CHAPTER III

METHODOLOGY

A. Research Design

The study applied descriptive research method to diagnose students' misconception about plant structure in relation photosynthesis. According to Best, descriptive research is concerned with how what is or what exists is related to some preceding event that has affected a present condition or event (Cohen et al., 2007). Furthermore, Fraenkel and Wallen (2007) reveal that descriptive studies describe a given state of affairs as fully and carefully as possible.

In this research, the data is gathered using drawing method, while the interview and questionnaire are implemented as the supporting data to complete the study. Then, these data are analyzed and used to describe the current misconception that experienced by the sample of this research.

B. Population and Sample

The location of this research is International Junior High School in Bandung. This school uses English as the formal language of instruction and applies Cambridge Curriculum in combined with National Curriculum of 2013.

The population of this research will be all 8^{th} grade students at International Junior High School X in Bandung. The samples are 32 students who have learnt about Plant Structure and Photosynthesis in School "X". The sampling technique that will be chosen is Purposive sampling. Fraenkel and Wallen (2007) stated that purposive sampling is different from convenience sampling in that researchers do not simply study whoever is available but rather use their judgment to select a sample that they believe, based on prior information, will provide the data they need. By using purposive sampling, the researcher selects the samples who have learnt plant structure and photosynthesis concept. It has purpose to diagnose students' misconception after the students learn plant structure and photosynthesis concept.

C. Operational Definition

In order to avoid misconception about this research, some operational definitions are explained in this study. Those terminologies are described as follow.

1. Misconceptions in plant structure is the number of students' drawing about root system and shoot system which not aligned with scientific concept and adjusted to the criteria in the rubric scale and interview as the supporting data. The drawing method of this study is based on Köse (2008).
2. Misconception in photosynthesis is the number of students' drawings that show scientifically incorrect photosynthesis concept and suit to the criteria of drawing with misconception in the rubric scale which based on Köse (2008). In addition, the interview session is applied to support the findings and the analysis of this study.
3. Drawing method that used in this study was developed by Köse (2008) and composed by five level of drawings. The students' misconceptions are diagnosed based on the third level of drawings which contains spesific criteria to describe students misconception concerning on plant structure in relation to photosynthesis.
4. Certainty of Response Index that applied in this study was developed by Hasan et. al (1999) in combined with answers to multiple choice and open-reasons that have been developed by Hakim et. al (2012). The students' misconception about plant structure in relation to photosynthesis are determined, if they give correct answer and incorrect reason; incorrect answer and correct reason; or incorrect answer and reason, with Certainty of Response Index > 2,5.

D. Research Instrument

In this research, instrument is necessary to be used for gaining idea. These are four types instrument that are used in this research. Those instruments are described below.

1. Drawing Instruction

The drawing instruction is applied to lead the students reflect their understanding about plant structure concept in relation to photosynthesis concept through drawing. This instruction consists of several guided statement related to the concept of plant structure and photosynthesis, which ask the students to draw on the A4- sized paper. The design of drawing instruction is shown in Appendix B1 and B2.

2. Rubric Scale

The rubric scale is used to identify the misconception about plant structure concept and photosynthesis concept that hold by junior high school students. This rubric contains a set of criteria, which categorize the students based on the five levels of conceptual understanding and misconception for these concepts. The design of the rubric scale will be used in this study is the similar rubric that have been used by Köse (2008) and it is shown in Table 3.1. Meanwhile, the modification of Rubric Scale of Drawing is presented in Table 3.10.

Table 3.1 Rubric for Students' Drawing

Level	Criteria
1	No drawing
2	Non-representational drawings
3	Drawings with misconceptions
4	Partial drawings
5	Comprehensive representation drawings

3. Questionnaire

The questionnaire is arranged to gain the data of students' interest in drawing and learning biology concept. The open- ended questions will be chosen as the format of the questionnaire. Moreover, the questionnaire provide additional findings about students' interest in drawing and other information which could be used to support analysis in this research.

