CHAPTER III
RESEARCH METHODOLOGY

3.1 Research Method and Research Design

3.1.1 Research Method

This research applies the descriptive correlational method to meet the research objectives. Therefore, the objectives of this study are to describe the current conditions regarding students' scientific argumentation skills both in writing and orally and also about their correlation. According to it, the use of this method is appropriate because the main purpose of the descriptive method is to describe the condition that occurs in the present by explaining and understanding what is there, as complete and careful as possible (Fraenkel, 2011). While the descriptive correlational method aims to find out whether there is a relationship or not between two or more variables, and if there is a relationship, how close is the relationship, and how meaningful that relationship (Pruzan, 2016).

3.1.2 Research Design

This research belongs to non-experimental with a descriptive correlational research design aimed to describe the current situation regarding education phenomena. All students come from one class at the seventh-grade level. To identify the oral skill of students' scientific argumentation, audio-video transcripts are used. Whereas, to identify written argumentation skill is using a written test. Moreover, rubrics from Toulmin's Argumentation Pattern are used to evaluate the quality of the students' scientific argumentation skills. Based on this strategy, the profile of students' scientific argumentation skills can be determined.

3.2 Population and Sample

This research was conducted in an international high school in Bandung. The school implements the Cambridge Curriculum so that English is the main language in all school activities, especially in learning. The participants of this research are 7th-grade students who have the topic of energy resources in their list of science topics. Which then using a convenience sampling technique, one class of 7th-grade

with a total of 14 students consisting of 8 girls and 6 boys was involved in this study. The sampling technique used in this study is convenient because the sample was taken based on the willingness of students without enforcement from any parties (Fraenkel et al., 2011).

3.3 Operational Definition

Operational definitions are written to describe how researchers measure and define variables in the research (Leech, Barrett, & Morgan, 2005). This was done to prevent misunderstanding in interpreting the research. These following are an operational definition of this research.

1) Scientific argumentation is practices carried out by individuals in making claims that are validated by scientific evidence as a rationale or as a form of communication ideas to draw optimal conclusions from multiple alternatives. The intention of the scientific argumentation of the students in this study is that it will be tested both orally and in writing. All are evaluated based on the Toulmin Argumentation Pattern and the level of Argumentation defined by Erduran, Simon, & Osborne, (2004).
2) Oral scientific argumentation in this study referred to the arguments expressed by students through verbal about renewable energy choice that has the potential to be developed in Indonesia. Data was taken through simple audio-video recordings which are done by each student. This oral scientific argument was then been assessed with the rubric of the Toulmin Argumentation Pattern and its Quality was determined by the quality framework of argument from Erduran framework,
3) Written scientific argumentation in this study is the arguments obtained from the students' answers to the three questions in the essay test. This written scientific argument is scored based on the Toulmin argumentation pattern and the level of argumentation based on Erduran, Simon, & Osborne, (2004).

3.4 Research Instrument

Research instruments are needed to collect the data in this study. The instruments used to obtain data in this study are observation sheet, essay

argumentation writing test, the framework for determining component, and level of argumentation.

3.4.1 Observation Sheet

The observation sheet was used to determine teacher and student activities when the lesson is conducted. The observation sheet was filled in by an observer according to his/her observations in the class by putting a checklist in the implementation column "yes" or "no" for each activity both students and teachers. The format of the observation sheet is shown in Table 3. 1.

Table 3. 1

Observation Sheet of Learning Process Implementation

Learning Stage	Problem Based Aspect	Activity	Yes	No
Introduction		The teacher greets the students and checks their attendance.		
		The teacher tells the objective and the activity.		
Main Activity	Organizing students into problem	Students are shown a video about global energy demand		
		Students are guided to mention the problems in the video		
	Organizing students to learn	Students are given the article about energy resources through google classroom		
		Students read the article		
	Assisting independent and group investigation	Students do the discussion in the Wa group as teacher decisions.		
	Developing and presenting works and exhibition	Group presentation session.		
	Analyze and evaluate the problem-solving process	Students are guided to review the discussion process.		
		Students fill the written argumentation skill test on a google form.		

