CHAPTER III

RESEARCH METHODS

3.1 Location and Time of Research

This research was conducted at the Islamic Boarding School of MAWARIDUSSALAM, which is located at the peringgan road in the village of tumpatan, nibung hamlet III, kec Batang Kuis, Tumpatan Nibung, Batang Kuis, Deli Serdang Regency. This research was conducted in class XI of the first semester T.P. 2019/2020.

3.2 Population and Research Samples

3.2.1 Population

The population of this study was all students of class XI Islamic Boarding School MAWARIDUSSALAM, in the first semester of T.P. 2019/2020 which consists of 2 classes.

3.2.2 Samples

The study sample consisted of two class, namely the experimental class and the control class randomly selected, namely by using a cluter random sampling technique, which is a sampling technique based on certain groups representing other groups randomly selected, so that each class has equal opportunity to be sampled. The sample class is taken from a population of as many as 2 classes, one class is used as an experimental class with a Guided Inquiry learning model and one class is used as a control class with conventional learning.

3.3 Research Variables

Variables in this study consist of two types, namely as follows:

1. Free variables, namely the application of guided inquiry learning models and conventional learning models.
2. The variable is bound, namely the science process skills of students in the subject matter of Measurement.

3.4 Types and Design of Research

3.4.1 Research Types

This study includes the type of quasi-experimental research that aims to see or know the consequences of something that is imposed on the subject, namely students. The intended influence is the science process skills of students with guided inquiry learning models that can be seen from the results of student answers to tests of students' science process skills.

3.4.2 Research Design

This study involved two classes namely the experimental class and the control class, where the two classes were given different treatments. The experimental class is given a guided inquiry learning model while the control class is given a conventional learning model.

To find out the science process skills of students obtained by these two treatments, students must be given a test twice, namely before treatment and after treatment. The research design used is the Two Group Pretest - Posttes Design which is shown in Table 3.1 below!

Tabel 3.1. ***Two Group Pretes – Posttes Design***

Groups/class	Pretest	Treatment	Posttest
Experiment	Y_1	X_1	Y_2
Control	Y_1	-	Y_2

(Arikunto, 2010 ;125)

From the results of research that has been done in get the following data

Tabel 3.1a. ***Data of Two Group Pretes – Posttes Design***

Groups/class	Pretest	Treatment	Posttest
Experiment	13.54	X_1	36.63
Control	14.12	-	19.44

Information :

Y1 = Pretest given to the experimental class and control class before being given treatment

Y2 = Postes given to the experimental class and control class before being given treatment

X1 = Teaching by applying the Guided Inquiry learning model

- = Teaching by Physics teachers by applying conventional learning models

3.5 Research Procedures

The research process is the stages of activities carried out by researchers to obtain the data needed. This research was carried out with the following steps:

1. Early Stage (Preparation and Planning)
    a. Make a letter of approval from the supervisor.
    b. Determine the problem, title, location, and time of research.
    c. Request permission from the school regarding the research activities to be conducted at the Islamic Boarding School of MAWARIDUSSALAM.
    d. Determine population and sample.
    e. Conduct preliminary studies (interviews with physics teachers about the problems faced by students in physics learning, and make direct observations to schools during the implementation of learning).
    f. Develop and develop learning tools and research instruments.
2. Stage of Implementation of Research
    a. Validating research tests / instruments.
    b. Conduct a pretest (Science Process Skill test) in both classes that will be used to determine the initial abilities possessed by students.
    c. Test the normality and homogeneity of the initial test data.
    d. Determine the experimental class and the control class of the existing population.
    e. Divide student learning groups for experimental class students.

f. Carry out learning with learning models according to research design.
g. Observing student activities during learning.
h. Giving postes (Science Process Skills test) to the experimental class and control class to find out the final abilities of students after being given treatment.