Table 3.2 Questionnaire Item Specification

No.	Indicator	Question
1.	Students' interest in learning biology	Do you like learning biology? (If yes, you may state the reason")
2.	The use of drawing in biology instruction	Have you ever used drawing in learning Plant Structure and Function, photosynthesis? (If yes, you could mention the topics taught by the teacher that involve drawings)
3.	Media or source of teaching that used to adapt the drawings	Where do you usually take/ adapt the figures that used for learning plant structure and function, photosynthesis concept? A. Teacher draws it by him/ herself B. Drawings are adapted from the book C. Models, such as torso D. Video E. Flash Animation F. Pictures Others (please, mention it.)
4.	The role of drawing to increase students' interest	Could the drawings increase your interest to plant structure and photosynthesis concept?
5.	The contribution of drawing to stimulate students' motivation	Could the drawings used by the teacher increase your motivation to learn plant structure and photosynthesis concept?
6.	The contribution of drawing to improve students' understanding	Could the drawings improve your understanding concerning on plant structure and photosynthesis concept?
7.	Drawing interest	Do you like drawing?
8.	Students' interest to describe the concepts using drawing	Do you like to describe the plant structure concept and photosynthesis, through drawings?

No.	Indicator	Question
9.	Readability of drawings in teaching media	Are the drawings (e.g. figure) on the book or other teaching media understandable well in learning plant structure and photosynthesis concept?
10.	Frequency of drawing usage in describing the biology concept	Do you often describe the plant structure and photosynthesis concept in the form of drawing?

4. Item Test in Combined with Certainty of Response Index (CRI)

Besides using drawing method, the students' misconception about plant structure in relation to photosynthesis will be identified using multiple choice questions with open- reason and Certainty of Response Index (CRI) that have been developed by Hasan et al. (Hakim et al., 2012). Multiple choice questions consist of 30 questions in combined with open-reason. The content of each questions is adjusted with the plant structure in relation to photosynthesis concept that have been taught in Secondary 2 level or equal with 8^{th} Grade.

Table 3.3 Specification of Multiple Choice with Open Reason Item

Concept	Number of Questions
Plant organs that made up root system and shoot system	1, 2, 3, 4
Function of root system and shoot system and its relationship with photosynthesis	5, 6, 7, 8, 9, 10
Plant organs and organelles as site of photosynthesis	11, 12, 13
Components needed for photosynthesis	14, 15, 29, 30
Products of photosynthesis	16, 17, 18, 19, 21, 22, 23
Time when photosynthesis occur	25
General equation of photosynthesis	26
Factors that affect photosynthesis	20, 27, 28

In addition, Certainty of Response Test (CRI) values shows the magnitude of the level of confidence in answering questions. Following criteria set by the CRI value: 0 for total guess the answer; 1 almost guess; 2 not sure; 3 sure; 4 is almost certain; 5 for sure. This value given by the

students themselves about beliefs when answering each question. In other words, when learners give CRI, actually provide an assessment of the learners themselves for choosing rules or concepts that have been ingrained in his mind so that they can determine the answer to a question (Hakim et al., 2012).

As a diagnostic test, there are several steps that have been designed to develop this instrument, such as:

a. Determining the standard competency and indicators for item test.
b. Constructing the specification of concept that will be used in multiple choice questions with open- reason.
c. Making a draft of instrument.
d. Instrument justification that judged by:
   1) Assessments in science education lecturer
   2) Plant anatomy experts
   3) Science teaching and learning lecturers.
e. Try out on students.

   After being judged by lecturers and some experts in related field, the instrument should be revised and tried out on another class which had learned the topic before. Based on the test results, the instrument questions will be analyzed with the following requirements:

   1) Validity

      Anderson, S. B. as quoted in Arikunto (2003) revealed that "A test is valid if it measure what it purpose to measure". Validity of an instrument is used to measure what it is designed to measure. The aspect that measured through this instrument is cognitive aspect toward plant structure in relation to photosynthesis concept.

      The researcher use the Coefficient of Product Moment Karl Pearson to measure the validity of each test item, there is:

$$r_{xy} = \frac{n\sum xy - [(\sum x)(\sum y)]}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

(Arikunto, 2003)

With, r_{xy} : correlation coefficient between x and y variable

n : amount of student
x : total score in test item
y : total score of student

Interpretation about r_{xy} will be divided into different categories based on Guilford quoted by Arikunto (2003):

Table 3.4 Classification Validity Coefficient

r_{xy}	Interpretation
$0{,}90 \leq r_{xy} \leq 1{,}00$	Very high validity
$0{,}70 \leq r_{xy} < 0{,}90$	High validity
$0{,}40 \leq r_{xy} < 0{,}70$	Medium validity
$0{,}20 \leq r_{xy} < 0{,}40$	Low validity
$0{,}00 \leq r_{xy} < 0{,}20$	Very low validity
$r_{xy} < 0{,}00$	Invalid

2) Reliability

Anderson stated that validity and reliability are two important factors in developing test instrument, "A reliable measure in one that provides consistent and stable indication of the characteristic being investigated" (Arikunto, 2003). In order to be said as a reliable, the research instrument has to be stable and consistent, which resulted the similar results even it is done by different people, times and places.

