the test

Then, Classification of difficulty level according to Arikunto (2008) is presented on the table 3.5 below:

Table 3.5

Classification of difficulty level

Difficulty index	Category of test
0,0 – 0,3	Difficult
0,3 – 0,7	Medium
0,7 – 1,0	Easy

d)   Discriminating Power

Discriminating power of test item is the ability of test item to differentiate between high achiever and low achiever (Arikunto, 2008). To determine discriminating power of test item, the equation below is used:

$$D = \frac{B_A}{J_A} - \frac{B_B}{J_B} = P_A - P_B \qquad (2)$$

With:

D   = discriminating power

JA = amount of high achiever

JB = amount of low achiever

BA = amount of high achiever who answers question with the right answer

BB = amount of low achiever who answers question with the right answer

P_A = proportion of high achiever who answers question with the right answer

P_B = proportion of low achiever who answers question with the right answer

Then, criteria of discriminating power according to Arikunto (2008) are presented on the table 3.6 below:

Table 3.6

Criteria of discriminating power

Discriminating power interval	Criteria of discriminating power
Negative	Test item is not appropriate
0,0 – 0,2	Poor
0,2 – 0,4	Satisfactory
0,4 – 0,7	Good
0,7 – 1,0	Excellent

Recapitulation of validity test item about motion with constant acceleration concept inform of multiple choice question is shown on the table 3.7 below:

Table 3.7

Recapitulation of validity test item

Question Number	Discriminating Power	Difficulty Level	Validity		Conclusion
			Value	Significant	
1	50.00	Medium	0,604	Significant	Valid
2	50.00	Medium	0,604	Significant	Valid
3	58.33	Easy	0.454	Very significant	Valid
4	62.50	Easy	0,548	Very significant	Valid
5	75.00	Medium	0,536	Significant	Valid
6	66.67	Easy	0.716	Significant	Valid
7	75.00	Medium	0.776	Significant	Valid

Table 3.7

Recapitulation of validity test item (continued)

Question Number	Discriminating Power	Difficulty Level	Validity		Conclusion
			Value	Significant	
8	50.00	Difficult	0.826	Very significant	Valid
9	25.00	Difficult	0.307	-	Invalid
10	50.00	Difficult	0,728	Very significant	Valid
11	33,33	Medium	0,228	-	Invalid
12	0,00	Medium	0,027	-	Invalid
13	50.00	Medium	0,428	Significant	Valid
14	25,00	Difficult	0,181	-	Invalid
15	66.67	Medium	0,416	Significant	Valid
16	37,50	Difficult	0,327	-	Invalid
17	33,33	Difficult	0,290	-	Invalid
18	25,00	Difficult	0,436	-	Invalid
19	0.00	Difficult	0,088	-	Invalid
20	58.33	Medium	0,436	Significant	Valid
21	0,00	Difficult	0,004	-	Invalid
23	66.67	Medium	0,459	Significant	Valid
24	8,33	Medium	0,233	-	Invalid
25	0,00	Difficult	0.044	-	Invalid
26	37,50	Medium	0,367	-	Invalid
27	8,33	Difficult	0,233	-	Invalid
28	0,00	Difficult	-0,088	-	Invalid
29	0,00	Difficult	-0,061	-	Invalid
30	50.00	Medium	0,459	Significant	Valid

According to the table 3.4, it can be seen that from 30 questions is taken 15 questions to be instrument for determine students' cognitive achievement because only 15 questions have been valid.

2. Questionnaire

According to Sugiyono (2008), the questionnaire is a list of questions or statements must be answered by the person being evaluated (the respondent). Questionnaire is also a tool for collecting data. Questionnaire is intended to know how the students' response toward learning process by using 7E learning cycle model. To fill the questionnaire is conducted at the end of the study after students did posttest. This questionnaire only conducted by experimental class.