3. The Final Stage of Research
   a. Processing and analysis of research data.
   b. Consolidation of research results.

Below is a picture of the flow of the research design to be carried out::

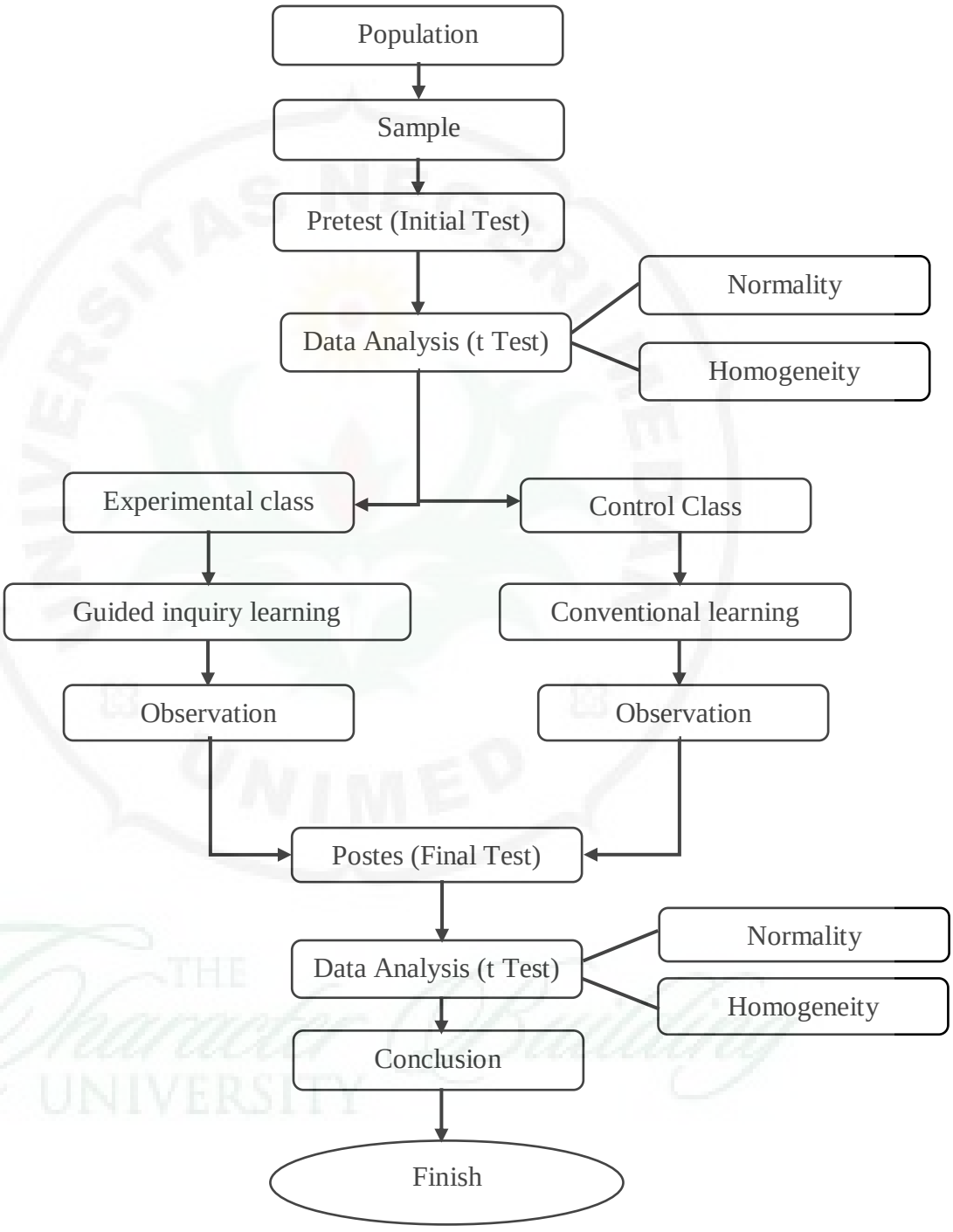

Figure 3.1 Research Design Scheme

3.6 Research Instruments

The research instrument used was test and non-test. The test instrument used to assess students' science process skills is the science process skills test in the form of a description while the non-test instrument is in the form of an observation sheet of a science process skill activity.