The value of reliability is determined based on coefficient value which is gained by Alpha formula, as follows:

$$r_{11} = \left(\frac{n}{n-1}\right)\left(1 - \frac{\sum s_i^{\,2}}{s_t^2}\right)$$

(Arikunto, 2003)

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Explanation:

r_{11}: reliability coefficient
s_i^2: score variant each test item
n : amount of test item
s_t^2 : total score variant

Table 3.5 Classification of Reliability Coefficient

Value r_{11}	Interpretation
$0{,}90 \leq r_{11} \leq 1{,}00$	Very high reliability degree
$0{,}70 \leq r_{11} < 0{,}90$	High reliability degree
$0{,}40 \leq r_{11} < 0{,}70$	Medium reliability degree
$0{,}20 \leq r_{11} < 0{,}40$	low reliability degree
$r_{11} < 0{,}20$	Very low reliability degree

3) Discriminating Power

Another important procedure in item analysis is calculating the item discrimination power (DP) which can be defined an item test discriminates between high achiever students with low achiever students. Arikunto (2003) to obtain the discrimination power of the items the following formula has been used:

$$DP = \frac{RU - RL}{\frac{1}{2}T}$$

(Arikunto, 2003)

Explanation:

DP = Discriminatory power.
RU = The number of tests in the upper group who got the item right.
RL = The number of tests in the lower group who got the item right.
T = The total of tests included in item analysis.

Table 3.6 Discriminating Power Classification

Value DP	Interpretation
$DP \leq 0{,}00$	Very poor
$0{,}00 < DP \leq 0{,}20$	Poor
$0{,}20 < DP \leq 0{,}40$	Fair
$0{,}40 < DP \leq 0{,}70$	Good
$0{,}70 < DP \leq 1{,}00$	Very good

4) Difficulty Level

A difficulty index will affect the quality of the item test, because an item test which has a low difficulty index (very difficult) probably cause the students desperate and decrease their spirit to solve the problem of the item test (Arikunto, 2003). This case has led the researcher to investigate the difficulty index for each item test. The difficulty index (P) is calculated using the formula below.

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

Where:
P = Difficulty index
B = students who answer right
JS = total amount of students

Arikunto (2003)

Classification of difficulty level in each test item that used is based on Arikunto (2003):

Table 3.7 Coefficient Classification of Difficulty Index

Value P	Interpretation
IK = 0,00	Very difficult
0,00 < IK ≤ 0,30	Difficult
0,30< IK ≤0,70	Medium
0,70< IK <1,00	Easy
IK = 1,00	Very easy

Table 3.8 Recapitulation of Multiple Choice Item Test

Question Number	Discriminating Power (%)	Difficulty Level	Correlation	Significance Correlation	Status
1	42,86	Very Easy	0,624	Very Significance	Accepted
2	0,00	Very Easy	NAN	NAN	Rejected
3	-14,29	Very Easy	-0,230	-	Rejected
4	57,14	Very Difficult	0,375	Significance	Accepted
5	0,00	Medium	-0,009	-	Revised
6	14,29	Very Easy	0,267	-	Rejected
7	-14,29	Medium	-0,012	-	Rejected
8	28,57	Very Easy	0,253	-	Rejected
9	28,57	Very Easy	0,580	Very Significance	Accepted
10	42,86	Very Difficult	0,320	Significance	Accepted
11	28,57	Easy	0,325	Significance	Accepted
12	0,00	Medium	0,093	-	Rejected
13	14,29	Easy	0,379	Significance	Accepted
14	28,57	Easy	0,021	-	Revised
15	57,14	Medium	0,651	Very Significance	Accepted
16	42,86	Very easy	0,678	Very Significance	Accepted
17	57,14	Medium	0,492	Very Significance	Accepted
18	42,86	Medium	0,337	Significance	Accepted
19	57,14	Very Difficult	0,467	Very Significance	Accepted
20	42,86	Easy	0,533	Very Significance	Accepted
21	57,14	Very Easy	0,561	Very Significance	Accepted
22	57,14	Medium	0,432	Very Significance	Accepted
23	14,29	Medium	0,218	-	Rejected
24	0,00	Medium	0,053	-	Rejected
25	42,86	Very Easy	0,772	Very Significance	Accepted

