CHAPTER III
RESEARCH METHODOLOGY

A. Research Method and Design

1. Research Method

The research method was used in this research wascombination of pre experimental and descriptive based on Fraenkel (2007).This research only uses one group research without any classroom control (Arikunto, 2010). Determination of the research method is considered by the sampling technique which is not taken randomly and by analyzing the interrelationship within the variables. Those variables are project-based learning as independent variable and student's understanding and creativity as dependent variables.

2. Research Design

The design which is used in this research is one group pretest and posttest design. The design is convergent parallel design where the quantitative and qualitative data are collected simultaneously (Creswell, 2012). The quantitative data is obtained to explain the students' understanding. Meanwhile the qualitative data is obtained to explain students' creativity. In this research design, there is a test to know students' prior knowledge or pretest (O_1), treatment of project-based learning in teaching learning process (X), and after the concept given the treatment of the final posttest will be conducted (O_2). Qualitative data collection is also obtained before and after treatment by measuring students' creativity through creativity rubric.

Table 3.1 The one group pretest and post-test

Pretest	Treatment	Posttest
O1	X	O2

(Arikunto, 2010)

Note:

O_1 = Pretest   X = Treatment   `O_2 = Post-test

B. Research Subject

The research was conducted in Darul Hikam International School Bandung which applied Curriculum 2013 and Cambridge Curriculum in the learning process.

Population of this research was all of students' cognitive abilities and creativity skill that belongs to all secondary one level students in the school. The sample is all of cognitive abilities and creativity skill on global warming chapter in one class. The sampling technique of this research is purposive sampling, the consideration of the sample is based on the preliminary test where the class has lower result of achievement and creative skill compare to another class.

C. Operational Definition

In order to conduct the research in accordance with the expected aims and avoid misunderstanding, operational definitions need to be elaborated as follows:

1. Project-based learning is an instructional model to empower and attract students' motivation. In learning activities, students are able to demonstrate their understanding through a variety of presentation modes. This learning model is categorized as hands-on learning with five stages of syntax (assign collaborative working groups, present a real-world problem that pupils can connect, set the parameters for completing the project, teacher consultation input/feedback, final project shared with larger group).
2. Students' understanding that is mentioned in this research is something that can be achieved and shown from students' cognitive knowledge on global warming concept after having learning experience through project-based learning, students' understanding is measured by objective test through pretest and post-test.

3. Creativity is one of thinking process which generates possibility and perspectives in overcoming something. Students' creativity in this research is measured through their project based learning product that use rubric as an instrument.

D. Research Instrument

The research instrument which is used to collect the data in this research consist of:

1. Objective test in a form of multiple choice questionis is used to measure students' understanding before and after treated project-based learning in chapter of global warming.

2. Students' creativity is measured based on creativity rubric on Creative Product Analysis Matrix (CPAM)

3. Questionnaire form is used to analyze the students' respond towards implementation of project-based learning model in global warming chapter.

E. Instrument Development

The instruments development started by analyzing the curriculum applied at the involved school. The researcher later on formulates the objective test to be used as an instrument of pretest and posttest. The objective test consist of 40 multiple choice question (Appendix A.1)

Before being implemented, the instrument passed several steps. First, the instrument needs to be judged by some experts in related field. Second, the instrument which is not appropriate should be revised. Third, the revised instrument should be tried out on another class which has the same level of research sample. Based on the test results, the instrument questions was analyzed with the following requirements:

1. **Instrument Objective Test Requirements**

   a. **Validity**

   Validity that is used in this research is a content validity. Content validity has a relation with quality of the instrument.The instrument can be concluded as valid or invalid if the measuring instrument is able to measure what should be measured. In this research, the instruments are validating by some experts in related field.

   b. **Reliability**

   Reliability test is a measurement which stated about consistence of the measurement tools that is used. Arikunto (2010: 86) stated that reliability tends to a definition about trusted instrument which is used as collecting data tools because of that instrument has already good. The reliability of the test is measured by SPSS 20 program.

   c. **Discriminating power**

   Analysis discriminating power means the ability of question to distinguish between high achiever and low achiever students (Arikunto S., 2012 : 226). The questions which can be answered correctly by both low achiever and high achiever students are not good questions. Otherwise, the questions which can not be answered by both high and low achiever are also not good because it has no discriminating power.