Learning Stage	Problem Based Aspect	Activity	Yes	No
Closure		Students are given the assignment to make a simple video speech.		
		Teacher closes the class and greets the students		

3.4.2 Essay Argumentation Written Test

Essay tests are used to determine the quality of students' argumentation skills in answering questions given by the teacher. These questions consist of three questions on the topic of energy resources in science and will be assessed based on the Toulmin Argumentation Pattern indicator which includes data, claims, warrants, backing, qualifiers, and rebuttal and quality level based on Erduran, Simon, & Osborne, (2004). The essay tests have been reviewed and validated by the supervisor and several experts in related fields to modify or revise essay tests that not in accordance with the research objectives.

In order to validate the student's scientific argumentation essay test, which has been checked by lecturers and some experts, the essay test is being tested by students who have learned the topic of energy resources. The test was conducted on 8th and 9th-grade students in three separate schools with a final number of 50 students. Analysis of the test instrument is in the terms of validity, reliability, and level of difficulty.

1) Validity

Test validity is used to assess the capacity of the instrument to determine what it is meant to be evaluated. The instrument is considered to be valid if the measurement test has the proper content to measure the object that should be measured by specific parameters. The validity check through ANATES sofware, the value and the interpretation are generated by the software itself.

2) Reliability

Test reliability is used to measure the same subject or object at various times and measurements made by different individuals and the results should remain the same (not changeable, consistent). The reliability in this study was tested using ANATES software and then the results were interpreted according to Table 3. 2.

Table 3. 2

Interpretation of Reliability

Value of r_{xy}	Category
0,800 – 1,00	Very high
0,600 – 0,800	High
0,400 – 0,600	Enough
0,200 – 0,400	Low
0,000 – 0,200	Very low

(Source: Frankel, 2011)

3) Difficulty Level

The degree of difficulty refers to the numbers that show the question of complexity. Since the difficulty level is also tested by ANATES, so the results and the interpretation are automatically generated by the software.

4) Discriminating power

The discriminating power (DP) is the ability of a question to be able to distinguish between high-ability students and low-ability students. After getting the value from ANATES software, the distinguishing power index obtained is then interpreted by referring to the Table 3. 3.

Table 3. 3

Interpretation of discriminating power

D	Classification
0,00 – 0,20	Poor
0,20 – 0,40	Satisfactory
0,40 – 0,70	Good

3.4.2.1 Question Construction of Argumentation Written Test

This test is based on the material limitations in the 2013 curriculum and the Cambridge syllabus that apply in schools. In the test there are three indicators which also produce three description questions. The questions used are listed as follows as shown in Table 3.4.

Table 3. 4

Blueprint of Argumentation Written Test

Indicator	Questions	Question Number
Explain the relationship of increasing population with energy demand	What is your opinion about the relationship between increasing population and energy demands? Explain!	1
Evaluate the use of fossil energy as a part of non-renewable energy sources	How do you think about the use of fossil energy? Do we need to continue to use it or not? Why?	2
Explain the potential of renewable energy sources as the alternative to meets the world's energy demand.	Do you think we need to optimize renewable energy sources? Why?	3

Table 3. 4 shows the details of the questions for each number and the indicators, after constructing the questions, this instrument will then go through an expert judgment process and also a validity test, as explained in the next point.

3.4.2.2 The Result of Question Judgement

Based on the ANATES analysis, the test reliability results were 0.8 (high). The number of questions directly used in this analysis was 2 and the number of revised questions was 1. Table 3.5 includes a description of the essay tests and details for each question item.

Table 3. 5

Recapitulation of Test Item Instrument by ANATES V4

Question Number	Reliability	Discriminating Power	Level of Difficulty	Validity	Noted
1	High	Satisfactory	Medium	Significant	Accepted with revision
2	High	Good	Medium	Very Significant	Accepted
3	High	Satisfactory	Medium	Very Significant	Accepted

3.4.2.3 Final Question Test for Written Argumentation

After collecting and processing the results of the instrument trial, the result stated that the three questions were acceptable but the first question needed to be revised. After the researcher has made a revision, the final questions for the written argument are as follows as shown in Table 3. 6.