Question Number	Discriminating Power (%)	Difficulty Level	Correlation	Significance Correlation	Status
26	-42,86	Very Difficult	-0,645	-	Revised
27	28,57	Very Easy	0,267	-	Revised
28	57,14	Medium	0,564	Very Significance	Accepted
29	42,86	Medium	0,365	Significance	Accepted
30	14,29	Very Easy	0,323	Significance	Accepted
31	42,86	Very Easy	0,630	Very Significance	Accepted
32	57,14	Medium	0,442	Very Significance	Accepted
33	57,14	Easy	0,343	Significance	Accepted
34	0,00	Difficult	0,041	-	Revised
35	14,29	Very Easy	0,351	Significance	Accepted
36	71,43	Medium	0,627	Very Significance	Accepted
37	28,57	Medium	0,090	-	Rejected
38	42,86	Easy	0,226	-	Rejected
39	57,14	Medium	0,390	Significance	Accepted
40	14,29	Medium	0,177	-	Revised

5. Interview Guideline

After the drawings is evaluated and categorized according to the criteria above, individual interviews will be conducted among the students with randomly chosen. The purpose was to check the validity of the interpretation of the drawings.

In the interview section, students are asked to answer the questions like what is the function of each plant basic organ, photosynthesis concept, in which parts of the plants they take place, the role of leaves as the basic structure of plant in photosynthesis, and what the nutriment of plants is and where they get it from. A detail description of interview guideline is shown in the table below.

Table 3.9 Interview Guideline

Name :

Class :

Signature :

No.	Aspect	Indicator	Question
1.	Teaching methodology	Teaching method that implemented in learning plant structure and photosynthesis concept	What kind of teaching method (e.g. lecturing, field observation, and etc.) does your teacher choose in teaching plant structure and photosynthesis concept?
2.			How should the teacher teach the concept of plant structure and photosynthesis?
3.	Teaching media	Learning sources	What kind of teaching media that used in learning structure and photosynthesis concept?
4.		Book as the media to learn plant structure and photosynthesis concept	What kind of book that used to learn these concepts? Mention the name of the book and publisher.
5.	Plant structure and function, photosynthesis concept on learning biology	The most difficult of plant structure and function concept should be understood by the students?	Which parts of plant structure and function concept are **most** difficult to be understood?
6.		The most difficult of photosynthesis concept should be understood by the students?	Which parts of plant structure and function concept are **most** difficult to be understood?
7.	Students' Understanding	Difficulty to describe the concepts using drawing	Is it hard to describe the plant structure and photosynthesis in the form of drawing?

No.		Indicator	Question
8.			When you are asked to draw the plant structure concept and photosynthesis, have you ever found the difficulties? Could you like to explain it?
9.		Reason of the students' answer	Why do you draw the concept of plant structure and photosynthesis like this (researcher shows the interviewees' drawings)?
10.		Students' certainty of the answer and the drawings	Are you sure with your answer and the drawings?
11.		Concept mastery	Researcher several questions related to structure and function of root system and shoot system.
12.			Teacher asks several questions concerning on plant structure and photosynthesis concept, such as: a. Where are the organelle cells as the site of photosynthesis? b. What are the major organs in plant that take a role as sites for photosynthesis? c. What are the components needed for photosynthesis? d. What are products that resulted from photosynthesis? e. When does photosynthesis occur?

E. Data Processing

Data obtained from the students' drawing, questionnaire, multiple choice questions with open- reason and Certainty of Response Index (CRI), and interview. The detail description of data processing techniques are explained as follows:

1. Drawing Analysis

The students' drawing of plant structure in relation to photosynthesis concept is analyzed through two steps as follow:

a. Drawing is categorized based on the criteria of level of drawing

The concept of plant structure in relation to photosynthesis that has been drawn by the students would be categorized based on the criteria on the level of drawing rubric. The criteria of the rubric is adopted from the rubric that has been developed by Köse (2008).The students' drawings are categorized into five level of drawing according to the specific criteria as shown in the table below.

Table 3.10 Rubric of Level of Drawing

Level of Drawing		Concept	
		Structure and Function of Plant	**Photosynthesis**
1	No Drawing	No response was given to the statements.	No response was given to the statements.
2	Non-representational Drawings	State identifiable elements of plant structure.	a. State identifiable elements of photosynthesis. b. Include diagrams and formulations, instead of drawings.