   The formula which use to analyze discriminating power based on Arikunto (2012) as follow:

   $$Dp = \frac{B_A}{J_A} - \frac{B_B}{J_B} = P_A - P_B$$

   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

To determine whether the discrimination index is good or not, it can be checked in the Table 3.2.

Table 3.2The Classification of Discriminating Power

D	Classification
0,00 – 0,20	Poor
0,21 – 0,40	Satisfactory
0,41 – 0,70	Good
0,71 – 1,00	Excellent

(Arikunto, 2012: 232)

d. Level of difficulty

Level of difficulty here means level of difficulty of the student's ability to answer questions, but it is not from the perspective of a teacher. Good questions are the question which is not too easy or too difficult to be answered (Arikunto S., 2012: 222). The questions which are too easy will not stimulate the students to try harder to solve it, while too difficult questions will make the students give up and lose heart (Arikunto S., 2012) . The proportion of three categories based on the normal curve. Means that, most of the problems are in the medium category, some are included into the category of easy and difficult with balanced proportions.

The formula which used in this research to determine the level of difficulty of the problems is:

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

P = Difficulty level

B = Number of students who answer correctly

N= Total number of students

(Arikunto, 2010: 208)

The smaller index obtained, the more difficult questions. Otherwise, the greater index gained, the easier of question The difficulty index criteria is showninTable 3.3 below:

Table 3.3Level of Difficulty

Value	Criteria
0 – 0,29	Difficult
0,30- 0,69	Middle
0,70 - 1,00	Easy

(Arikunto, 2010: 210)

F. Research Plot

The research plot consisted of 3 stages, that are preparation stage, implementation stage, and analysis & conslusion stage. The research scheme can be seen on the Figure 3.1
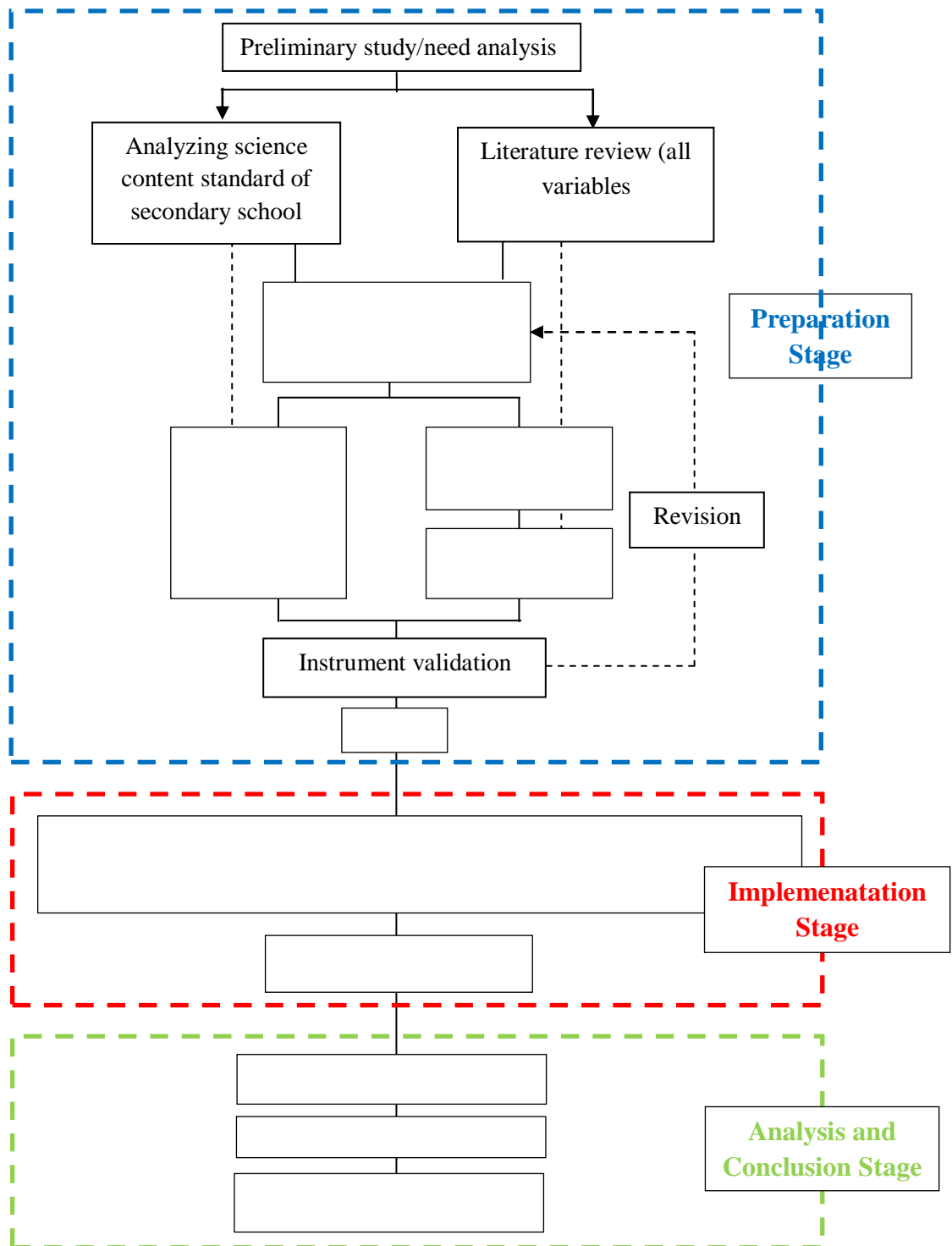
Figure 3.1 Diagram of Research Plot