Blueprint of questionnaire about students' respond toward the implementation of 7E learning cycle is shown on the table 3.8 below:

Table 3.8

Blueprint of questionnaire

Indicator	Statement	Question Number
Students' interest toward implementation of 7E learning cycle	By using this kind of learning, I feel happy and interest in motion with constant acceleration learning.	1
	By using this kind of learning the atmosphere become "life" and fun.	5
Students' respond toward implementation of 7E learning cycle	I can follow all of phases in learning.	2
Students' motivation toward implementation of 7E learning cycle	By using this kind of learning gives me motivation to keep attention to the material during learning process.	3
	By using this kind of learning makes me actively to ask.	4

Table 3.8

Blueprint of questionnaire (continued)

Indicator	Statement	Question Number
Students' motivation toward implementation of 7E learning cycle	By using this kind of learning can help me to understand concept easily.	6
Students' respond toward implementation of each 7E learning cycle phase	I like the way when the teacher began the lesson by asking questions.	7
	I like when teacher gives animation about motion with constant acceleration so I was interested to matter.	8
	I like when teacher give experiment about motion with constant acceleration so I have experience directly.	9
	I like when teacher gives students the opportunity to explain the experiment results.	10
	I understand the way teacher gives explanation.	11
	I can solve the problem/question from teacher.	12
	I like when teacher apply the problem in daily life.	13

F. Research Stage

This research will be conducted through 3 stages which are defined below:

1. Preparation stage

Activities that will be conducted in this stage consist of:

a) Literature study is done to get accurate theory about 7E learning cycle, conventional, achievement, and cognitive domain.

b) Curriculum analyse is done to know basic competence that will be achieved so the learning model of 7E learning cycle that implemented in experimental class will get the appropriate result with competence in curriculum that relevant to motion with constant acceleration concepts. Curriculum used in this research is KTSP (Indonesian Curriculum) because school which is used to take the data using Indonesian curriculum.

c) Doing observation to get information about class condition, teaching style when conduct the learning, students' characteristic, organizing schedule and learning infrastructure such as experiment equipment.

d) Lesson plan design about motion with constant acceleration concept based on 7E learning cycle model and its properties that appropriate with Indonesian curriculum.

e) Instrument design, the instrument is divided into two; there are test and non-test. Test used in this research are 30 multiple choice questions of motion with constant acceleration to measure student 'achievement, meanwhile non-test is questionnaires to know how the students' respond toward 7E learning cycle model. Then the instrument should be judge by 3 lectures and make revision if there is mistake. After that, the instrument should be tested to students to determine which questions that used as a test.

f) Analyse the result of instrument trial by using Anates (validity, reliability, discriminating power and difficulty index) and the result is 15 questions that will be used as a pretest and posttest where pretest and posttest using the same questions. This test will be conducted before and after instructional.

g) Determine research subject of this research that consist of experimental and control class.

2. Implementation stage

   Activities that will be conducted in this stage consist of:

   a) Conduct pretest for both classes (experimental and control class) to know students' prior knowledge about motion with constant acceleration concept in the first meeting of lesson.

   b) Conduct the learning for both classes. Experimental class is given treatment by 7E learning cycle and it conduct for 5 meeting, while control class is given by lecturing and the concept prove by doing experiment (conventional), it conduct for 4 meeting.

   c) Conduct posttest for both classes (experimental and control class) to know the improvement of students' achievement after given the learning in the last meeting. But, in the experimental class after conduct posttest then questionnaire is given directly. Questionnaire is distributed to know students' respond after implement of 7E learning cycle.

3. Final stage

   Activities that will be conducted in this stage consist of:

   a) Processing data and analysing data of pretest and posttest data by using statistic test, while questionnaire by using percentage.