Level of Drawing		Structure and Function of Plant	Photosynthesis
3	Drawing with Misconception	a. Show some understanding about plant structure. b. Demonstrate some misconception on the drawings (e.g. students cannot differ petiole and stem; Students draw plant structure and state incorrect function).	a. Show understanding about plant structure. b. Demonstrate some misconception on the drawings (e.g. students draw the raw materials needed for photosynthesis and product of photosynthesis interchangeably).
4	Partial Drawings	Draw the structure of plant incompletely and there is no misconception. For instance, the students only draw the stem to represent the whole plant basic organs.	Draw the components of photosynthesis incompletely and there is no misconception. For instance, the students only draw water and CO_2 as the materials needed for photosynthesis.
5	Comprehensive Representation Drawings	Drawings show sound understanding and contained five or more elements of plant structure in combined with the function for each plant parts.	Drawings show sound understanding and contained five or more elements of photosynthesis, as follow: a. Site for photosynthesis: Leaves, include chlorophyll and chloroplast. b. Components needed for photosynthesis: carbon dioxide, light, water, mineral, and nutrients. c. Simple Process of Photosynthesis. d. Product of photosynthesis: oxygen and glucose

b. Calculation of Students' Drawing Percentage

After the students' level of drawing is categorized based on the criteria above, then the percentage for each level of drawing would be calculated using formula as follow:

$$\%\ \text{Level of Drawing} = \frac{\text{Number of Students for Each Level of Drawing}}{\text{Total Number of Students}} \times 100\%$$

2. Questionnaire Analysis

The questionnaire is used to analyze the students' interest in drawing. This instrument contains a set of questions that could give additional information and findings to support the analysis of students' misconception about plant structure in relation to photosynthesis. The questionnaire will be processed using a simple formula as follow.

$$\%\ \text{Students} = \frac{\text{Number of students' answer}}{\text{Total Number of Students}} \times 100\%$$

3. Certainty of Response Index (CRI) Analysis

Besides using students' drawing as qualitative data, the identification of students' misconception about plant structure in relation to photosynthesis concept involves certainty of response index (CRI) which developed by Hasan et al. (1999). Certainty of response index (CRI) is one technique to distinguish the students who understand the concept, misconception, and do not understand the concept (Hakim et al., 2012). In order to analyze the result of CRI data, there are several steps that administered in this research as follow:

a. The item test consists of 30 multiple choice questions that combined with open reason and scale of CRI for each number.

b. The category of students' understanding is determined by the answer of multiple choice question, reason, and the scale of CRI that chosen by the students. The categorization which adapted from Hakim et. al (2012) is described in the table below.

Table 3.11 Modified Certainty of Response Test

Answer	Reason	Value of CRI	Description
Correct	Correct	> 2,5	Understand the concept well
Correct	Correct	<2,5	Understand the concept, but not sure
Correct	Incorrect	>2,5	Misconception
Correct	Incorrect	<2,5	Do not understand the concept
Incorrect	Correct	>2,5	Misconception
Incorrect	Correct	<2,5	Do not understand the concept
Incorrect	Incorrect	>2,5	Misconception
Incorrect	Incorrect	<2,5	Do not understand the concept

c. Analyze students' answer to differ the students who understand the concept well, understand the concept but not sure, misconception, and do not understand the concept.

d. The result of students' understanding category is calculated using a simple formula as follow:

$$P = \frac{f}{N} \times 100\%$$

Description:

P : Percentage for each category

f : Number of students for each category

N: Total number of students.

4. Interview Result

After the drawings and CRI item tests were evaluated, individual interviews were conducted about the detailed subjects with randomly chosen 14 students. In this interview, the students were asked several questions which have been constructed by researcher. The interview section is implemented to check and clarify the drawings and dig more information about students' misconception.

The students' responses during interview were recorded and written on a given format as shown in the table 3.4.

F. Research procedure

The procedure of this study consisted of following sequential step, which divide into three stages:

1. Preparation Stage

The activities consist of several steps, they are:

a. Conducting literature study.

This part is an initial step that conducted to gain actual information related to the theories and research problem. These data could be taken from compatible resource, such as the latest book, journal, articles, and etc.

b. Choose the topic for implementing research.

c. Determine the school as the place to conduct the research.

d. Contact the schools and science teacher.

e. Make a permission letter.

f. Conducting prior study.