Table 3. 6

Final Question of Written Argumentation Test

Indicator	Questions	Question Number
Explain the relationship of increasing population with energy demand	What is your opinion about increasing population? Does it affect energy demands? Is there anything else that might affect energy demands? Explain!	1
Evaluate the use of fossil energy as a part of non-renewable energy sources	What do you think about the use of fossil energy, do we need to continue to use it or not? Why?	2
Explain the potential of renewable energy sources as the alternative to meets the world's energy demand.	Do you think we need to optimize renewable energy sources and not use any non-renewable, even when non-renewable energies have higher energy density? Or do you have another opinion? Explain it clearly!	3

3.4.3 Framework for determining argumentation components

The framework for determining the argumentation component contains the Toulmin Argument Pattern Indicator (TAP) which is a claim, data, warrants, help, qualifications, and rebuttal in the form of a rubric. This rubric will be used to evaluate the oral and written argumentation components. The rubric is shown in Table 3.7 below.

Table 3. 7

The Rubric of Argumentation Components

Argumentation Aspects	Indicator	Description	Linguistic Feature
Claim	Making a claim appropriate to the problem	• Making accurate claim appropriate to the problem • Articulating correct claim based on a particular field of study or discipline • Articulating claim with good and correct language structure	• I agree with… • I support… • I think… It is right…
Counterclaim	Making a counterclaim appropriate to the problem	The counterclaim is a statement of disagreement. It is a statement of student base on valid sources or opinions of other students.	• I disagree with it… • I don't concur with it… • I think… It is not right…
Data	Giving and analysing data to support the claim	• Giving appropriate data (based on observations,	• Based on ... • From the article...

Argumentation Aspects	Indicator	Description	Linguistic Feature
		measurements and so on) and supporting the claim • Giving adequate data (based on observations, measurements and so on) both in quality and quantity • Analysing data to support the claim	
Warrant	Explaining the relationship between data and claim	Describing the logical relationship between data and claim (such as analogy, causation, comparison and so on)	• Why I support…because... • The thing that makes me disagree is…
Backing	Underlying justification or warranties to support the claim	Proposing principles, laws, concepts, or theories that	• Based on what I've experienced… • According to what's in the book… • When we see facts about… • From the theory that I read… • I've heard that... • The following phenomenon/data/facts prove…
Qualifier	Explaining the power of data in a warrant	A qualifier is the power of data to warrants and can	• Mostly… • Usually… • Always… • Sometimes…

Argumentation Aspects	Indicator	Description	Linguistic Feature
		limit a universal claim	
Rebuttal	Explaining the weaknesses of others' arguments.	A rebuttal is refinements especially against other student statements or refutations of all other group statements.	• I do not agree with your opinion because… • I disagree with all your statements because… • I do not agree with you because based on what I've experienced.…

(Source: Sampson & Gerbino, 2010; Roshayanti & Rustaman, 2013)

Student arguments that do not include linguistic indicators from the above table will be classified on the base of characterization from Toulmin's argumentation pattern components expressed by students.

3.4.4 Framework for Level Argumentation Determination

The purpose of this framework is to determine the quality level of student argumentation. This level of determination is used after the argument component has been recognized. Framework for deciding the level of argumentation defined by Erduran, Simon, & Osborne, (2004). The criteria for the level determination of students' argumentation are defined as follows in Table 3. 8.