G. Research Procedure

In order to arrange the sequence of research systematically, the procedure of research is arranged based on the syntax of project-based learning implemented. There are three stages of procedure consists ofpreparation stage, implementation stage,and analysis and conclusion stage. Those three stages will be explained as follows:

1. Preparation stage

In this stage, the researcher conduct several steps that support the research, there are:

a. Formulate problem that will be investigated

b. Determine the focus of variable research

c. Conduct literature review of projectbased learning, students' understanding, students' creativity, and curriculum

d. Arrange the research proposal which is presented in proposal seminar

e. Revise of research proposal after having suggestions and critics from lecturers.

f. Arrange the research instrument and being judged by expert or lecturer.

g. Revised of research instrument after having suggestions.

h. Try out of research instrument

i. Revised of research instrument based on instrument try out analysis result

2. Implementation Stage

This stage explains the step of how research will be implemented, it consists of:

a. Determination of experimental class

b. To get initial condition of students, pretest will be given to the sample class

c. Processing pretest result.

d. Conduct research activity by implementingprojectbased learning model in experimental class with following scenarios:

1) First meeting, there are two stages of projectbased learning that are applied. The stages are*assign collaborative working group* and *present*

a real-world problem that pupils can connect. In the beginningof class, teacher inform that in the end of the chapter students should make a project in a group related with the photo and video shown. Teacher assign collaborative learning group which consist of low and high achiever students. After the students gathered in their own group then the learning continued to the next syntax.

In *present a real-world problem that pupils can connect*syntax, teacher asks students related to global warming phenomenon that happens in the world. Students' answer is written down on the board so that all students can see. In the end of class, teacher determines the theme of each group. Teacher give homework to each group to bring an article related to their theme.

2) In second meeting, the *set parameters for completing the project* and *teacher feedback/consultation* stages are implemented. In the beginning of class, teacher explains several criteria related to the project completion. In *teacher feedback/consultation* stage, each group is asked to report their project progress and share their difficulties in completing the project.