It could be done by examining schools' archived file about students achievement in science subject and observe how the lesson is conducted in the classroom.

g. Determine the research sample.

h. Construct and justify the instrument.

2. Implementation Stage

a. Administration the instrument.

b. Analyze the data.

c. Recording misconceptions and identifying students holding those misconceptions.

d. Conducting interviews to the students who hold the misconceptions.

3. Completion Stage

a. Data analysis and data collection

b. Draw conclusion

c. Give suggestion for further research

G. Research Plot

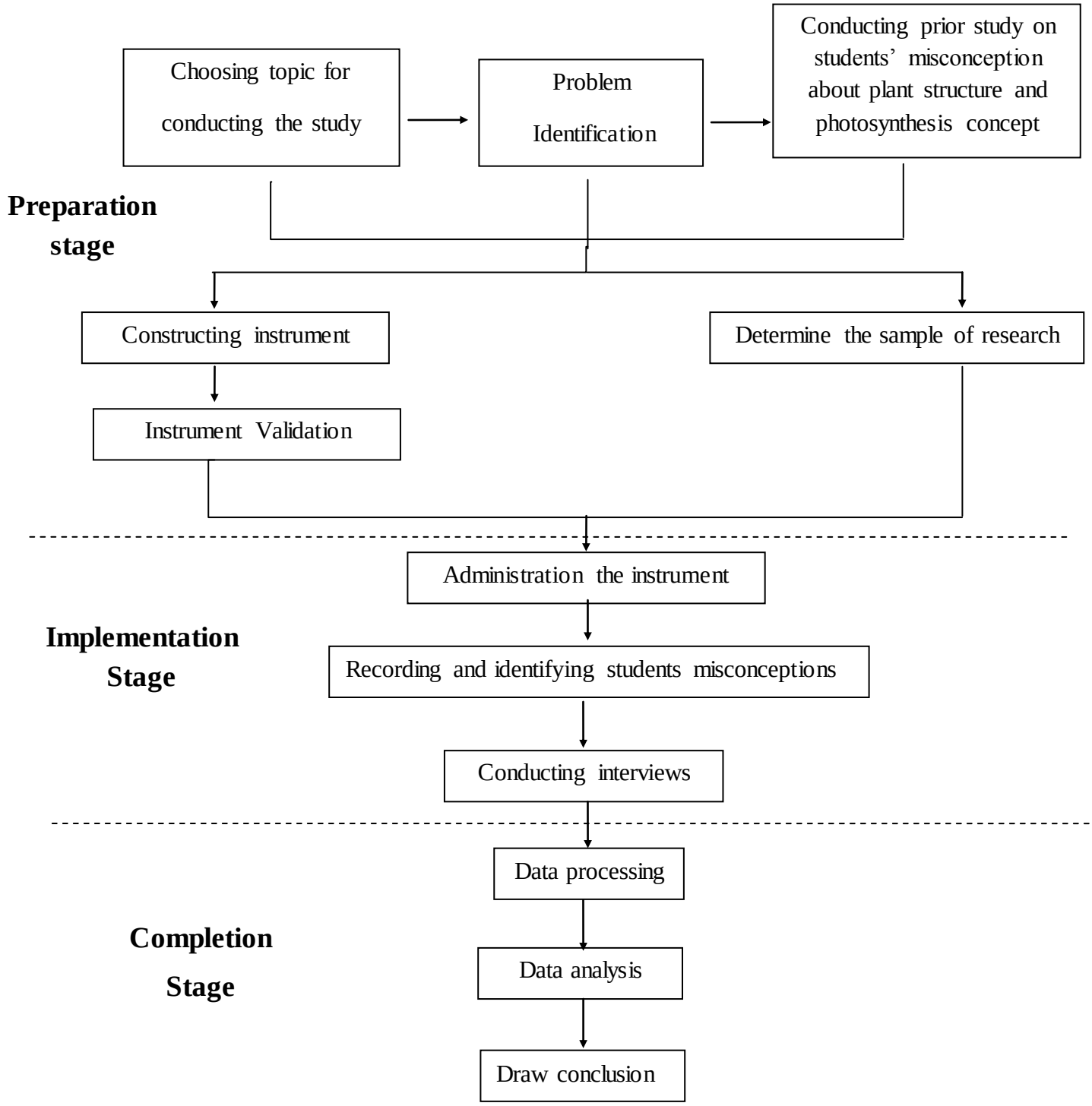

Figure 3.12 Research Plot