3.6.1 Instrument for Student Science Process Skills

The test instrument used to assess students' science process skills is the science process skills test in the form of a description, scoring guidelines can be seen in Table 3.2

Table 3.2 Scoring Guidelines for Science Process Skill Instruments

Science Process Skills	Indicator
Observe (observation)	1. Use as many senses 2. Collecting or using the relevant facts
Group (Classification)	1. Note any observations separately 2. Looking for differences and similarities 3. Contrast the characteristics 4. Compare 5. Looking for basic grouping or classification 6. Linking the results of his observations
Interpreting (Interpretation)	1. Linking the results of his observations 2. Find a pattern in a series of observations 3. Concluded
Forecasting (Prediction)	1. Using the patterns the observations 2. Express what might happen to a situation that has not been observed
Ask a question	1. Ask what, how, and why 2. Asked to explain 3. Ask questions that set the hypothesis
Hypothesize	1. Knowing that there is more than one possible explanation of the single instance 2.Realize that an explanation needs to be tested for its truth in obtaining the evidence more or do a problem-solving way

Science Process Skills	Indicator
Planning The Experiment/Research	1.Determine the tools/materials/resources will be used 2.Specifies variables or the deciding factor. 3.Determine what will be measured, observed, noting 4. Determine what will be implemented in the form of working steps
Use the tools/materials	1.Wearing tools and materials 2.Know the reasons why use of tools/materials 3.Find out how to use the tools and materials
Implementing the concept	1.Using concepts that have been learned in the new situation 2.Use the concept in a new experience to explain what is going on
Communicate	1.Describe/illustrate the empirical data or observations experiment results with a graph or a table or diagram 2.prepare and submit reports systematically 3.describe the results of an experiment or research 4.Read the graph or table diagram 5.Discuss the results of the activities of an issue or an event 6. Change the presentation
Carry out experiments / experimentation	1. Conduct an Experiment

Temiz(2013)

3.6.3 Trial of Educational Instruments

Before conducting research, tests that have been prepared are first tested. This trial was conducted to obtain a valid data collection tool that could be scientifically justified.

3.6.3.1 Content Validation

Content validation is the degree to which a test measures the scope of the subtance to be measured. A test is said to have a validity of the content of a given lesson. The number of questions to be validated as many as 8 questions in the form of description. Following are the validator score guildelines.

Tabel 3.3 Guildelines for Scoring Validators

No	Field of Study	Criteria
1	In accordance with indicators of science process skills	1. Not in accordance with the indicator 2. Not suitable with the indicators 3. In accordance with the indicators but not right 4. In accordance with the indicator and fixed
2	Questions are clearly formulated	1. The subject is unclear 2. The subject matter is formulated but is wrong 3. The subject matter is formulated unclearly 4. The subject matter is clearly formulated
3	Did not provide clues to the answer	1. The subject is unclear 2. The subject matter is formulated but is wrong 3. The subject matter is formulated unclearly 4. The subject matter is clearly formulated
4	Questions are not double	1. The ssubject matter is double 2. The subject matter is almost all double 3. The subject matter is a bit double 4. The subject matter is not double
5	Use language in accordance with Indonesian language rules	1. Questions are not in accordance with Indonesian rules 2. The problem of using Indonesian is difficult to understand 3. The problem of using Indonesian which is in accordance with the rules but is not quite right 4. Problem using Indonesian in accordance with the rules

Information :

0.0 - 33.2 = Invalid

33.3 - 66.6 = Valid with Repair

66.7 - 100 = Valid

The results of the validation by 2 lecturers and 1 teacher are as follows. (the data can bee seen in Appendix 6 page 88)

Tabel 3.4 Result of Validation by Expert

Validator	Areas of Expertise	Position	Score	Conclusion
Drs. Rappel Sihotang, M.Si	Design and Objctive Test Instrument	UNIMED Physics Lecturer	95.00	Valid
H. Abdul Rais, S.Pd,ST,M.Si	Design and Objective Test Instrument	UNIMED Physics Lecturer	98.75	Valid
Yulida S.Si	Design and Objective Test Instrument	High School Physics Teacher	95.00	Valid

3.7 Data Analysis Techniques

3.7.1 Data Analysis of the Science Process Skill Test

The quantitative data management analysis technique tests the Science Process skills in the experimental class and control class with the following steps:

3.7.1.1 Determine the average value and standard deviation

a) Determine the average score of each sample group using the formula:(Sudjana, 2005)

$$\bar{X} = \frac{\sum X_i}{n} \qquad (3.1)$$

hit :$\sum X_i$ = Amount of all prices X that is in the collection

$\bar{X}$= average student grades

n = Number of samples (students)