Table 3. 8

The Rubric of Argumentation Level

Level of Argumentation	Description
Level 5	Argumentation displays an extended argument with more than one rebuttal
Level 4	Argumentation has arguments with a claim with a clearly identifiable rebuttal. Such an argument may have several claims and counter-claims
Level 3	Argumentation has arguments with a series of claims or counter-claims with either data, warrants, or backings with the occasional weak rebuttal
Level 2	Argumentation has arguments consisting of a claim versus a claim with either data, warrants, or backings but does not contain any rebuttals
Level 1	Argumentation consists of arguments that are a simple claim versus a counter-claim or a claim versus a claim

(Source: Erduran, Simon, & Osborne, 2004)

3.5 Data Analysis Technique

If the data analysis technique for written scientific argumentation skills is done by essay test, another way for oral scientific argumentation skills is to use audio-video recordings of each student. Audio-video recordings are transcribed first before the argumentation components are analyzed and then proceed to determine the quality level of student argumentation. The transcription process was carried out after the learning session, students make an independent audio-video about the selection of renewable energy that is possible in Indonesia. Video-audio transcripts as well as essay tests did not include students' real names but are disguised as coding.

3.5.1 Determination of Scientific Argumentation Components

The identification of the argumentation components is carried out by the comprehension of sentences expressed by students and tested with linguistic features in the instruction for the determination of the argument components. For example, if the student states the linguistic element, "I think ... that's right ...," the sentence is categorized as part of the statement of claim. If sentences are not defined based on linguistic features in the analysis process, the sentence shall be considered by examining the description or characteristics of each part of the statement based on the Toulmin argumentation pattern. Toulmin's argumentation components are claim, data, warrant, backing, qualifier, and rebuttal.

3.5.2 Determination of Scientific Argumentation Level

The determination of the argumentation quality level is made after the phase of the argumentation component has been determined. The determination of the level follows the framework developed by Erduran, Simon, & Osborne, (2004). The quality framework for the level of scientific arguments is divided into five levels. In short, the higher the level of argumentation, the higher the detection of a clear rebuttal phrase, the lower the level of argumentation means that no rebuttal is found. However, in Level 1 student is only able to give their approval or disagree with something, while Level 2 students are able to express claims and support in the

form of data, warrants, or backing or qualifier. There has been a rebuttal from Level 3 to Level 5, but at Level 3 it is still uncertain, at Level 4 it can be properly indicated, and at Level 5 it is more than one.

3.5.3 Examine the Correlation

In this study, the correlation was applied to find out the relationship between oral and written scientific argumentation. Since the score is in the ordinal type of data, Kendall's tau-b correlation was applied. Kendall's tau b correlation test is part of non-parametric statistics. Therefore, there are no assumptions or special requirements that require the research data to be normally distributed and that the relationship between variables must be linear (Cunningham & Aldrich, 2011). The correlation of this research was tested by using IBM SPSS Statistics 26, then the value was interpreted as the table 3. 9.

Table 3. 9

Interpretation of Correlation Coefficient

Correlation coefficient	Interpretation
$0{,}80 < r \leq 1{,}00$	Very strong
$0{,}60 < r \leq 0{,}80$	Strong
$0{,}40 < r \leq 0{,}60$	Medium
$0{,}20 < r \leq 0{,}40$	Low
$0{,}00 < r \leq 0{,}20$	Very Low

3.6 Research Procedure

Research procedures in this study will be carried out in three stages. The stages are preparation; implementation; and the completion stage. The three stages will be explained as follows:

3.6.1 Preparation Stage

The preparation stage in this study are:

1) Formulate the problem that is going to be investigated.
2) Determine the focus of variable research.
3) Conduct the literature review of scientific argumentation, problem-based learning, and reviewing energy resources as content that will be implemented to the students.

4) Arrange the lesson plans and research instruments.
5) Judgment research instrument by supervisor.
6) Revise the research instrument.
7) Research instrument trials
8) Instrument analysis using ANATES
9) Revise the research instrument based on the result of instrument trials analysis.

3.6.2 Implementation Stage

This stage explains the steps of how the research will be implemented. The steps are as follows:

1) Conducting the research through problem-based learning with energy resources topic
2) Conducting students' written scientific argumentation test in writing
3) Giving the student an assignment for selecting one potential renewable that can be developed in Indonesia in the form of personal video-audio
4) Collecting all the data result

3.6.3 Completion Stage

The steps will be conducted in this final stage are:

1) Analyze students' scientific argumentation both in writing and oral
2) Generating the discussion in order to elaborate on the findings of the study with the theory
3) Consulting the findings with the supervisor
4) Constructing the conclusion of the research
5) Arranging the report of the research.