3) In the last meeting, the *project shared with the larger group* is implemented. Each group is asked to present their final project in front of class. The other groups give feedback in form of question and additional information related to the concept that is being presented. The teacher has a role to guide the students' discussion, on the other hand teacher also minimizing the misconception that might happen during the discussion. In the end, the teacher concludes the whole learning and clarifies all the concepts.

e. Give post-test in the sample class to recognize the improvement of achievement in the sample class.

f. Give questionnaire to know the student's response towards implementation of project-based learning in the whole learning.

3. Analysis and Conclusion Stages

   This is the final stage of research design, the step that will be conducted in this stage will be explained as the following steps:

a. Analyze the result of the whole research from based on the instrument result.
b. Discuss and conclude for the data analysis result.
c. Arrange the report of the research

H. Data Collection Technique

In this research there are three different data which are collected, those data has different instrument to measure. The data collection techniques are explained as follow:

1. Data of Students' Understanding

The students' understanding is the quantitative data of this research. This data will be collected through objective test in form of multiple choice questions consist of 40 questions. The result will be collected then analyzed using the normalized gain formula.

Table 3.4Test Item Specification

Indicator	Test Item
1) Remembering	1, 2, 4, 6, 18, 24, 32, 35
2) Understanding	3, 5, 8, 9, 12, 14, 15, 19, 22, 25, 26, 27, 29, 30, 31, 33, 36, 37, 38, 40
3) Apply	11, 13, 16, 21, 23
4) Analyze	10, 17, 20, 28, 39

Adopted from Bloom's Taxonomy (Anderson, 2001)

2. Data of Students' Creativity

The students' creativity is the qualitative data of this research. It is obtained through measurement of students' product using Creative Product Analysis Matrix (CPAM) rubric. The rubric will have some indicators that show the percentage of students' creativity. The CPAM blue print is shown in Table 3.5 as follows:

Table 3.5Rubric to Measure Students' Creativity (Blue Print)

No	Creativity Dimension	Indicator	Measured Aspect	Score 1	2	3	Note
1	Novelty	Original	Theme				
			Product Design				
		Surprising	Theme				
			Product Design				
		Germinal	Product Design				
3	Resolution	Valuable	Product Design				
		Logic	Product Design				
		Useful	Product Design				
3	Elaboration and Synthesis	Organist	Product Design				
		Elegant	Product Design				
		Complex	Purpose and Product Design				
		Understandable	Product Design				
		Artistic	Presentation				

Adapted from Basemer and Treffinger

The data obtained from research instrument, then is analyzed by convert it to percentage. The percentage is interpreted using Purwanto index to determine its creativity level.

3. Data of Students' Response

Students' respond data collection is used to determine students' response toward project based learning implementation in global warming chapter.The data obtained from the questionnaire is a supportive data, and it is processed by a percentage calculation. The blue print of students' response questionnaire is shown in Table 3.6 as follows:

Table 3.6Table of Students' Response Questionnaire

Indicators	Category and Number
Students' response toward team work ability as a group	Positive statement: 1, 3
	Negative statement: 2, 4
Students' response toward project based learning implementation in global warming chapter	Positive Statement: 5, 7, 9
	Negative Statement: 6, 8, 10
Students' response in creative thinking skill on global warming chapter	Positive Statement: 11, 13, 15
	Negative Statement: 12, 14, 16
Students' response toward making a poster as final product of project	Positive Statement: 17, 19
	Negative Statement: 18, 20

I. Instrument Analysis Result

1. Recapitulation of Students' Understanding Instrument

The instrument for measuring students' understanding is an objective test in a form of 40multiple choice. The instrument should be tested in terms of validity, reliability, discriminating power, and difficulty level as explained before. The test was given to 20 students which have learned about the chapter that is learned for the research. The summary of test item analysis is shown in Table 3.7 as follows:

Test item recapitulation:

Reliability test   : 0.85 (Good degree)