Determine standard deviation: (Sudjana, 2005)

$$S = \sqrt{\frac{\sum(X_i - \bar{X})^2}{n-1}} \quad (3.2)$$

WhitS = standard deviation

Average Values and Standard Deviations obtained from the results of the research are (the data can be seen in Appendix 9 page 102) :

- Pretest
  - Experiment Class
    Average : 13.5
    Deviation : 6.8
  - Control Class
    Average : 14.1
    Deviation : 5.3
- Postest
  - Experiment Class
    Average : 36.6
    Deviation : 9.8
  - Control Class
    Average : 19.4
    Deviation : 7.6

3.7.4 Normality test

To determine the average value used the formula (Sudjana, 2005: 67), that is:

$$\bar{X} = \frac{\sum f_i x_i}{\sum f_i} \quad (3.5)$$

To calculate the standard deviation (s) the formula is used (Sudjana, 2005: 94), that is:

$$S = \sqrt{\frac{n\sum x_i^2 - (\sum x_i)^2}{n(n-1)}} \quad (3.6)$$

This test aims to see whether the sample is normally distributed or not. The test used is reliability with steps (Sudjana, 2005: 466), as follows:

a. Arrange student scores from the lowest score to the highest score
b. Search for raw scores using formulas: $z_i = \frac{x_i - \bar{x}}{s}$ (3.7)

   Whit$\bar{x}$= Average standard deviation value
c. For each of these raw numbers using a standard normal distribution list, then the opportunity is calculated F(z_i)= P(z≤ z_i)
d. Calculating proportions$z_1, z_2, \ldots z_n$which is smaller or equal toz_i.If the proportion is stated with S(z_i) then

   S(z_i) = $\frac{the\ amount\ of\ z_1, z_2, \ldots z_n\ that \leq z_i}{n}$ (3.8)
e. Calculate the difference F(z_i) - S(z_i)then specify the absolute price
f. Take the biggest price between the absolute prices, the nameL_{count}, then compare$L_{count}$with priceL_{label} (a= 0,05)

   With testing criteria:

   IfL_0< L then the sample is normally distributed

   IfL_0> L the sample is not normally distributed

The results of research conducted by researchers, the results of the normality test are Normal. (the data can be seen in Table 4.3 page 41 and Appendix 10 page 106)

3.7.5 Homogeneity Test

The examination of variance homogeneity test aims to determine whether the sample data has a homogeneous variance or not. Homogeneous test variants using the F test, with the following hypothesis**:**

$H_0: \sigma_1^2 = \sigma_2^2$, both populations have the same variance.

$H_0: \sigma_1^2 \neq \sigma_2^2$, both populations have different variances.

To test the hypothesis above (Sujana, 2005: 250) a formula is used:

$$F_{count} = \frac{biggest\ variant}{smallest\ variant} \quad (3.9)$$

Testing Criteria are:

F_{count}<$F_{tab1/2a(v_1v_2)}$, H_0be accepted

$F_{count} > F_{tab1/2a(v_1v_2)}$, H_0rejected

By: real level$a$= 0,05

$v_1 = n_{1-1}$andn_1 = largest size variant

$v_2 = n_{2-1}$andn_2 = smallest variant size

If processing data shows thatF_{count}<F_{tabel}thenH_0be accepted, it can be concluded that the two samples have a homogeneous variance. If the management of the data shows that$F_{count} > F_{tabel}$thenH_0rejectedandbe acceptedH_a, it can be concluded that the two samples do not have a homogeneous variant.

The results of research conducted by researchers, the results of the Homogeneity Test are Homogen . (the data can be seen in Table 4.4 page 42 and Appendix 11 page 111)

3.7.6 Hypothesis Testing

To test hypotheses, statistical analysis is done, testing the similarity of two means (two-party t test and one-party t test). Hypothesis testing is done with two events, namely:

a. Test post-test average similarity (One-party t Test)

One-party t test was used to determine the effect of a treatment that is the Guided Inquiry learning model on students' Science Process Skills. The hypothesis being tested is shaped

H_0 : $\mu_1 = \mu_2$

H_a : $\mu_1 > \mu_2$

Information :

$\mu_1 = \mu_2$: Student learning outcomes in the experimental class and control class are the same, meaning there is no influence of the guided inquiry learning model