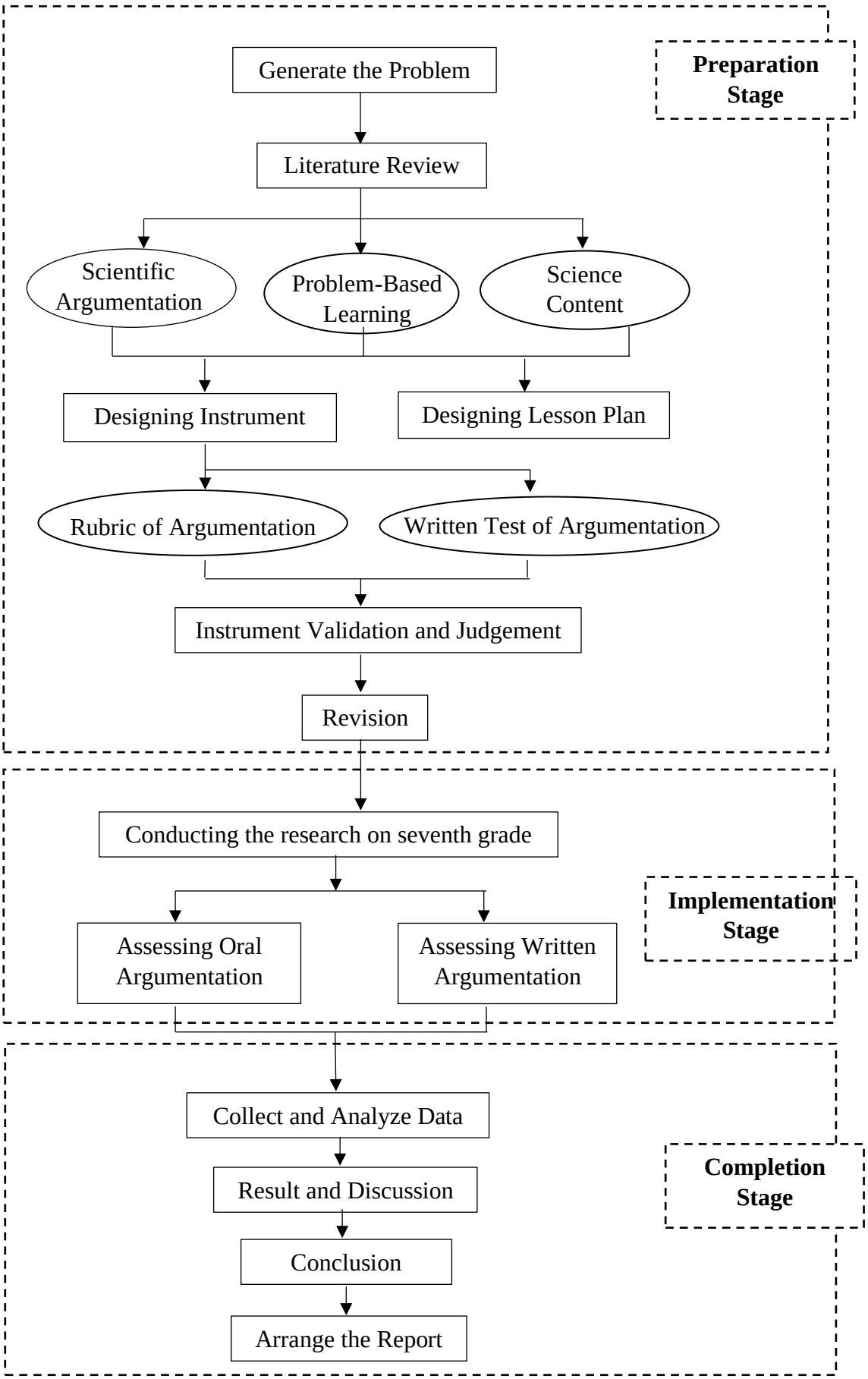

Figure 3. 1 Flow Chart 23