   b) Taking conclusion

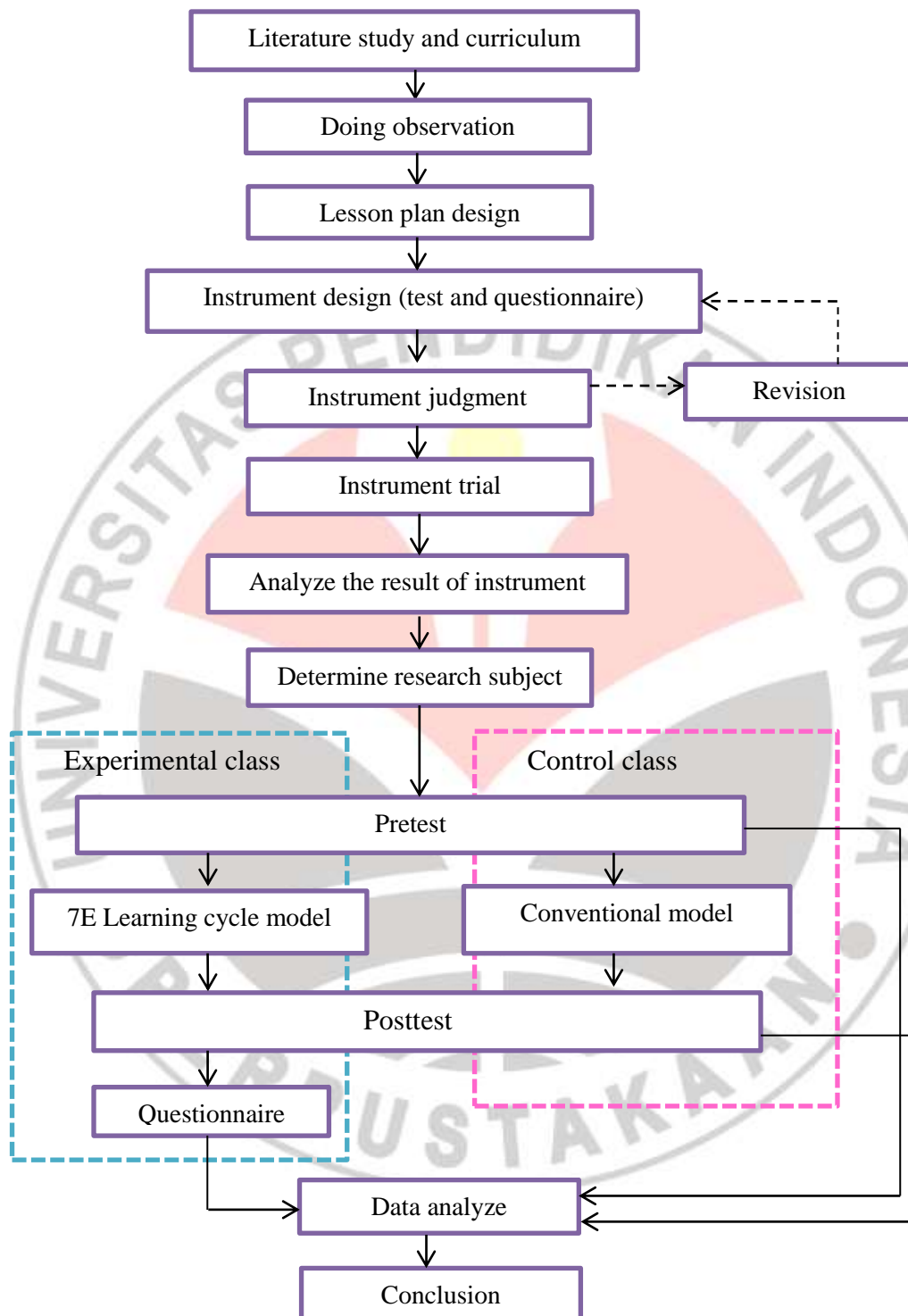   For more details, research plot which conducted can be used in figure 3.1 below:

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┌─────────────────────────────────────┐
│   Literature study and curriculum   │
└─────────────────────────────────────┘
                  ↓
        ┌─────────────────────┐
        │   Doing observation │
        └─────────────────────┘
                  ↓
        ┌─────────────────────┐
        │  Lesson plan design │
        └─────────────────────┘
                  ↓
┌──────────────────────────────────────────┐
│ Instrument design (test and questionnaire)│ ←- - - - - ┐
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        ┌─────────────────────┐    - - - →  ┌──────────┐┊
        │  Instrument judgment│             │ Revision │┘
        └─────────────────────┘             └──────────┘
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        │   Instrument trial  │
        └─────────────────────┘
                  ↓
     ┌───────────────────────────┐
     │ Analyze the result of     │
     │ instrument                │
     └───────────────────────────┘
                  ↓
      ┌──────────────────────────┐
      │ Determine research subject│
      └──────────────────────────┘
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Experimental class   Control class

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           ┌──────────────── Pretest ────────────────┐
                  ↓                    ↓
   ┌──────────────────────┐   ┌──────────────────────┐
   │ 7E Learning cycle    │   │  Conventional model  │
   │ model                │   │                      │
   └──────────────────────┘   └──────────────────────┘
                  ↓                    ↓
           ┌──────────────── Posttest ───────────────┐
                  ↓
      ┌──────────────┐
      │ Questionnaire│
      └──────────────┘
                  ↓
        ┌─────────────────────┐
        │    Data analyze     │ ←──
        └─────────────────────┘
                  ↓
        ┌─────────────────────┐
        │     Conclusion      │
        └─────────────────────┘
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Figure 3.1

Research plot

G. Data Collection Technique

Data collection techniques used in this study is cognitive achievement test and questionnaire. The following is an explanation of the data collection techniques:

1. Cognitive achievement test

   This test is to measure students' cognitive achievement before and after instructional in experiment and control class. Tests will be used are pretest and posttest where pretest and posttest using the same questions as much as 15 questions. The questions used in the form of multiple choice of motion with constant acceleration concept. All of instrument refers to cognitive domain on the aspect of remembering (C1), understanding (C2), applying (C3) and analyzing (C4).