Table 3.7 Recapitulation of Test Item for Students' Understanding

Question Number	Discriminating Power	Difficulty Level	Validity	Status
1	Very poor	Very easy	Validated	Revised
2	Very good	Medium	Validated	Used
3	Poor	Very easy	Validated	Revised
4	Fair	Medium	Validated	Used
5	Poor	Easy	Validated	Revised
6	Very good	Medium	Validated	Used
7	Poor	Easy	Validated	Revised
8	Good	Easy	Validated	Used
9	Poor	Very easy	Validated	Revised
10	Fair	Medium	Validated	Used
11	Poor	Medium	Validated	Revised
12	Poor	Very difficult	Validated	Revised
13	Very good	Easy	Validated	Used
14	Good	Medium	Validated	Used
15	Poor	Very difficult	Validated	Revised
16	Fair	Easy	Validated	Used
17	Good	Easy	Validated	Used
18	Very good	Medium	Validated	Used
19	Very poor	Very easy	Validated	Revised
20	Very poor	Difficult	Validated	Revised
21	Fair	Very easy	Validated	Used
22	Very poor	Very difficult	Validated	Revised
23	Very poor	Easy	Validated	Revised
24	Very good	Medium	Validated	Used
25	Poor	Difficult	Validated	Revised
26	Poor	Very easy	Validated	Revised
27	Very poor	Very difficult	Validated	Revised

Question Number	Discriminating Power	Difficulty Level	Validity	Status
28	Very poor	Very difficult	Validated	Revised
29	Very poor	Very difficult	Validated	Revised
30	Very good	Easy	Validated	Used
31	Very poor	Medium	Validated	Revised
32	Very good	Easy	Validated	Used
33	Fair	Medium	Validated	Used
34	Fair	Easy	Validated	Used
35	Fair	Easy	Validated	Used
36	Fair	Medium	Validated	Used
37	Very good	Medium	Validated	Used
38	Fair	Medium	Validated	Used
39	Good	Easy	Validated	Used
40	Good	Easy	Validated	Used

2. Instrument Non-Test Requirements

a. Rubric of Creative Product Analysis Matrix

Rubric of Creative Product Analysis Matrix is used to measure students' creativity of project based learning product. The poster is assessed into some criteria which is available in the rubrics. The observermeasure students' creativity based on their product. The observer gave the checklist on the rubric if the obsever found the sub indicator appearinstudents' creative product.

b. Questionnaire

Questionnaire is used to know the response of the students towards the implementation of project based learning model in global warmingchapter during the lesson. This data obtained from students' answer from questions given in the end of the lesson.

J. Processing Data

Data obtained from both quantitative data and qualitative. Quantitative data obtained from the pretest and data of students' understanding (post-test), while the qualitative data obtained from the students' creativity rubric and questionnaire. Explanation of data processing techniques are obtained as follows:

1. Quantitative Data Analysis

Quantitative data analysis is done by Microsoft excel calculation, in order to determine the score of pretest and posttest. The process of calculating data is explained as follow:

a) Scoring of Test Item

The first step to process data is scoring the test item. The test item is provided in the 40 number of questions. All of the score is processed using Microsoft excel.

b) Calculation of Gain Score and Normalized Gain

After get the data of the test item score, the data is processed through gain score and normalize score. According to Hake, gain score is obtained from the differences between pretest and posttest. It is assumed as the effect of the treatment itself. And normalized gain test itself is to determine the categories of student's achievement improvement.