$\mu_1 > \mu_2$: Student learning outcomes in the experimental class are greater than the control class, meaning there is an influence of guided inquiry learning models

Hypothesis testers if the research data is normally distributed and homogeneous using the t test with the formula, namely:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S\sqrt{\left(\frac{1}{n_1}\right) + \left(\frac{1}{n_2}\right)}}$$

S is the combined variance calculated by the formula:

$$S^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}$$

Information

t = Distribution

$\bar{X}_1$ = The average value of the experimental class

$\bar{X}_2$ = The average value of the control class

n_1 = The size of the experimental class

n_2 = Size control class

S_1^2 = Experimental class variance

S_2^2 = Control class variance

Test criteria are: if $-t_{1-1/2a} < t < t_{1-1/2a}$ where $t_{1-1/2a}$ obtained from the distribution list t with dk = $(n_1 + n_2 - 2)$ and opportunity $(1 - 1/2a)$ and a= 0,05 that is H_0 be accepted. For other t prices H_0 rejected.

The null hypothesis is rejected and work is accepted if data processing shows that, $t > t_{1-a}$, or the calculated t value obtained is more than the valuet_{1-a}.

The conclusion can be drawn that student physics learning outcomes in the experimental class are greater than student learning outcomes in the control class,

then the guided inquiry learning model is said to have a significant effect on student learning outcomes.

Data manager shows that, $t < t_{1-a}$, or the calculated t value obtained is less than the valuet_{1-a}, null hypothesis is accepted. The conclusion can be drawn that if the student physics learning outcomes in the experimental class are the same as student learning outcomes in the control class, then using the guided inquiry learning model is said to have no effect on student learning outcomes

The results of research conducted by researchers, the results of the Test post-test average similarity (One-party t Test) are Initial ability of students in both groups the same sample. (the data can be seen in Table 4.7 page 45 and Appendix 12a page 114)

b. Test similarity Pretest Average (Two-party t Test)

The one-party t test is used to determine the effect of a treatment, namely the Guided Inquiry learning model. The hypothesis tested is shaped:

$$H_0: \bar{\mu}_1 = \bar{\mu}_2$$
$$H_a: \bar{\mu}_1 > \bar{\mu}_2$$

$\bar{\mu}_1$ = The average learning outcomes of the experimental class

$\bar{\mu}_2$ = The average learning outcomes of the control class

Information :

$\bar{\mu}_1 = \bar{\mu}_2$: The average student learning outcomes in the experimental class are the same as the average student learning outcomes in the control class, which means there is no significant effect of the guided inquiry learning model on student learning outcomes.

$\bar{\mu}_1 > \bar{\mu}_2$: The average student learning outcomes in the experimental class is higher than the average student learning outcomes in the control class, which means there is a significant effect of the guided inquiry learning model on student learning outcomes.

If the researcher data is normally distributed and homogeneous then to test the hypothesis using the t test with the formula (Sudjana, 2005), :

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S\sqrt{\left(\frac{1}{n_1}\right)+\left(\frac{1}{n_2}\right)}} \quad (3.13)$$

Where S is the combined variance calculated by the formula (Sudjana, 2005),:

$$S^2 = \frac{(n_1-1)S_1^2+(n_2-1)S_2^2}{n_1+n_2-2} \quad (3.14)$$

Information: t = Distribution

$\bar{\mu}_1$ = The average value of the experimental class

$\bar{\mu}_2$ = The average value of the control class

n_1 = The size of the experimental class

n_2 = Size control class

S_1^2 = Experimental class variance

S_2^2 = Control class variance

The applicable testing criteria are: acceptH_0if$t < t_{1-a}$, where (t_{1-a}) obtained from the distribution list t with dk = $(n_1 + n_2 - 2)$ and opportunity (t_{1-a}) and$a$= 0,05. If t has a priceH_0rejected. If$t_{count} > t_{tabel}$, then H_a accepted by stating that there is a significant effect of the guided inquiry learning model on students' science process skills in the subject elasticity.

The results of research conducted by researchers, the results of the Test similarity Pretest Average (Two-party t Test) are Initial ability of students in both groups the same sample. (the data can be seen in Appendix 12b page 116)