2. Questionnaire

   This questionnaire is done by experimental class in the last meeting. This is use to know how student's respond after implemented 7E learning cycle. Questionnaire is given in form of a sheet and students have to fill it by a fixing a check mark (√) in the space provided.

H. Data processing Technique

After the data is obtained, then it is made the selection of data which is processed and analyzed. It is categorized into two categories, namely quantitative and qualitative data.

1. Cognitive Achievement Test

Data of cognitive achievement test obtained from pretest and posttest. Make scoring from the result of pretest and posttest in experimental and control class by using formula the correct amount multiplied by 100 and divided by the number of questions in Microsoft Excel. Analyze the data to answer the hypothesis. Data analysis techniques in this study using a statistical test that is average test. Average test will be used to determine the differences improvement in students' achievement by using 7E learning cycle and conventional.

After the data is obtained, the next step is to analyze and process the data by using statistical test. Data processing is performed on the pretest and posttest scores. Explanation of data processing techniques obtained are as follows:

a) Descriptive statistic analyse

This is done to determine the maximum value, minimum value, mean, standard deviation, and variance of the data that has been obtained. To test the hypothesis by using statistical tests (t-test) and it is done by using software SPSS (Statistical Product and Service Solution) 18.0 for windows which is operated by using a laptop.

b) Normality test

Normality test conducted to determine whether data obtained normally distribute or not. To count it we can use SPSS software using *Kolmogorov-Smirnov* statistic test with 5% signification level. Normality test conducted to pretest and post test score from two different class/group (experimental and control class).

If both data distribute normally, we can continue the data processing to homogeneity test. If the data show that the distribution from one or all the data not normally distribute, the data processing can continue using *non parametric* statistic it is using *Mann Whitney* test.

c) Homogeneity test

If the data obtained normally distribute the next process to continue is homogeneity test. Homogeneity test is used to determine whether both groups have homogenous variances or not. To count homogeneity we can use *Leven's* test with 5% signification level. Homogeneity variances test done in order to determine which statistic test will be used to test our hypothesis (similarities and mean test).

If both data normally distribute and homogenous, the hypothesis test will be use is *t-test* (less than 30 students), meanwhile if the data comes from normal and did not have homogenous variances hypothesis test that will be use is *t' test*.

d) Compare mean test

Compare mean test is done to determine whether both classes (experimental and control class) have the same mean score or not. If the data obtained normally distribute and has homogenous variances, the next test will be *t-test* (independent sample t test). If the data normally distribute and did not have homogenous variances will be tested by using *t'-test* (independent simple t test). Meanwhile if the data obtained did not distribute normally, the test will be used is non-parametric test *(*Mann-Whitney test*)*.

It has already explained in the beginning that the data which is processed and analysed in this research are pretest and posttest data. The similarity test of those two classes and the mean test are done to both pretest and posttest data. Similarity test done to determine whether both classes (experimental and control class) has the same initial mean score or not.

Meanwhile, difference test and mean test done to the posttest data only to determine the improvement of student's cognitive achievement. The counting obtained from pretest and posttest score experimental class and control class. Gain index will be used if the mean test of pretest score are different and to determine the student's achievement of cognitive quality improvement. The improvement occurred after and before the learning process according to Hake (1998) is calculated by gain index formula below:

$$< g > = \frac{\%posttest\ score - \%pretest\ score}{\%maximum\ ideal\ score - \%pretest\ score} \quad (3)$$

The criteria of the gain that is used by Hake (1998) are presented on the table 3.9 below:

Table 3.9

Criteria Gain

Gain	Interprets
$g > 0{,}7$	High
$0{,}3 < g < 0{,}7$	Medium
$g < 0{,}3$	Low

For more detail, cognitive achievement test data processing shown in figure 3.2 below:
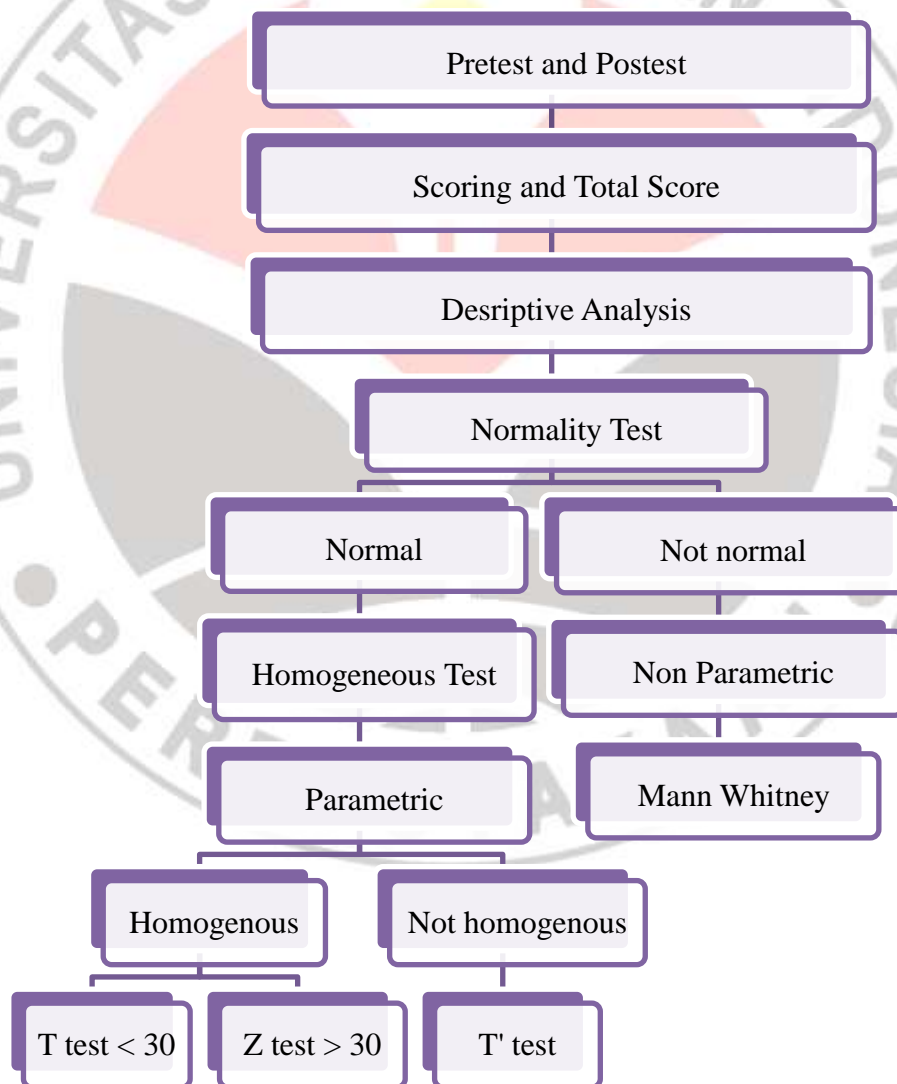

Figure 3.2

Steps of test processing data

2. Questionnaire

Questionnaire is conducted at the end of meeting and filled by students. This questionnaire contains five selections of answers: Strongly Agree (SA), Agree (A), Neither (N), Disagree (DA), and Strongly Disagree (SDA). Questionnaire is filled by students as the respondent by a fixing a check mark ($\sqrt{}$) in the space provided. This is used to know how student's respond is after implemented 7E learning cycle.

For this questionnaire, the data were processed by classifying students' respond that consist of Strongly Agree (SA), Agree (A), Neither (N), Disagree (DA), and Strongly Disagree (SDA). Then, the answer is expressed as a percentage. This percentage to determine the percentage of students' responds toward 7E learning cycle.

Data obtained from the questionnaire is processed by counting the total number of respondents who chose the items that are available, and then the number converted into percentage below:

$$P = \frac{f}{n} \text{ x } 100\% \qquad (4)$$

With :

P = Percentage of the respondent's answer

F = Frequency of the respondent's answer

n = Number of respondent

Calculation of the percentage classification in each category of interpretation according to Arikunto (1990) is shown on the table 3.10 below:

Table 3.10

Classification of percentage interpretation questionnaire

Percentage of Answer (%)	Criteria
0%	No improvement
0 % - 25%	Just a little
26% -40%	Almost half of total
41% -50%	Half of total
51% - 75%	Most of
76% - 99%	Almost all
100%	Total improvement