According to Hake (1998) here is the formula to get the gain score:

$$G = S_{f} - S_{i}$$

Description:

G =   Gain score

S_f =   Post test score

S_i =   Pre test score

(Hake, 1998)

The effectiveness of project-based learning model in increasing students' understanding of global warming conceptis seen from the result of the normalized gain that achieved by students during the learning process. For the calculation of the normalized gain value and its classification uses equations (Hake, 1998) as follows:

Normalized gain of each student <g> will be determined by this formula:

$$<g> = \frac{\%G}{\%Gmax} = \frac{\%Sf - \%Si}{100 - \%Si}$$

Where,

<g>	=	Normalized gain
G	=	Actual gain
Gmax	=	Maximum gain possible
S_f	=	Post test score
S_i	=	Pre test score

Average of normalized gain (<g>) which is formulated as:

$$<g> = \frac{\% <G>}{\% <G> maks} = \frac{(\% <S_f> - \% <S_i>)}{(100 - \% <S_i>)}$$

Description:
<g>   = Normalized gain
<G>   = Actual gain
<G>max = Maximum gain possible
<S_f>   = Average of post-test score
<S_i>   = Average of pretest score

(Hake, 1998)

The value of Normalized gain which already got can be interpreted using Table 3.8 as follow:

Table 3.8 Interpretation Table

Value	Classification
$\langle g \rangle \geq 0,7$	High
$0,7 > \langle g \rangle \geq 0,3$	Medium
$\langle g \rangle < 0,3$	Low

(Hake, 1998)

c) **Normality and Homogeneity test**

Using of parametric statistic has a deal with assumption that each variable in this research that will be analyzed form a normal distribution. If, the data is abnormal, the homogenity varians test can not be done or the parametric technique can not be used.Meanwhile if the data is normal and homogen, the parametric technique can be used. Normality test is to know whether the sample comes from population that has normal distribution or not. In this research, Normality test uses statistic test from SPSS 20, *Kolmogorov-Smirnov* with significancy level (α) is 0,05. When significance value > 0,05, H_0 will be accepted and H_0 will be rejected or denied if significance value < 0,05 (Sarwono, 2013). The hypotheses are:

H_0 : Sample comes from population that has normal distribution.

H_1: Sample comes from population that has not normal distribution.

The homogeneity test is also uses statistic test from SPSS 20, with significancy level (α) is 0,05. When significance value $\geq 0,05$, the data is considered as homogen (Sarwono, 2012).

d) One Sample T-test

One sample T-test was done to determine whether the class had achieved the standard score after the implementation of project based learning represented by the Posttest Score. T-test requires data which is normal and homogen. In SPSS 20, the test is used *One Sample T-Test.* If the level of significancy (*sig)* ≤ 0.05 H_0 is rejected. If the level of significancy (*sig)*> 0.05 H_0 is retained. In testing the similarity means is used two-tailes hypotheses, the hypotheses is determined as bellow:

H_0 : Students' mastery concept score in learning global warming concept has achieved the school standard of 75 .

H_1 : Students' mastery concept score in learning global warming concept less than school standard (<75)

2. Qualitative Data Analysis

The qualitative data is obtained from both creativity rubrics offinal product and questionnaire. The rubricsassess the poster as the final product. The analysis of rubrics is conducted by converting the raw score into percentage form. Further, the result of percentage can be classified into several categories.

The technique of converting score into precentage is used formula as follows:

$$\textbf{NP} = \frac{R}{SM} \textbf{ x 100\%}$$

Note:

NP = percentage

R   = raw score

SM= maximum score

(Purwanto, 2008:102)

The interpretation of score percentage of students' creativity is categorized into certain criteria according to Purwanto (2008) as shown in Table 3.9 as follows:

Tabel 3.9 Percentage Interpretation

Percentage (%)	Criteria
86-100	Very good
76-85	Good
60-75	Enough
55-59	Lack
<54	Very lack
100%	All of them

The other data that is analyzed qualitatively is from questionnaire result. The qualitative analysis describes the real situation of the research result and also the result of students' respond in learning global warmingby using project-based learning model.

Processing is done by calculating Likert scale, it is calculated into score and then converted into percentage, the percentage of answers observer to then be evaluated for the next lesson. The scoring guideline is shown in the Table 3.10 as follows:

Table 3.10 Scoring Guideline of Students' Response

	Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
Positive Statement	4	3	2	1
Negative Statement	1	2	3	4

The percentage of each likert scale in each indicator determines the students' respond toward project based learning implementation.